Ph.D. Dissertation

Optimal Risk Allocation
to Facilitate Private Initiative in Toll Roads

By

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Acknowledgements

This research was conducted in the Budapest University of Technology and Economics in the period from 2000 to 2002.

I’ve had many useful experiences here in Hungary and I believe that my experience and study will be contributed to the good cooperation between Hungary and Korea in their future transport development plan.

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Gi Seog, KONG (in Budapest, Hungary)
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General Overview

Over a hundred years ago private finance was being sought to develop major infrastructure projects, like the Trans-Siberian Railway and the Suez Canal, which could not be financed from government funds.

Recent worldwide trend in road projects has been to introduce private capital in many areas to build and operate road infrastructure.

In short, the advantages of Private Participation in Infrastructure (PPI) are an increase in efficiency in the provision of services, avoidance of political interference in operations, and alternative of public sector budget constraints.

The success of PPI projects depends on a synthesis of the public and private sector strengths, skills and resources, which satisfies the priorities of both parties.

But PPI projects generally need huge initial investment cost making continued private funding very difficult.

In addition, PPI projects take up too much time, thus making early retrieval hard.

The implementation of PPI requires acting with extreme precautions and needs appropriate government support.

So one of the most important factors in PPI is how to efficiently allocate, mitigate and overcome the risks that may arise in the course of PPI projects.

But every project is different and it is not possible to evaluate which method is good or bad to facilitate PPI projects.

What is a major risk for one project may be quite minor for another.

Moreover, PPI projects need many participants such as the public sector (central and local government, public authorities etc.) and the private sector (sponsor, lender, contractor, operator, technology owner, supplier, equity investor, multilateral and bilateral agencies etc.)
It is rather complicated and difficult to consider the optimal risk allocation and mitigation methods for all parties because their interests are often contradictory.

So my dissertation suggests methods and policies that are common to most projects for optimizing and mitigating risks mainly focused on the public sector, which is a key player to implement PPI projects.

But I tried to include private interest as far as possible because it cannot be ignored.

To deal with these issues more efficiently, my findings and recommendations are as follows:

· Establish standard cost/benefit appraisal procedure.
· Create a complex framework for a secure political consensus and acceptance of tolling by the public.
· Use various risk analysis theories and techniques.
· Develop the useful methods to forecast the future traffic volume.
· Devise optimal risk allocation methods.
· Organize a joint venture as a risk mitigation device.
· Limit the number of pre-qualifiers and develop suitable pre-qualification criteria.
· Special financial support to promote PPI.
· Adopt co-financing methods.
· Make dispute resolution procedure clear.

As a result of my research, expected practical results are as follows:

· Analyzed case studies give some lessons on how to design and operate PPI projects successfully.
· Suggested standard cost/benefit appraisal procedure for PPI road projects prevents the decision makers from subjective or risky decision and makes the private sector to believe the results of a project appraisal done by the public sector has already done.

So this will reduce time and cost, and avoid unnecessary political intervention etc.
· Recommended various theories and techniques for mitigating and allocating risks will contribute to implement PPI project smoothly based on the public private partnership principal.
· Mentioned comprehensive risk analyses would be helpful for further studies related to more detailed and specified risk management measures.
Chapter One: Significance and Methodology of the Topic

1.1 Significance of the Topic

In spite of scarce resources and a dense population (473 persons per square km), ranking it the third most densely populated country in the world, South Korea has achieved rapid economic development since the early 1960s.

This specialty plus the fact that 60% of the total land (99,408 square km) consists of mountainous regions make efficient land use very important.

Despite steady investment in roads, ports and other infrastructure since the 1970s, there is still not enough transport facility to handle the rapidly growing passenger and freight traffic volumes.

Korea’s logistics costs (Korean Won 74.2 trillion) recorded about US$ 57 billion (16.5% of the GDP) in 1998, an increase of 6.6% over the previous year.

The national logistics cost is 1.5 times higher than other developed countries with industrial logistics taking up 12.9% of the total cost (1997) where the USA and Japan recorded 9.0% and 6.5%, respectively, for the same years giving 1.4-2 times higher average (Ministry of Construction & Transportation, South Korea, 2001).

Excessive logistics costs cause prices of products to rise and therefore are acting as a major factor in weakening the price competitiveness.

As a government official participating in the policy-making process of economic development, I have come to the conclusion that industrial growth plans pursued by the Korean government have been geared toward expanding the infrastructure facilities.

Road infrastructure like railway, airport and seaport etc. is a kind of social overhead capital, which plays a vital role in activating national and regional economies.

If a nation were wealthy enough to provide roads wherever they are needed, it would contribute to improve the economic value of a nation or region.
In reality, however, it is not the case (see table 1.1)

Table 1.1 Road Situation in South Korea (data as of December 2000)

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Responsible Authority</th>
<th>Paving Rate (%)</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressways*</td>
<td>Ministry of Construction &amp; Transportation</td>
<td>100</td>
<td>2,131</td>
</tr>
<tr>
<td>National Highways</td>
<td>Ministry of Construction &amp; Transportation</td>
<td>98.2</td>
<td>12,413</td>
</tr>
<tr>
<td>Metropolitan Roads</td>
<td>Mayor</td>
<td>88.7</td>
<td>17,839</td>
</tr>
<tr>
<td>Local Roads</td>
<td>Governor</td>
<td>78.3</td>
<td>17,151</td>
</tr>
<tr>
<td>City/County/District</td>
<td>Local Government</td>
<td>60.4</td>
<td>39,241</td>
</tr>
<tr>
<td>Roads</td>
<td></td>
<td>85.12</td>
<td>88,775</td>
</tr>
</tbody>
</table>

* The Korea Highway Corporation (2,090.7 km) and a Private Concession Company (40.3 km) managed expressways instead of Ministry of Construction & Transportation.
Source: Ministry of Construction & Transportation, Korea (2001)

The financial condition of government budget has become constrained because road infrastructure requires several years or decades from planning to use and also a huge number of experts.

In Korea the construction costs are at least about US$ 15 million (Korean Won 20 billion) per kilometer of a four-lane expressway and US$ 3.8 million (Korean Won 5 billion) for widening a two-lane regional road into a four-lane one (Korea Research Institute for Human Settlements, 1999).

A comprehensive and integrated road development program (2000-2020) in Korea has been adopted as a key element in the national development plan.

A national master plan, with a completion date of 2020, sets the target for expanding some 25,000 km to the road network.

When completed, this will comprise of 10,000 km of high-speed arterial network (of which motorways/expressways and high-quality national roads will be 6,000 and 4,000 km respectively).
A further 15,000 km of national roads are included.

The plans for this network envisage a grid construction of seven north-south and nine east-west corridors across the country.

By the year 2020, estimated investment needs for roads (see table 1.2) will be about US$ 171 billion (Korean Won 196.4 trillion).

If current investment trend is maintained, the central government and public corporations can be raising up to about US$ 162.64 billion (Korean Won 186.8 trillion) by budget and toll revenue etc.

The gap of about US$ 8.36 billion (Korean Won 9.6 trillion) has to be filled mainly by increased investment participation from the private sector.

But public budgets for infrastructure investment needs in Korea are constrained by the need to maintain a balanced budget by cutting public spending and capping public debt, aiming to achieve sustainable economic growth and political objectives.

**Table 1.2 Estimated Investment Needs in South Korea (2000-2020)**

<table>
<thead>
<tr>
<th></th>
<th>Korean Won (Trillion Won)</th>
<th>US$ (Billion $)</th>
<th>%</th>
<th>Major Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads*</td>
<td>196.4</td>
<td>171</td>
<td>57.1</td>
<td>7 x 9 expressway, national road system</td>
</tr>
<tr>
<td>Railways</td>
<td>72.9</td>
<td>63.4</td>
<td>21.3</td>
<td>High-speed railways, expansion of railway</td>
</tr>
<tr>
<td>Airports</td>
<td>15.6</td>
<td>13.6</td>
<td>4.5</td>
<td>Hub airports, expansion of airports</td>
</tr>
<tr>
<td>Ports</td>
<td>38.3</td>
<td>33.3</td>
<td>11.1</td>
<td>Hub ports, expansion of ports</td>
</tr>
<tr>
<td>Logistics</td>
<td>20.5</td>
<td>17.8</td>
<td>6.0</td>
<td>Major logistics centers, freight terminals</td>
</tr>
<tr>
<td>Total</td>
<td>343.7</td>
<td>299</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

* Local roads and subways excluded. All figures calculated US$1 into about Korean Won 1,150

As a consequence of these reasons, the share of the public budget allocated to road infrastructure financing doesn’t meet its need sufficiently.

To solve these problems and mobilize the financial resources necessary for these investments, the Korean government enacted the Act on Private Participation in Infrastructure (PPI Act) in 1994. But the inducement of private sector participation has been less than expected in spite of efforts.

To achieve these goals, PICKO (Private Investment Center of Korea) was established in 1999 as a public organization under the PPI Act.

The Korean government realized the need for changes in infrastructure (Social Overhead Capital) policy directions for more efficient and transparent execution of adequate funding mainly through the private sector, especially foreign investor participation to the infrastructure provision. In 1998, the government enacted the amended PPI Act.

The InCheon International Airport Expressway was opened in Nov. 2000 the first infrastructure (SOC, Social Overhead Capital) in Korea to be built with private investment and the main concession projects for toll roads and bridges are being in discussion and progress as follows (see table 1.3)

PPI (Private Participation in Infrastructure), PPP (Public Private Partnership), PFI (Private Finance Initiative) are nowadays widely used for transport projects in the world under the government’s tight budget constraint.

The meaning of these terminologies and aim of these methods are almost the same but have been used differently.

But I will use PPI to avoid confusion among these in the dissertation because the Korean government is also using this terminology.

Many projects have been undertaken and various kinds of guidance and research papers describing PPI/PPP/PFI methods have been published especially during the last decade.
Table 1.3 Concession Projects in South Korea (Roads and Bridges)

<table>
<thead>
<tr>
<th>Greenfield Projects</th>
<th>Length (km)</th>
<th>Approx. cost (US$ mil.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwangju-Paldang toll road</td>
<td>9.8</td>
<td>92</td>
<td>1 bridge across Han River (1.9km), 3 interchanges</td>
</tr>
<tr>
<td>Yangpyung-Kanam expressway</td>
<td>28.8</td>
<td>165.6</td>
<td>1 bridge across South Han river (2.2km), 2 tunnels.</td>
</tr>
<tr>
<td>Kosaek-Pyungta toll road</td>
<td>18.4</td>
<td>156.4</td>
<td>4 bridges, 4 interchanges.</td>
</tr>
<tr>
<td>Anseongcheon toll bridge</td>
<td>1.05</td>
<td>73.6</td>
<td></td>
</tr>
<tr>
<td>Pyungtaek-Umsung expressway</td>
<td>33.8</td>
<td>349.6</td>
<td>10 bridges, 3 tunnels.</td>
</tr>
<tr>
<td>Machang toll bridge</td>
<td>1.65</td>
<td>193.2</td>
<td></td>
</tr>
<tr>
<td>Ilsan Grand Bridge</td>
<td>1.8</td>
<td>110.4</td>
<td>2 interchanges</td>
</tr>
<tr>
<td>North Harbor bridge</td>
<td>0.85</td>
<td>349.6</td>
<td></td>
</tr>
<tr>
<td>Sub Total (8)</td>
<td>96.15</td>
<td>1,490.4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Projects in Progress</th>
<th>Length (km)</th>
<th>Approx. cost (US$ mil.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheonan-Nonsan expressway</td>
<td>81</td>
<td>1,012</td>
<td>114 bridges, 6 interchanges, 3 Junctions.</td>
</tr>
<tr>
<td>Northern beltway between Ilsan and Taekaewon</td>
<td>36</td>
<td>1,380</td>
<td>50 bridges, 5 interchanges, 5 tunnels.</td>
</tr>
<tr>
<td>Busan-Keojeh link (toll bridge)</td>
<td>8.2</td>
<td>1,039.6</td>
<td>2 cable stayed bridges (900m), 1 immersed tunnel (2.9km).</td>
</tr>
<tr>
<td>Daegu-Daedong expressway</td>
<td>82</td>
<td>2,208</td>
<td>104 bridges, 2 junctions, 7 interchanges, 13 tunnels.</td>
</tr>
<tr>
<td>Sub Total (4)</td>
<td>207.2</td>
<td>5,639.6</td>
<td></td>
</tr>
<tr>
<td>Total (12)</td>
<td>303.35</td>
<td>7,130</td>
<td></td>
</tr>
</tbody>
</table>

Note: All costs quoted in US$ million (1999 prices)

However, there is still insufficient recognition of what is the optimal risk allocation and how the government policy ensures it.

PPI projects generally need huge initial investment cost making continued private funding very difficult.
In addition, PPI projects take up too much time, thus making early retrieval hard. Political influence promoting public private co-operation is particularly strong in several countries, not independently from the decision-making traditions in the given country.

The implementation of road tolling requires acting with extreme precautions and needs appropriate government support.

In most of the road projects under consideration, the profitability and viability are often in doubt since the cash flow accrued from the project is insufficient and unstable without appropriate government support.

Financial support from the government is needed to make the project viable but the support should be carefully designed to avoid any efficiency deterioration.

So one of the most important factors in PPI is how to efficiently allocate, mitigate and overcome the risks that may arise in the course of PPI projects.

1.2 Objectives of the Topic

My country has introduced private participation in many areas to build and operate toll road infrastructure like many countries.

Roads have been the most important infrastructure in Korea carrying over 90% of the country’s passenger and freight transport volume.

Road expansions began along with the economic development following the 1960s and have played the leading role in the country’s economic growth and territorial development.

The road sector investment accounts for almost 60% of the total investment in transport infrastructure currently planned in Korea.

Various methods are being sought to secure the enormous funds necessary for infrastructure expansions, including active promotion of private investment projects, increasing fuel tax, and raising toll and other facility usage fees.
To achieve the above mentioned objectives, my dissertation is mainly focused on PPI toll road projects as follows:

- Introducing additional financial sources to develop transport infrastructure
- Comparing toll road development models in PPI
- Reviewing economic and financial analysis in PPI
- Identifying and analyzing through PPI case studies in some model countries
- Developing optimal risk allocation and mitigation measures
- Recommending government policies to promote PPI.

1.3 Hypotheses and Methodologies

Every project is different and it is not possible to evaluate which method is good or bad to facilitate PPI projects.

What is a major risk for one project may be quite minor for another.

Moreover, PPI projects need many participants such as the public sector (central and local government, public authorities etc.) and the private sector (sponsor, lender, contractor, operator, technology owner, supplier, equity investor, multilateral and bilateral agencies etc.)

It is rather complicated and difficult to consider the optimal risk allocation and mitigation methods for all parties because their interests are often contradictory.

So my dissertation suggests methods and policies that are common to most projects for optimizing and mitigating risks mainly focused on the public sector, which is a key player to implement PPI projects.

But I tried to include private interest as far as possible because it cannot be ignored.
To this end, my research methodologies are based on the following:

· Case studies about PPI projects
· Review of relevant academic theories, dissertations and seminar papers
· Internet sites and magazines etc.

1.4 Structure of the Dissertation

Following the introduction chapter, the structure of the dissertation will be as follows:

Chapter 2 introduces sources of development capital in infrastructure projects

Chapter 3 analyzes toll road development models in PPI

Chapter 4 demonstrates international experiences in PPI toll road projects

Chapter 5 reviews developing and comparison of appraisal methodologies for financial and economic feasibility of road project development by PPI

Chapter 6 identifies and analyzes main risk factors through PPI case studies in some model countries

Chapter 7 develops optimal risk mitigation and allocation measures

Chapter 8 recommends government policy to facilitate PPI

Chapter 9: the final chapter, conclusion, recommendations, limitation and further issues are to be presented.

To accomplish the overall task in a rather clear and well-based argument, the dissertation contains tables and figures and uses related references.
Chapter Two: Sources of Development Capital in Infrastructure Projects

2.1 Introduction of Infrastructure Financing

There are various types of transport infrastructure financing, from “traditional” public funding through budgetary resource allocation relying on general taxes and duties, to “pure” private funding through limited recourse project financing based on road pricing or toll collection.

We can distinguish between funding sources generated through the system of taxation (general taxation covering the whole population, or road user charges) and/or collection of access charges or tolls.

The source of capital used for funding road expenditures include:

· Public funding (budget, special funds, sovereign borrowing): This is the traditional way to finance motorways in most countries around the world.

· Private funding (investors, lenders, financial markets): Private sector involvement in the provision and/or management of motorways are widely acknowledged and sought for.

· Mixed: Private Participation in Infrastructure (PPI) is not a precisely defined term. In the simplest PPI, the private sector provides a service or manages a facility for an agreed period and fee, without taking the financing or commercial risk. It is somehow more complex when the public and private sectors jointly finance, own and operate a facility as a joint venture.

But transport infrastructure investment needs huge amounts of money and allocation procedures reflect a fierce “competition” with other fundamental public services like education, safety, administration, health and defence among others for the strictly limited amount of budgetary resources.

Public budgets are constrained by the need to maintain a balanced budget by cutting public spending and capping public debt, aiming to achieve sustainable economic
growth and political objectives.

Transport infrastructure is vital to strengthening national competitiveness as well as improving the quality of life for the people.

Project finance is often used for transport infrastructure investment. Project finance is an emerging solution for financing infrastructure needs in many parts of the globe.

In emerging markets, where the demand for infrastructure far outstrips the economic resources, it provides a financing scheme for important development.

In countries moving from centralized to market-based economies, it provides needed upgrades or replacement of existing infrastructure assets that have not been maintained adequately.

### 2.2 Background of PPI on Public Services

Traditionally, governments have played the main role to supply the public services. But because of the public budget constraint, many countries try to set up new forms of extra-budgetary or off-budgetary financing within the framework of an enlarged and renewed co-operation between public bodies and private companies allowing to develop further or maintain properly their infrastructure.

The private sector increasingly participates in the supply of these facilities such as telecommunication, power, gas, water, transport etc. regarded as public services. According to this trend, public services’ scope has changed dramatically in some fields mentioned above.

The two main reasons behind introducing the private sector are to back up the limited government budget and to make use of creativity and efficiency of the private sector.

PPI projects need actual partnership involving close collaboration and the combination of the strengths of the private sector (more competitive and efficient in economic terms) and the public sector (more responsible and accountable toward the society).
PPI projects financed by the private sectors allow the spreading of the project cost for the public over a longer period of time, in line with the expected benefits (savings on vehicle operation cost, on travel time, on accidents).

**Figure 2.1 Schematic Illustration of Cost and Benefits Flows to the Community under Public versus Private Financed Projects**

![Diagram showing cost and benefits flows for public and private financed projects](source: Groupe EGIS)

Public funds are thus freed up for investments in sectors where private investment is impossible or inappropriate (social services).

On public financed projects, an initial investment is made by the public sector and recovered by the community in form of the project benefits.

On private financed projects the cost for the community is incurred through payments to the private sector over the entire project operation phase, either through regular payments from the government or through collection of tolls from the road users.

**2.3 Project Financing**

The term “project finance” is generally used to refer to a non-recourse or limited recourse financing structure in which debt, equity, and credit enhancement are combined for the construction and operation, or the refinancing, of a particular facility.
in a capital-intensive industry, in which lenders base credit appraisals on the projected
revenues from the operation of the facility, rather than the general assets or the credit of
the sponsor of the facility, and rely on the assets of the facility, including any revenue-
producing contracts and other cash flow generated by the facility, as collateral for the
debt.

In project financing, therefore, the debt terms are not based solely on the sponsor’s
credit support or on the value of the physical assets of the projects.

Rather, project performance, both technical and economic, is the nucleus of project
finance.

Project financing is used widely in countries, which want to develop privately funded
toll motorway.

But because project financing is either non-recourse, or of limited recourse, to the
project sponsor, financial responsibility for the various risks in project financing must
be allocated to parties that will assume recourse liability and that possess adequate
credit to accept the risk allocated.

The project finance participants are as follows:

· Government
· Sponsor, Lender
· Contractor, Operator
· Technology Owner
· Supplier, Output Purchaser
· Equity Investor, Multilateral and Bilateral Agencies etc.

2.4 Source of Financing

Traditionally, infrastructure projects have been financed partly by debt and equity,
but finance for PPI projects is available from a wide variety of sources (SAPTE, W.,
1997).

2.4.1 Equity

PPI projects will normally be financed at least in part by the subscription for shares
in the concession company.
The principal subscribers will be the project sponsors, though there may be other investors (The host government, institutional investors and, in some cases, the general public in local or international capital markets).

2.4.2 Senior Debt

To date the commercial banks have been the greatest source of senior debt for PPI projects.

The financing of projects has become a specialized area, particularly as the term of the debt to be much longer than the term of loans for general corporate purposes.

The lenders of senior debt are generally considered to be the parties taking the greatest risk in PPI projects, so banks will wish to receive enhanced margins on their loans compared, for example, with corporate lending direct to the sponsors.

They also will wish to have priority over all other providers of funding and in particular will wish to control the ability of other funding providers to take action against the concession company to their debt.

2.4.3 Mezzanine Finance

Mezzanine finance has characteristics of both debt and equity, and will rank between the two in terms of priority.

It normally falls somewhere between senior debt and equity.

Essentially this type of finance is treated as debt while the project has sufficient resources to service it, but is treated as equity if has not.

Examples of mezzanine capital are subordinated debt and preference shares.

The risks in the project taken by mezzanine providers are greater than those taken by lenders of senior debt, and the required returns of mezzanine providers will be higher.

The mezzanine providers themselves have opportunity to earn a reasonable rate of return without taking the full risks of providing equity.
2.4.4 Capital Markets

To date the capital markets have not been used extensively to finance PPI projects.

Although a number of bond issues have been made in the United States for project financing and a limited number of PPI projects have been successfully financed via the capital markets in the United Kingdom, these are traditionally conservative markets.

The expectation is that these markets will in the future be used more extensively.

2.4.5 Development Finance Institutions

Many developing countries have access to funding from development finance institutions, such as the International Finance Corporation (IFC) and the Asian Development Bank (ADB).

Funds are available with long maturities, but, depending on the institution, might only be available to governments or for projects that have the benefit of a host government guarantee.

This is particularly the case where funds are available at a subsidized rate.

Certain agencies provide financing for PPI projects, such as the IFC, the UK’s Commonwealth Development Corporation and the European Bank for Reconstruction and Development (EBRD).

The financing will be offered on commercial terms, but may be available for longer terms than is available in the commercial sector.

These agencies will generally be required to limit the percentage of total project costs, which they will finance.

2.4.6 Export Credit Agencies

These sources of funds and credit support are likely to be attractive to a PPI project in that they generally offer a competitive rate of interest, often at a fixed rate, and longer loan maturities.
It needs to be borne in mind that the support is generally available only to promote exports of the agency’s home country.

A careful evaluation of the advantages and disadvantages of the support should therefore be made.

These agencies are able to offer a variety of incentives, including:

· Buyer credits in the form of direct loans to the concession company;
· Loans and grants to overseas governments;
· Guarantees to project lenders; and
· Political risk insurance for project lenders and sponsors.
Chapter Three: Toll Road Development Models in PPI

Road Pricing refers to a new economic approach in the transport sector. According to it, the prices of every transport activity should reflect the true costs that have an impact on the environment and society.

Aggregate external costs of land transport have been estimated in various OECD studies.

Estimates suggest that over 90% of these costs are related to road transport (Commission of the European Communities, 1995).

Table 3.1 Rough Estimates of the External Costs of Transport (Expressed as Percentages of Gross Domestic Product)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pollution (a)</td>
<td>0.4%</td>
</tr>
<tr>
<td>Noise</td>
<td>0.2%</td>
</tr>
<tr>
<td>Accidents</td>
<td>1.5%</td>
</tr>
<tr>
<td>Congestion</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

(a) Excluding Global Warming

Source: Various Studies and OECD (1994)

Congestion represents a major external cost, as although all infrastructure users put together pay for the total time costs, there is still an externality and ensuing wastage of scarce resources.

Tolls have always been the fairest and most direct method of paying for roads, but before electronic tolling their collection was clumsy.

The great bulk of tolls (over 99%) are still being collected by automatic coin machines or human hand.

It is costly for the road authority and annoying to the customers.

The first electronic toll tags (transponders) were in use on the Dallas North Toll way in Texas, on a couple of bridges in New Orleans and on the Oklahoma Turnpike in the USA (SAMUEL, P., 2001).

Table 3.2 presents four indicators of toll road development in 14 selected countries, including the length of toll roads in service, gross domestic product per capita, auto ownership, and the extent of private sector involvement.
### Table 3.2 Indicators of Toll Road Development in 14 Selected Countries

<table>
<thead>
<tr>
<th>Countries</th>
<th>Total Length of Toll Roads in Operation (km)</th>
<th>GDP per Capita (US$) 1999</th>
<th>Autos per 1000 pop. 1999</th>
<th>Extent of Private Sector Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>197 (1996)</td>
<td>7,697 e</td>
<td>180.6</td>
<td>Moderate</td>
</tr>
<tr>
<td>China</td>
<td>4,735 (1998)</td>
<td>3,600</td>
<td>6.4</td>
<td>High</td>
</tr>
<tr>
<td>Colombia</td>
<td>1,330 (1998)</td>
<td>2,011 f</td>
<td>42.9</td>
<td>High</td>
</tr>
<tr>
<td>France</td>
<td>6,716 (1998)</td>
<td>23,912</td>
<td>561.9</td>
<td>Moderate</td>
</tr>
<tr>
<td>Hungary</td>
<td>254 (1998)</td>
<td>4,772</td>
<td>257.6</td>
<td>Moderate</td>
</tr>
<tr>
<td>Italy</td>
<td>6,440 (1997)</td>
<td>20,473</td>
<td>618.8</td>
<td>High</td>
</tr>
<tr>
<td>Japan</td>
<td>9,219 (1998)</td>
<td>35,517</td>
<td>567</td>
<td>Low</td>
</tr>
<tr>
<td>South Korea</td>
<td>2,050 (1999)</td>
<td>8,666</td>
<td>238.3</td>
<td>High</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1,127 (1998)</td>
<td>3,607 g</td>
<td>222.1</td>
<td>High</td>
</tr>
<tr>
<td>Mexico</td>
<td>6,061 (1997)</td>
<td>4,921</td>
<td>64.9</td>
<td>High</td>
</tr>
<tr>
<td>Philippines</td>
<td>168 (1998)</td>
<td>1,046 h</td>
<td>30.2</td>
<td>High</td>
</tr>
<tr>
<td>Spain</td>
<td>2,255 (1997)</td>
<td>15,220</td>
<td>520.7</td>
<td>High</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>8 (1997)</td>
<td>24,228</td>
<td>517.6</td>
<td>High</td>
</tr>
<tr>
<td>United States</td>
<td>7,363 (1996)</td>
<td>33,836</td>
<td>648.6</td>
<td>Low</td>
</tr>
</tbody>
</table>

Sources:  
- a. Figures in this column include toll bridge and tunnel roadway, although their contributions to the totals are generally minor.  
- These figures are based on a seminar report on Asian Toll Road Development Program (The World Bank and Ministry of Construction, Japan, 1999) and South Korea item added.  
- (Autos include passenger cars, buses, and trucks)  
- d. This indicator is based on a seminar report on Asian Toll Road Development Program (The World Bank and Ministry of Construction, Japan, 1999) and South Korea item added.  
- e-h. These indicators are based on the data of the Ministry of Foreign Affairs, South Korea. The year is e (2000), f (2001), g (2000), h (2000) respectively.

While some countries have historically avoided charging tolls for public roads, in the present environment of fiscal restraint nearly all have turned to tolls as a preferred means for financing highway infrastructure investment.
Except for a few countries such as Japan, the private sector is now playing a major role in toll road development.

In most cases special solutions for toll collection can appear together at one road infrastructure element. The following highways are good demonstrations for special toll collecting solutions (SMALL, K. A. and JOSE, A. Gomez-Ibanez, 1995, ORPSZ, C. and PÁSTI, B. 2001):

- Nam San Tunnel No. 1 and No.3, Seoul (congestion pricing, variable prices)
- City Center, Singapore (congestion pricing, electronic road pricing)
- Melbourne City Link, Australia (electronic road pricing)
- Autoroute A1, France (Single facility, congestion pricing)
- I-15, California (fully automatic toll collection, variable prices, express lanes)
- QuickRide, Huston (electronic toll collection, carpool lanes)
- State Road 91, California (fully automatic, variable prices)
- Highway 407, Toronto (automatic, congestion pricing)
- Oresund Bridge, Variable Bridge Tolling
- Cordon Tolls in Norway (city toll ring)

3.1 The Justification of “Users Pay Principal”

“Users pay principle” is fair, as people with higher incomes use more the car, and thus pricing will particularly affect them.

. It will lead to an efficient transport system, with great benefits in countries’ competitiveness, economic and social growth.
. It will affect travel patterns and modal shift towards public transport modes. Changing routes and timing is also a positive issue.
. It is fair that the user should pay, so that the infrastructure becomes more efficient and improved.
. It aims towards a more differentiated charging system and not towards extra taxation of road transport
. It will result in rescheduling low value road haulage and shifting transport modes (train, etc.) with great financial gains for companies and industries.
3.2 Marginal Social Cost Pricing Approach

Marginal costs are the costs generated by an additional transport unit (vehicle/train/barge/ship/plane) when using infrastructure. I begin by assuming that the capacity of infrastructure is taken as given.

This means that there are some costs, which are “fixed” (the costs of infrastructure construction is the simplest example) and others, which are variable. Of the latter, some will vary only loosely with the level of traffic.

In other cases there are clear links with traffic flows and between the individual transport units and the costs imposed. It is this subset of variable costs, which are defined as marginal costs.

Whilst some of these costs are reflected in current prices (and are “internal costs”), there are many costs, which are not borne by those who cause them, but affect third parties and so have not been “internalised” in the charges paid. Most of these “external costs” are marginal social costs.

3.2.1 Types of External Costs

The progress made in evaluating external costs of transport can best be followed on the base of the UIC (Union International des Chemins de Fers is the international association of the railway companies), which have been published in 1995 and 2000.

While the UIC 1995 study only looked at four effects (accidents, noise, air pollution and climate change), the updated study UIC 2000 gives a considerable extension of external cost accounting.

Impacts on nature and landscape, separation of urban areas, costs from up-stream and down-stream processes and finally cost of congestion have been added (ROTHENGATTER, W., 2001)

3.2.2 Principle of Congestion Pricing

In this paper, I will introduce the marginal social cost price approach on external cost of congestion for example.
The basic justification is based on the concept of the “externalities” which drivers impose.

When a driver makes a journey s/he is faced with costs in terms of time and vehicle operating costs.

However, as demand increases, the addition of journeys will increase the costs faced by all other users of the facility.

The size of this effect is determined by the relationship of traffic speed to flow on the facility under consideration.

This external effect is not recognized by the individual driver in making decisions and hence may lead to decisions to travel where the benefits of the trip are less than the total costs which it generates.

The purpose of congestion pricing is to charge drivers an amount which represents this extra cost to the other which they cause, thus leading to travel decisions which are based on a correct calculation of the total costs involved i.e. travellers are faced with the marginal social cost rather than marginal private cost, though it must be recognized that congestion is only one external effect.

There is growing current concern about environmental externalities but this is not mentioned here.

### 3.2.3 Optimal Marginal Social Cost Pricing on Congestion

If we were obliged to pay the true marginal costs of the car journey, including the road provision, plus our social costs in terms of delays to other road users, perhaps we would make fewer car trips?

This is the basis of the economist’s solution to road congestion.

In the UIC 2000 study total, average and marginal costs have been calculated. Total cost calculation is based on aggregate figures and applies a top-down approach.

This means that overall costs are calculated by type of effects and then broken down to the transport unit by subdividing the cost figures by passenger/km or ton/km to result in average costs (ROTHENGATTER, W., 2001).
In the theory of optimal marginal social cost pricing plays an important role as it can be shown that in a perfectly competitive or in a perfectly centralized public regime prices would equal marginal costs if the infrastructure were optimally designed.

Although the concept of marginal costs looks simple, it is associated with a number of quantification problems. In the case of congestion costs it is necessary, for instance, to calculate the dead-weight losses (welfare losses through deviations from the socially optimal link loads)

Look at the figure 3.1 and let us see how we can analyse this technically:

**Figure 3.1 Economic Definitions of External Congestion Costs**


The dead-weight loss (depicted by the area ABC in the figure above) can be interpreted as the loss of social welfare sub-optimal use of the existing based on decentral individual decision making not taking into account congestion externalities.

Suppose a marginal social cost pricing approach was adopted; the price would be OC and the flow, or demand, would be OE. Beyond that flow, every additional road user costs other road users (measured by the marginal social curve) more than his/her benefit (measured by the demand curve).
Moving from flow OF to flow OE will reduce costs by ECBF and benefits by only ECAF.

So if we did use a marginal social cost pricing policy, we would save resources equivalent to area ABC.

Price would be set equal to the marginal social cost OC, and flow would be reduced by EF, by imposing a charge of CD.

There will, of course, still be some congestion, since there would remain enough road users to cause delays to others, but economic theory tells us that resources are allocated efficiently, as the marginal social cost imposed by the user equals the benefits s(he) gains (Transport Tutorial Association, 1990).

This formal economic analysis shows the way in which the use of road space could be efficiently allocated by pricing.

### 3.3 Important Issue for Toll Financing

An important issue here involves consideration of the relative advantages and disadvantages of toll financing of highways as compared to financing from tax revenues.

The decision of whether to toll or not to toll is important where traffic levels are relatively low. But, it has not been adequately considered in many of the case study countries. Another sub-issue is that the costs of establishing a toll system can be high.

For example, the case studies and other evidence indicate that, depending on whether an open or closed tolling system is employed, additional construction costs can range between 2 and 8 percent of initial costs and that operating expenses can range between 5 and 20 percent of toll revenue.

It is also very beneficial for a toll road project to obtain domestic financing in order to avoid currency exchange rate risks between local toll revenues and foreign currency debt.

When the capital cost is small, it is relatively easy to attract domestic capital in the form of both debt and equity.

However, in many countries, local capital markets are not sufficiently developed to provide the long-term capital required for toll road projects. In contrast, in many developed countries such as the United States and the United Kingdom, the tenure of
commercial bank loans may extend 15 to 30 years to match the concession period.

For developing countries, it may make sense to either establish a financing institution or a similar mechanism to provide long-term loans for privately financed infrastructure projects.

**3.4 Comparison of Tolled Motorway Project with Power Plant Project**

The following figures set forth a comparison of typical examples of a tolled motorway and a power plant project. This comparison is relevant because the pool of potential debt and equity investors overlaps on these types of projects. One must assume that they compete for investors (The Chartered Institute of Transport, 1993).

**Figure 3.2 Cash Flow of Tolled Motorway Project**

Investors choose between opportunities based on money criteria. The purpose of this comparison is to illustrate a structural impediment to tolled motorway investment when compared with power plant projects.

The figures assume that the capital investment and financing are the same and ignore, for the purpose of illustrating a basic difference, taxation and accounting issues.

The figures illustrate that, for projects of equal net present value (NPV), the cash flow
available for disbursement to investors in a tolled motorway project occurs much later than with a power plant project, for example.

**Figure 3.3 Cash Flow of Power Plant Project**

This results in a longer equity payback period. Because of this, all other factors being held equal, investors would prefer to participate in a power plant project than in a tolled motorway project.

This phenomenon occurs primarily because tolled motorways are generally constructed to accommodate traffic demand increasing many years after completion of construction.

There is also typically a learning period before the base level of road use is established. The revenues later grow at levels in excess of inflation. The effects are exacerbated by the fact that market price elasticity probably dampens income in the early years more than the later years when people are more accustomed to paying tolls.

This phenomenon of late payback occurs to a lesser extent in other types of transport projects. It is an important factor in assessing the practical finance ability of these projects.
3.5 PPI Toll Road Development Models

The principal responsibilities for toll road development include design, construction, maintenance, toll collection, arranging financing, and legal ownership.

The most important typical frameworks for the cooperation between the public administration and private sector have been duly described and classified in a Report of the PIARC Committee on Financing and Economic Evaluation (C9) prepared by G. Maring and G. Esterman to the World Road Congress, Montreal 1995.

The following main types of PPI in toll road projects are worthy of note:

BOO (Build, Own and Operate): a private corporate entity finances and builds an infrastructure, which is owned, tolled and operated by that company for an unlimited time (e.g. the Ambassador’s Bridge, on the border of the United States and Canada).

BOT (Build, Operate and Transfer): a concession is awarded to a private corporate entity to build and operate a tolled infrastructure during a limited period (usually of 20 to 40 years), at the end of which the infrastructure is transferred free of charge to the public administration.

DBFO (Design, Build, Finance and Operate): a private corporate entity is selected through competitive tender to build, own, finance and operate infrastructure for a limited time. Payment is made to the private owner/operator by the public sector in the form of shadow tolls, based on the number of vehicles using the road or on some other formula.

BTO (Build, Transfer and Operate): a private corporate entity finances and builds the infrastructure, but upon completion transfers its ownership to the State.

The infrastructure is then leased from the state, operated and tolled by the same, or another private company during a limited period (usually 20 to 40 years), at the end of which all rights have to be transferred to the State.

Although the state can “own” the infrastructure from the first day of operation, the private company often keeps the full financial responsibility, which is not transferred to the state (e.g. in California SR 91).
This model has been applied in the case of the Incheon International Airport Expressway in South Korea.

BBO (Buy, Build and Operate): this is a theoretical model, whereby a private corporate entity purchases an existing infrastructure from the state, upgrades or repairs it, then operates it and collects the revenues generated (usually tolls) indefinitely.

There are no practical examples of this model as the acquisition of a public road infrastructure is rarely acceptable politically or legally.

LIO (Lease, Improve and Operate): a private corporate entity leases existing infrastructure, upgrades or repairs it, then operates and collects the revenues generated (usually tolls) over the duration of the lease.

This model is frequently used in Latin America, notably in Argentina and in Brazil, and has been successful in the rehabilitation of the road network.

3.5.1 BOT Model

BOT model is the common approach used to assign responsibilities in PPI toll road projects.

BOT is a broadly defined term that includes build-own-operate-transfer (BOOT), build-lease-transfer (BLT), rehabilitate-operate-transfer (ROT), lease-rehabilitate-operate (LRO), and similar arrangements that are used to develop new facilities or improve existing ones.

3.5.1.1 Principal of BOT

BOT structure involves the grant of a concession by a properly empowered governmental authority (the grantor) to a special purpose company (the concessionaire).

Under the concession, the concessionaire would agree to finance, build, control and operate a facility for a limited time, typically 20 to 40 years, after which responsibility for the facility is transferred to the government, usually free of charge.

The concessionaire typically assumes primary responsibility for constructing the project, arranging financing, performing maintenance, and collect tolls, while the public sector retains legal ownership.
In most projects, responsibility is shared, with the public sector taking the lead in the preliminary design (including route alignment, number of lanes, interchanges, and other high-level design specifications) and the private sector completing the detailed design, subject to government approval.

The concessionaire would engage a construction company (the contractor) to perform the construction works on the terms and conditions contained in a construction contract.

The concessionaire would also usually engage an independent party (operator) to operate and maintain the project on the terms and conditions contained in an operating and maintenance contract.

The concessionaire is to receive sufficient revenues during the operational phase: to service the debt that would be provided by the banks and financial institutions (the project lenders) for the design, development and construction of the toll road; to cover the concessionaire’s working capital and maintenance costs; to repay the investment of the investor who are initiating the project (the sponsors), as well as the other investors who would participate in the project later; and, hopefully, also provide a reasonable profit for sponsors and other investors.

The annual revenue is usually affected by many risk factors. In a toll road project, the annual revenue is almost entirely determined by traffic volume under assumption of fixed toll (and given that there are no distinguished vehicle types).

If the toll is fixed at P regardless of traffic volume Q, the annual revenue R is simply given by $R = P \times Q$.

Therefore, the relationship between traffic volume and revenue is linear.

### 3.5.1.2 Advantages and Disadvantages of BOT

Concession non-recourse project financing structures of the BOT type are frequently seen as the panacea for all infrastructure development problems.

Many government officials still express a strong belief in the ability of IFIs (International Financial Institutes) to arrange BOTs for major parts of the road network, regardless of estimated traffic volumes, public acceptability of tolls and contributions from local stakeholders and lenders in the project financing. (VOGELAAR, H., 1997).
To discover why BOT-type private financing is so popular and yet why there are not so many actual examples, the advantages and disadvantages are listed below.

**Advantages:**

- Increased efficiency due to innovative proposals, greater flexibility, experimentation with new designs, construction and operation concepts and more appropriate/motivated management;
- Private finance minimizes the impact of additional taxation or debt burden if a government is unable to incur more debt or contingent liabilities, or prefers to finance large public works from external sources for budgetary or political reasons;
- Promotes private entrepreneurial initiative, which may support the transition process;
- Access to new sources of funding and increases the range of financial resources;
- Improved recognition of project risks by governments;

**Disadvantages:**

- Long life and high risks (e.g. construction, revenues) which could be unattractive from the private sector perspective;
- Costs involved in preparing tender documents, heavy front-end investment in construction and associated risks and a potentially long period before transport infrastructure becomes profitable and repays its debt;
- Financing charges/cost of capital for the private sector are probably higher than for the public sector;
- Governments may be required to provide substantial guarantees to facilitate award of the contract (e.g. foreign exchange rates, minimum traffic levels);
- The higher levels of return (depending on the perceived risks) required by private sector investors may render governments reluctant to embark on concession financing;
- Complex, time-consuming procedures and negotiation.
On balance, the most important aspects of BOTs are:

- The development of a new source of funds to solve the government budget constraints because contract-based relationships such as BOTs and concessions allow private entry without complete redesign of the regulatory framework.
- The application of the “users’ pay principal” from making users internalize the external costs of their travel by tolling.
- The profit motive, that is, the project cash flow covering debt service and investor returns, increases cost effectiveness and market awareness.
- Although the cost of private capital may be higher than the cost of capital raised by the public sector, this is probably offset by the private sector’s greater efficiency.

3.5.2 DBFO (Shadow Toll) Model

The DBFO (Shadow toll) model has been used in the UK, Finland and the Netherlands, and the terminology has confused many people.

In Finland, the Parliament has authorized application of a shadow toll system for a 70 km section between Jarvenpaa and Lahti.

In the Netherlands, shadow toll method has used for two tunnels: Noord tunnel (commissioned in 1992, length 2 km), Wijker tunnel (on A22 to the west of Amsterdam, length 2km).

Construction and maintenance are the responsibility of the State (Rijkswaterstaat), acting on behalf of the private investor.

The latter consequently only bears traffic risks, insofar as technical risks are borne by the State.

This is therefore the same shadow toll method as used in the UK. And Finland (French Study for the DERD/WERD, 1998).

In Spain, the Madrid administration has also been experimenting with shadow tolling for roads (36km, a 25 year concession on tolls, about US$ 420M) in the south of Madrid (World Highways, September 2001).

The United Kingdom (UK) government’s initiative for the promotion of PPIs is known as the Private Finance Initiative (PFI).
At the start of the 1990s the UK government acknowledged that the old methods of funding public sector projects through the ‘tax and spend’ regimes of the 1970s and 1980s had become unsustainable, and had resulted in systematic under-investment in infrastructure.

A better means of procurement was required and prioritization of projects was needed.

The PFI was therefore introduced by the Chancellor, Nigel Lawson, in his Autumn Statement of 1992 (SAPTE W., 1997).

The fundamental points behind the initiative were that:

- The private sector had genuinely to assume risk;
- There should be competition where the government facilitated a project or sought private sector partners, or where the government purchased services as a customer;
- The initiative would apply not only to infrastructure projects, but also to other capital investment which provided services to the public sector.

By April 1997 the number of signed PFI contracts had increased considerably and included 8 DBFO roads, 6 rail-related projects etc.

### 3.5.2.1 Principal of DBFO (Shadow Toll)

An example of PFI projects is DBFO roads for the Highways Agency.

Under these concessions the private sector has contracted to design, build, finance and operate new roads or upgrade existing roads in return for ‘shadow’ tolls.

No tolls are levied from road users under this approach. But government pays the shadow tolls to the operator, based on traffic counts on the road and an agreed rate per vehicle/vehicle type.

Actually, the band system enables a nonlinear toll tariff, which takes usually a form of piece-wise linear function.

Taking the UK example, four “traffic bands” have been defined (see figure 3.4 below), each with a specific company remuneration rate, as follows:
Figure 3.4 The Example of Traffic Bands and Payments of Shadow Toll

- 0 to 70 million veh.km: 9 p/veh.km (about US$ 0.129)
- 70 to 100 million veh.km: 6 p/veh.km (about US$ 0.086)
- 100 to 130 million veh.km: 3 p/veh.km (about US$ 0.043)
- Over 130 million veh.km: zero remuneration.

Remuneration of the concession company is thus capped, as there is no further payment (“price cap” system) above a certain level (130 million veh.km in the example examined).

It should be noted that the concession companies were free to establish their own traffic bands, and their own remuneration rates. These parameters were then negotiated with the Transport Department.

Candidate concession companies had access to traffic data recorded on the section in question, or traffic predictions established by the British Highway Agency in the case of new motorways.

The benefits of this system do not therefore stem from the development of a new source of funds, or from making users internalize the external costs of their travel, but rather from:
The government commitment to continued financial support over several years

The involvement of the private sector and their responsibility for efficient delivery of service.

3.5.2.2 Advantages and Disadvantages of DBFO (Shadow Toll)

The advantages and disadvantages of the shadow toll can be gauged by comparison with other types of funding, namely budgetary and toll concession funding.

The advantages of road funding by means of a shadow toll system, compared with toll concession funding are as follows:

**Advantages:**

- There is no tendency to shift traffic onto other roads. In the case of a motorway infrastructure under toll, a certain number of users avoid the motorway both because of the toll cost, and the distance between access points.
- The shadow toll approach does not require traffic to slow for toll collection.
- No expenses associated with toll collection are incurred. It is estimated that between 10 and 15% of revenue are absorbed by toll collection costs (For example, toll collection costs in Norway represent an average of 17% of toll revenue), while approximately 10% of the initial cost of the infrastructure represents construction of the toll stations (French Study for the DERD/WERD, 1998).

**Disadvantages:**

- A shadow toll system does not solve the funding problem, as the concession authority must pay shadow toll remuneration to the concession company in due course.
  It does not therefore generate new funding sources. Such an arrangement makes it possible to shift responsibility for the financial package onto the concession company (so that the debt is non-public), but the final cost must be borne by the taxpayer (“delayed” budgetary funding), and not the user.
- It reduces the freedom of budgetary allocation of future government.
- The financial and legal costs, tendering cost of this type of arrangement can be high, and should not be underestimated.
  This has led to significant criticism of the approach in the Netherlands.
It requires the government and private sector to agree the vehicle counts so it is
difficult to apply to the countries that do not have well-developed traffic data and
traffic counting system.

In case that country has significant volume of foreign traffic, it is difficulty to
apply this method because of lack of taxpayer’s payment justification.

### 3.5.3 Comparison of BOT and DBFO (Shadow Toll) Models

Similar to a BOT arrangement, a DBFO strategy calls for the development and
maintenance of a road segment to be transferred to the private sector for a specified
period of time.

The difference is that under a DBFO arrangement, the concessionaire typically
provides the facility and the services to the government in return for the receipt of so
called shadow tolls that are based on highway usage and the availability of the facility.

DBFO might also reduce the disbenefits of tolling, which reduces time saving unless
there is an effective electronic charging system.

However, a major disadvantage of shadow tolls is they fail to pass correct economic
signals to users (FLYNN, R., 1994).

The following table 3.3 summarizes the features of both contract mechanisms.

### Table 3.3 Contract Mechanisms of DBFO and BOT Projects

<table>
<thead>
<tr>
<th></th>
<th>DBFO (Shadow Toll)</th>
<th>BOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue source</td>
<td>Shadow toll paid by government</td>
<td>Real toll charged to users</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partial government support</td>
</tr>
<tr>
<td>Toll revenue</td>
<td>Nonlinear (Band system)</td>
<td>Linear</td>
</tr>
<tr>
<td>relationship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other risk factors</td>
<td>Traffic related payments, lane closure charges, Payments</td>
<td>Various risks such as traffic demand</td>
</tr>
<tr>
<td></td>
<td>to reward improved safety</td>
<td>demand risk by charging direct toll etc.</td>
</tr>
<tr>
<td>Contract period</td>
<td>Basically 30 years</td>
<td>Variable (varies with revenue) with maximum period</td>
</tr>
<tr>
<td>Country</td>
<td>A few countries are using (UK, Finland etc.)</td>
<td>Most countries are using (France, Italy, Hungary, Korea etc.)</td>
</tr>
</tbody>
</table>
3.5.3.1 Revenue Structure

In DBFO (shadow toll) projects, the relationship between traffic volume and shadow toll revenue is determined by the band system proposed by the bidders.

In toll road projects, the relationship between traffic volume and real toll revenue is a linear function since the same toll is applied to all users (neglecting various vehicle types and discounted tolls etc.).

3.5.3.2 Risk Factors

The Shadow tolls should be based on actual usage, leaving some of the demand risk with the government, but the concession company would not need to forecast the price elasticity of demand.

But the concession company is encouraged to carry out motorway repairs efficiently. Payment by the public authority takes account, not only of the traffic recorded, but also the performance of the concession company.

This performance can be measured, for example, on the basis of the number of lanes closed to traffic (and the time taken for the repair work), or the measures introduced by the concession company to improve road safety.

3.5.3.3 Contract Period

In DBFO projects, the contract period is basically fixed at 30 years. The exception is that, when Force Majeure occurs, the period is extended by five years.

In BOT projects, the contract period is variable. The contract is terminated when all the funds are repaid or, equivalently, the pre-determined net present value of revenue is achieved.

The maximum contract period is also set and the contract period is terminated at the maximum even though the funds are not repaid.
Chapter Four: International Experiences in PPI Toll Road Projects

After World War I, infrastructure was mainly designed, constructed and financed from public funds and prior to 1982 there was virtually no private financing of transport infrastructure in developing or transition countries.

The trend towards the liberalization and privatization of infrastructure activities that began in a few countries in the 1970s and 1980s turned into a wave in the 1990s.

Developing countries have been on the crest of this wave, pioneering better approaches to providing infrastructure services.

Market leaders among emerging economies such as Argentina, Chile, and Hungary have gone further in privatizing infrastructure than all but a few industrial countries.

Simultaneously, initiatives aiming at outsourcing maintenance activities to private firms are being implemented in Africa, Asia and to a larger extent in Latin America.

In some cases, an existing, tolled facility is made part of the concession agreement as a condition of building new infrastructure either linking with it or enhancing its capacity (e.g. – the Dartford Tunnel and the Second Severn Bridge in the UK or the Tagus River Bridge <Vasco Da Gama Bridge> in Portugal, the North-South Highway in Malaysia).

Developed and developing countries throughout the world have accumulated a diverse base of experience with respect to the institutional, regulatory, and financial aspects of building and operating toll motorway systems.

While some countries have historically avoided charging for motorways, in the present environment of fiscal restraint nearly all have turned to tolls as a preferred means for financing motorway infrastructure investment.

Except for a few countries such as Japan, the private sector is now playing a major role in toll motorway development.

4.1 The United States

In the United States roads played an important role in the early development of the
country but particularly in the latter half of the 20th century most interstate highways and urban expressways have been developed as un-tolled facilities.

Toll system acceptability in the U.S is relatively low. The American consumer knows that he or she already pays for road investments through motor spirit tax, and is not ready to pay a toll for road usage.

The tax code adopted in 1986 substantially reduced private sector participation in the funding of road infrastructures in the U.S.

In two ways, firstly by limiting the maximum period of concessions in certain cases, and secondly by refusing tax exemption for the debts of private concession companies.

However, there has been a renewed interest in toll financing for highways. Recent innovative financing initiatives have involved public-private partnerships between state governments and private sector highway development consortia.

Projects where private sector funding participation is strong are therefore limited (Dulles Greenway, SR 91, etc.).

On the other hand, public organizations holding highway concessions are numerous at State level (there are numerous “toll authorities” in Texas and Florida in particular).

It should also be pointed that U.S Government subsidies to the individual States for highway road projects date back no further than 1991.

4.2 Germany

Until recently, financing motorways in Germany were exclusively financed from public budgets. Since the reunification, the State has had to cope with an increasing need for public sector funding, and studies have been carried out to find out to what extent it is possible, useful and necessary to change a policy considered as a real tradition.

- Basic changes in political assessment of toll roads since 1970.
- Attempts to invent and implement a “concession model” based on leasing opportunities, compatible with the legal system
Introduction of a vignette type motorway user charge for heavy good vehicles etc.

4.3 United Kingdom

All British motorways currently in operation have been funded from central government sources, but the government is now promoting the use of the DBFO mechanism to encourage increased private financing of roads.

After reflections made on the possibility of private financing of infrastructures and in particular on road pricing in Great Britain, in 1992 the Department of transport launched the principle of DBFO type contracts with a significant transfer of risks toward the private sector and relying on the concept of shadow toll.

Successful concession projects in U.K are Dartford Bridge, Second Severn Bridge etc.

4.4 Countries with Developed Toll Motorway Systems

France, Italy, and Spain have advanced, well-developed toll motorway networks, and they each provide valuable lessons.

France initially made a commitment to using tolls for financing motorway construction by semi-public companies, but later moved towards a policy of more extensive private sector involvement.

However, partly as a consequence of the energy crises of the time, the French motorway system was confronted with a serious cash deficit problem in the 1970s and 1980s. In response, the French government partially nationalized the private toll road companies in the early 1990s.

France is also known for pioneering the technique of toll road development through cross-subsidization. Over time, the concession companies have been expected to subsidize new and more costly routes with operating surpluses derived from older, more heavily traveled segments that had been built at a lower cost.

In return for developing new motorways, the operators have been granted extensions in the periods of their older and more profitable concessions.
Italy has undertaken toll motorway development by granting of most concessions to companies controlled, at least in part, by public bodies.

The toll road program in Spain has been keeping complementary relationship between the development of a private sector concession-based system and government-funded toll-free roads.

However, in response to recent budgetary stringency, the Spanish government has again become more amenable to private involvement in toll road development.

4.5 Central and Eastern Europe

In Central and Eastern Europe, Hungary adopted a BOT approach to develop a toll motorway network in the early 1990s. But Hungary’s pioneering experience with BOT has not been without difficulty.

The previous government’s plan is to introduce a “vignette system” on all Hungarian motorways including M5 (private funded motorway). The new government (established in 2002) prefers the adaptation of a EU conformance solution.

Poland is working on various forms of public/private partnership. This includes the A1 Motorway from Gdansk to Torun.

The Polish government and its advisers are building on the mixed success of BOT projects elsewhere, plus experience with DBFO in the U.K., Portugal and Finland.

The aim is to develop an approach that is economically attractive in the long term for the Polish government, and which mobilizes private finance and management skills.

In the Czech Republic, a study of the recourse to private financing was made on occasion of Plzen – Rosvadov – German border section of the D5 motorway.

The call for tenders, of the BOT type, has been issued, but upon examination of the answers, it was decided to not pursue the project for the time being (World Road Association, 2000).

4.6 East Asia

In the last ten years the private sectors have become increasingly involved in most of these countries, although public sector highway authorities were the main actors in the early stages of toll road development.
China’s Hong Kong Special Administrative adopted a plan for the private
development of public infrastructure at an earlier date than many of its neighbors.

Its first privately built and operated toll tunnel opened in 1972. While the
government utilized lease-type structures in their initial projects, they have lately been
adopting a more standard BOT-style approach with more sophisticated mechanisms for
toll adjustment.

The Asian financial crisis that began in mid-1997 has had a variety of consequences
for toll road programs in the selected countries (South Korea, China, Indonesia,
Malaysia, Philippines, Thailand etc.).

In many ways, the financial crisis has brought forward new issues in terms of the role
of governments in toll road development (KONG, G. S., 2000).

4.7 Latin America

All of the reviewed Latin American countries have been actively engaged in
concession road infrastructure projects to the private sector.

For example, since the early 1990s, the government of Argentina has granted private
firms the right to collect tolls on some of the country’s main highways in return for the
duty to carry out a program of maintenance, rehabilitation, and construction. But, the
latest program there calls for the development of a new 10,000 km national highway
network using public sector funding.

In Brazil, a 15,000 km toll road concession program is being implemented at both
Federal and State levels, although the ongoing devaluation of their currency is likely to
delay the ambitious development schedule.

Chile has also been actively engaged in concession road improvement projects to the
private sector, and it plans to build a modern toll-motorway network using BOT-style
concessions.

In Colombia the Government has awarded a dozen concession contracts for the
rehabilitation and construction of highways, and is currently targeting the modernization of 4,900 km of national highways.

Mexico initiated one of the world’s most extensive private concession toll road programs in 1989. This followed several decades of limited results in building state-run tolled and free of charge highways. After completing more than 5,000 km of new concession highways in only five years, financial instability brought the concession program to a standstill in 1995. Current plans call for a re-privatization.

4.8 Countries, Which Did Not Seek Private Financing

Switzerland, Slovakia, Japan etc. has followed a consistent policy of toll expressway development through public corporations.

Japan has a system of “toll revenue pooling” involving internal cross-subsidization for the entire national expressway network, which has made it possible for Japan to develop more than 9,000 km of toll roads throughout the country, over 6,400 km of which are toll expressways.
Chapter Five: Further Developing and Comparison of Appraisal Methodologies for Financial and Economic Feasibility of Road Project Development by PPI

5.1 Introduction

Worldwide trend in road infrastructure has been to introduce private capital on the basis of PPI in many areas to build and operate road infrastructure. The private sector has access to vast amounts of capital and it has better management skills than government workers.

The road projects appraisals have significant impact on the decision makers who are directly or indirectly concerned, whatsoever the results are from an economic or financial comprehensive analysis (see figure 5.1).

Figure 5.1 General Procedure of Cost Benefit Analysis

Transport Infrastructure Development Project

Aggregate Life-Cycle Benefits

Estimation (Present Value of Benefit)

Aggregate Life Cycle Costs

Estimation (Present Value of Cost)

Criteria for Economic Evaluation

- Benefit/Cost Ratio
- Economic Net Present Value
- Economic Internal Rate of Return

Comprehensive Feasibility Study

Since the road projects appraisal procedure is to prevent the decision makers from subjective or risky decision, the objective evaluation criteria should be used, and
reasonable and transparent evaluation procedure should be applied.

A comprehensive feasibility study ought to be three-fold. Firstly, alternatives considered have to be technically feasible to design, construct, and operate. Secondly, the environmental impacts need to be identified and possibly quantified and valued in monetary terms. Last, life-cycle costs and benefits are to be projected, and the overall economic viability is to be determined.

The collection, comparison and analysis of feasibility appraisal methodologies create the sound base for their efficient application in the frame of PPP.

5.2 Socio-Economic Analysis versus Financial Analysis

Confusion is often observed between social economic analysis and financial analysis. Although the definitions may vary and some concepts attached to each of the two topics are not so easy to tackle, a rough distinction can be established (the World Bank Tool Kit).

Socio-Economic Analysis (SEA) aims at identifying and comparing social and economic benefit and loss (e.g. economic activity, congestion, accident, environment etc.) accruing to the economy as a whole, setting aside for example monetary transfers between economic agents.

Financial Analysis (FA) consists in comparing revenue and expenses (e.g. investment, maintenance and operation cost etc.) recorded by the concerned economic agents in each project alternative (if relevant) and in working out the corresponding financial return ratios.

To figure out an aspect of the difference, toll roads are a good example: in the SEA, toll revenue accruing from existing traffic is not taken into account in the computation of total benefits because it represents a transfer from the road user to the road operator.

But it is obviously a key parameter of benefit computation in the FA whatever the institutional scheme.

Another confusion may arise: although tolls do not directly take part in the SEA computation of total benefits (except in the case of generated traffic), they are
nevertheless a key factor of the SEA because the level of tolls will affect the transport
demand and thus the economic ratios of the project, and in particular the economic rate
of return (depending on the gap between the economic optimum and the actual pattern).

Finally, it must be remembered that SEA and FA are not self-contained topics: they are
used to verify the economic and financial sustainability of the projects likely be
implemented.

Going back to the examples quoted above, the financial sustainability of a given
project may not be compatible with the economic sustainability, and the value of key
parameters like tolls must be adjusted in order to cope with both economic and financial
constraints.

5.3 Cost Benefit Analysis (CBA)

CBA is one of the most frequently used methods for assessing the impacts of road
projects.

It generalizes the classical criterion of financial gain by also considering the market
effects as well as the non-market effects of decisions, positive (=benefits) and negative
(= costs) and bringing these to a monetary value.

The values of benefits and costs being derived from monetary values, the biases that
may come from the analyst or the decision maker, seem weaker than with other methods
of evaluation, which apparently contribute to making the method more objective
(Permanent International Association of Road Congress, 1987).

Examples of elements taken into account:

Costs: Land Acquisition, Construction, and Maintenance etc.,
Benefits: Gain in time for the users, Economy in the wear and maintenance of
vehicles, Economy in fuel, Reduction in traffic accidents and Comfort
accruing to users etc.

The validity of a road project is satisfied when 1) the benefit is greater than the cost,
and 2) profitability is greater than those of other alternatives.
The main three criteria for verifying the validity of the road projects are:

1. Net Present Value,
2. Benefit/Cost Ratio,
3. Internal Rate of Return.

The strong and weak points of the above mentioned three most important evaluation criteria are discussed in the next section.

5.3.1 Net Present Value (NPV)

NPV is an absolute and present value of total net benefits.

\[
\text{NPV} = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t}.
\]

Here, \(B_t\) : Benefits of year \(t\), \(C_t\) : Costs of year \(t\), \(t\) : years (1, 2, 3 ...), \(i\) : discount rate (e.g. interest rate of risk free or inflation rate etc.)

The discount rate should reflect the opportunity cost of capital or what the investors can expect to earn on other investments of equivalent risk.

The NPV approach correctly accounts for the time value of money and adjust for the project’s risk by using the opportunity cost of capital as the discount rate.

Thus, it clearly measures the increase in market value or wealth created by the project.

The NPV of a project is not affected by “packaging” it with another project. In other words, NPV (A+B) = NPV (A)+NPV (B).

Decision rule is to accept projects with NPV greater than zero. For mutually exclusive projects, accept the project with the highest NPV, if the NPV is positive. So NPV is a proper method to select one among several alternatives.

The weakness of NPV is that the value changes as discount rate differs. Therefore sensitivity analysis is essential when NPV is applied as criteria.
5.3.2 Benefit/Cost Ratio (B/C)

B/C calculates this formula and the meaning of letters is the same here.

\[
B/C = \frac{\sum_{i=1}^{n} \frac{B_i}{(1+i)^t}}{\sum_{i=1}^{n} \frac{C_i}{(1+i)^t}}.
\]

(5-2)

B/C is a relative value, so it does not concern the value of NPV.
It is not proper to use B/C as criteria when choosing a project in mutually exclusive cases.

Though B/C is affected by the discount rate, it is an easy method to get a switching value.

Projects are ranked in order of their B/C ratios, those with the highest indices being undertaken in preference.

5.3.3 Internal Rate of Return (IRR)

The calculation of IRR can be done using the next equation and then by iteration.

\[
NPV = \sum_{i=1}^{n} \frac{B_i - C_i}{(1+r)^t} = 0.
\]

(5-3)

Here, r means IRR and the other letters are the same.

IRR is the rate of discounting the future that equates the initial cost and sum of the future discounted net benefits (namely B/C = 1 and NPV = 0).

The good point of IRR is that it does not need a discount rate in economic evaluation.
For mutually exclusively projects, IRR can give incorrect decisions and should be used to rank projects.
If one must use IRR for mutually exclusive projects, it should be done by calculating the IRR on the differences between their cash flows.

IRR is a barometer to know the rate of return from the investment directly.
According to the criterion for IRR the project is effective (viable) when the latter \( r \) is greater than the discount rate \( i \).

5.4 Further Methods for Supporting Decision Making in Road Project Evaluation

There are a large number of systematic frameworks that are advocated and used in many countries. The types of frameworks widely advocated and which we will concentrate on in this section are:

1. Cost Effective Analysis,
2. Multi-Criteria Analysis,

Above-mentioned analyses were well summarized in the reports supplied by members of PIARC Committee on Financing and Economic (C9) under the cost recovery and dedication of road user fees topic as follows (the World Road Association, 1999).

5.4.1 Cost Effective Analysis (CEA)

CEA deals with benefits that are not easily quantified or for which there are no easily defined money units. There is, thus, no formal rule for determining whether a policy is desirable or not.

The principal aim of CEA is to obtain a money-based index that is helpful in comparing alternatives with the same general type of objective.

Such an index can be obtained as follows:

\[
\text{Cost Effective Index} = \frac{\text{Units that measure consequence}}{\text{Cost in monetary units}}. \quad (5-4)
\]

Thus a project with the highest index is preferred.

5.4.2 Multi-Criteria Analysis (MCA)

MCA takes into account both the effects that are valued in monetary terms and other effects considered to be of interest.
In relation to CEA, MCA tackles the problem of several effects arising from a policy, which CEA cannot.

Since effects of a policy cannot be added together directly because of the lack of a common unit (which would be money in case of CBA), MCA places a weighting factor on the individual effects.

If, for example, reduced accidents were more important than gains in scenic beauty, then they would be weighted with a higher factor.

The various benefits may then be summed up in their weighted form. For example, if benefits are accident reduction (A), scenic beauty (S) and savings in travel time (T), and their respective weighting is a, s, and t, then the overall benefit is $B'$, where:

$$B' = aA + sS + tT.$$  \hspace{1cm} (5-5)

The weights are in fact prices since they reflect the relative importance of each of the objectives. They are, however, derived in a number of ways: by asking experts; by asking individuals and by asking decision-makers.

It should be observed that the resulting $B'$ can be assessed as the cost effectiveness index shown in (5-4) as $B'/C$ (where C is the cost in monetary units).

MCA is more complex than the general description given here.

The main advantage of MCA is that it incorporates the multiple objectives that decision-makers generally have, and if the weighting factors can be derived, it enables diverse objectives to be integrated.

When compared to CBA, the fundamental difference is that economic efficiency is not the sole objective of a policy.

5.4.3 Risk Benefit Analysis (RBA)

One of the key issues in PPP projects is the analysis and allocation of the various risks (such as completion risk, operation risk, commercial risk, financial risk, legal risk, political risk and environmental risk, etc.) associated with the project between the public and private sectors and, after that, among the individual parties involved.

The application of decision rules to risky events has led to the emergence of RBA. RBA is nothing other than CBA in the context of a risky event.

To see the formal equivalence, consider a transportation project that will increase the level of pollution and hence the risk of being sick.
The risk of such a policy is the number of people being sick due to the increased pollution. The benefits of “no action” are the avoided costs of decreasing the pollution and the illness.

We can therefore compare the risk with benefits to give us “risk benefit analysis”. The similarity with CBA is that RBA takes the number of sick people to be the cost and the foregone resource cost to be the benefit.

5.4.4 Environment Impact Analysis (EIA)

Major transport projects can be deemed from their intent to generate environmental impacts over large geographical areas. Such projects could entail major construction, and their effects may be related to the sensitivity of natural and human resources to disturbances.

Highly sensitive natural resources may include wetlands, tracts of agricultural or forest lands, habitats with threatened species, or regions with important cultural benchmarks.

The adverse effects on human resources may be related to increased levels of air and noise pollution as well as the displacement of inhabitants of affected land parcels.

As a general principle, projects should be designed so that any severe or dangerous localized effects are offset by mitigation measures of some form. It is essential that the cost of these measures is included in the investment cost of the project.

The World Bank, for example, has specific requirements concerning internalization of environmental costs (that is, ensuring that they are borne by the promoters or users of the project rather than third parties) including resettlement of displaced population.

Effects during construction should be clearly distinguished from effects during operation.

As a simple guideline, a checklist of environmental impacts to be considered in a comprehensive EIA is given in below Table 5.1 (Transport Infrastructure Needs Assessment, 1999).
Table 5.1 Check List of Environmental Impacts

<table>
<thead>
<tr>
<th>Impact Group</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Noise and Vibration</td>
</tr>
<tr>
<td></td>
<td>Air Pollution</td>
</tr>
<tr>
<td></td>
<td>Ecology (Habitats/Species/Soil/Vegetation)</td>
</tr>
<tr>
<td></td>
<td>Heritage Assets</td>
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<tr>
<td></td>
<td>Landscape and Townscape</td>
</tr>
<tr>
<td></td>
<td>Severance</td>
</tr>
<tr>
<td>Regional</td>
<td>Air Pollution</td>
</tr>
<tr>
<td>Global</td>
<td>Greenhouse Gas Emissions</td>
</tr>
</tbody>
</table>

5.5 Comparison of Road Investment Analysis Methodologies

The economic analysis is used worldwide. Recently a number of countries, which realized the limitation of the economic analysis, applied the comprehensive appraisal methodology as an alternative method (see table 5.2).

Table 5.2 Classification of Road Investment Appraisal Methodology Concerning Countries

<table>
<thead>
<tr>
<th>Applied Method</th>
<th>Traditional Benefit-Cost Analysis</th>
<th>Relying on Benefit-Cost Analysis</th>
<th>Relying on Multi-Criteria Analysis</th>
<th>Mainly on Multi-Criteria Analysis and Partially Benefit-Cost Analysis</th>
<th>No particular framework or framework varies with state or province*</th>
</tr>
</thead>
</table>

England prefers NPV and B/C for decision.
The Netherlands and Belgium rely mainly on the comprehensive appraisal and partially the economic analysis method.

Germany, Italy, and England base on the economic appraisal.
France used a multi-criteria analysis previously and nowadays considers the economic analysis. Germany values the environmental impacts in money terms.

The countries that prefer the economic analysis adopt a road project if the B/C ratio is higher than 1.0. But, Japan adopts one if the B/C is over 1.5 and Germany ranks one as first-order project if the B/C is higher than 3.0.
IBRD, ADB etc. prefer the IRR because to set the discount rate is not proper.

**Figure 5.2 Cost Benefit Appraisal System of COBA**

5.6 Appraisal Tools for PPI Road Project

In the PPI preparation phase the public project promoter will carry out a socio-economic and a financial analysis as part of the appraisal of the project and its set-up at the time.

The main objective is to determine whether the PPI option leads to a more efficient project implementation than with traditional public financing.
In the PPI negotiation phase these appraisal exercises will have to be updated for changes in the set-up of the project following step2. Moreover, the preferred bidders – lenders, investors, operators, suppliers and/or constructors – will perform their own (cash-flow and risk) analysis of the project.

In principle, there are several conceptual and functional differences between typical socio-economic and financial analysis.

5.6.1 Socio-Economic Analysis (SEA)

The SEA in its widest sense remains a fundamental criterion influencing decisions on tolling either stand-alone projects or a whole infrastructure network.

This means that the capital and operating costs, the direct benefits to the road users and the indirect benefits to all other entities and the community as a whole (especially associated to land use and regional development), together with social and environmental costs, have to be taken into account.

The significance of environment impact analysis is often emphasized as one of major elements in SEA.

The assessment or quantification of identified impacts is related to the likely duration of such impacts.

As such, immediate, interim, and long-term environmental impacts may be expected from the implementation of a potential project.

For instance, the construction of noise barriers along the sides of a major highway passing through residential areas could reduce the level of noise exposure to the inhabitants of affected areas but at the expense of an increased initial investment requirement.

These costs and benefits for the society evaluated in monetary terms can be converted into a socio-economic rate of return for a given project.
5.6.2 Financial Analysis (FA)

The financial analysis for a project is calculated taking into accounts only the actual costs and the monetary revenues and is expressed as a rate of return on investment or on equity.

The heart of the evaluation of financial viability is a cash flow model, showing the yearly or semi-annual distribution of all project-related expenses and revenues under several funding options.

The results of the financial viability evaluation (e.g. return on equity, debt/cover ratios) serve as a base for decision in respect of eligibility of the project for limited recourse project finance after taking into account the governmental support available. The impact of changes in assumed conditions or input data should be appropriately assessed by a series of sensitivity tests.

The investment financing activity can only be performed with the help of target software run on a computer providing manageability of the immense quantity of data records and producing an output corresponding to the expectations of the international financial institutions both in content and form.

Unlike the majority of the project finance models developed to the PC platform INNOFINance is based on a database (Microsoft Access) - an ideal instrument for project finance modelling not only in the economically stabilized countries, but also in the developing areas, where the shortage on sound financial data and forecasts makes the analysis of several cases very important (TÁNCZOS, K. and BÉKEFI, Z., 1997).

Special strength of the model is the wide range of sensitivity analysis, which provides a given type of risk assessment and results in a reduced total risk.

5.6.3 Socio-Economic Analysis for PPI Road Project

The decisions of the policy makers are based on the results of socio-economic analysis, while the financiers consider only the financial viability of an operation (see table 5.3).

A wide range of external effects is incorporated into a traditional socio-economic cost-benefit analysis of a project.
Table 5.3 Comparison between Socio-Economic Analysis and Financial Analysis

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Socio-Economic Analysis</th>
<th>Financial Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point of view</td>
<td>Public, Society.</td>
<td>Private, Project.</td>
</tr>
<tr>
<td>Objective</td>
<td>Maximize public benefits.</td>
<td>Maximize private benefits.</td>
</tr>
<tr>
<td>Types of Effects</td>
<td>All benefits and costs to society (including external costs, excluding transfer payments).</td>
<td>All receipts and outlays that affect the financial position of a company (excluding external costs, including transfer payments).</td>
</tr>
<tr>
<td>Time horizon</td>
<td>Lifetime of project.</td>
<td>Time of private involvement.</td>
</tr>
<tr>
<td>Taxes, Subsidies,</td>
<td>Excluded.</td>
<td>Included.</td>
</tr>
<tr>
<td>Prices used In valuation</td>
<td>If market prices fail to give a comprehensive picture of the value to society, these prices are to be replaced by economic prices.</td>
<td>Actual, Domestic market prices.</td>
</tr>
<tr>
<td>Evaluation Method</td>
<td>Cost Benefit Analysis, Multi-Criteria Analysis e.g.</td>
<td>Return on Equity, Debt/Cover Ratios, Cash-Flow Analysis e.g.</td>
</tr>
</tbody>
</table>

The project may yield an appropriate economic rate of return to the community while being unable to attract private investors and lenders, due to its weak revenue generating potential and lack of financial viability (e.g. low return on equity accompanied by high risk).

In this case, a PPI frame approach (leading to appropriate risk allocation, involving eventual public financial support) gives better position for more complex parties (governments, political parties, financing institutions, and all the industries involved in public services or facilities of any sort) making the project viable.

There are continuously developed methods to meet the needs of public sector, the private sector and domestic and international financial institutions together with a view to sharing the risks and rewards associated with such activities.
5.7 Summaries and Recommendations for a Specially Developed and Standard Appraisal Technique Considering the Characters of PPI Projects

As already reviewed, cost-benefit analysis (CBA), multi-criteria analysis (MCA) or a mixture of the two is the most frequently used methods for assessing the impacts of road projects (TÁNCZOS, K. and KONG, G. S., 2002),
The MCA method came out, as traditional CBA for road project appraisal did not cover versatile policy purposes in the evaluation process and as a result it failed to satisfy decision making efficiently.

Particularly some socio-economic and environmental impacts from road projects must be included in the decision process, however the CBA did not consider them successfully.

Considering the strengths and weaknesses of the different appraisal techniques and the special characteristics of PPI projects, I developed and recommend a standard appraisal techniques for decision-making, conceptual framework such as Socio-Economic Analysis (SEA).

The SEA is the basis for the collective approval of projects mainly used by the public sector. Project and priority selection should be based on this analysis.

As regards socio-economic aspects, they explore on the one hand ways to improve transparency of evaluations and reliability of assessment of impacts that cannot be converted into monetary terms, and on the other, they make progress on the knowledge of the infrastructure impact on the national and local development.

On the other hand, Financial Analysis (FA) aims at ensuring the financial viability and practicability of the project mainly used by the private sector. It determines who bears the initial costs and how they will be repaid.

Money has to be paid for; there must be return on capital.

The gap between SEA and FA is when the project is socio-economically sound but financially unjustifiable.

To bridge this gap the result of FA must be positive: the expected (private) benefits must (sufficiently) exceed the expected (private) costs (including risks).

Solutions to bridge the gap for road projects on the basis of public/private partnership principal, reasonable measures by the public sector are needed (subsidy, user charges, shadow tolling etc.).
Chapter Six: Risk Identification and Analysis through PPI Case Studies in Some Model Countries

PPI toll road projects have been used with ever increasing frequency and skill around the world in recent years, both in emerging markets and in OECD economies.

In Western European countries such as Spain, France, Italy and Portugal etc., a concession project is associated with direct payment by the user, in the form of a toll.

Toll systems are in widespread use in inter-urban contexts, where for roads or confined to bridges or tunnels.

PPI tolling in Asia is now being pursued in a wide variety of countries, including South Korea, China, India, the Philippines, Malaysia, Indonesia, and Thailand.

Over the last decade, the demand for high-standard road network increased substantially in East Asian countries (Japan, South Korea, China etc).

This was a reflection of rapid economic and population growth and increasing levels of vehicle ownership and use.

In the United States, Public/Private Transportation Act signed in 1995 by the Governor of Virginia and enacted by the Virginia General Assembly, which declared the private sector participation may result in the availability of transportation facilities in a more timely or less costly fashion, thereby serving the public safety and welfare.

Other US state authorities initiated tenders and signed performance-based maintenance contracts: Washington D.C., New Mexico, Oklahoma, Alaska, Florida, Mississippi, etc.

The toll road projects based on PPI have now started to take hold in Central and Eastern Europe as well as CIS countries.

After the political system change (since 1989), gradual revitalization of the economy and of the broken up traffic connections started.

In this region, governments are facing dramatic growth road needs, both for new facilities and for maintenance and rehabilitation of existing facilities.
Aiming to prevent further widening of the gap between transport infrastructure investment need and supply, at the Third Pan-European Transport Conference (Helsinki 1997) it was recommended to allocate an amount equivalent to 1.5% of GDP in this region to finance transport infrastructure.

To solve this situation, Hungary, Poland use PPI solution among other solutions and Croatia, Romania is also pursuing PPI projects to upgrade or extend their road networks.

But several countries of Eastern Europe and Asian countries are encountering economic recession, monetary problems and social tensions.

With this point of view, the dissertation evaluates some model countries’ PPI toll road projects.

6.1 The Dulles Greenway (Virginia, USA)

In the early 1960s Dulles International Airport was built in rural Loudoun County, 40 km northwest of central Washington, D.C., to provide service for the entire metropolitan area.

The Dulles Greenway was an extension of the existing Dulles Toll Road from the entrance to Dulles International Airport west for approximately 14 miles to the junction of Routes 7 and 15 near Leesburg, Virginia.

The current Dulles Toll Road runs alongside the Dulles Airport Access Road, which is free, but restricted to vehicles visiting the airport. The Dulles Toll Road was constructed in the mid 1980s to relieve congestion caused by suburban commuters residing in Loudoun County, Virginia, who worked in the metropolitan Washington area.

The Dulles Greenway was conceived to be a critical link in the transportation network between Fairfax and Loudoun counties (MILLER, J. B., 2000).

- Scope of the project: 16 miles long (four lane, seven interchange)
  (6 months ahead of schedule)
- Project cost: approximately USD 326 million
Financing structure
- A consortium: ten institutional investors led by three major project investors (USD 258 million of long term fixed rate notes) to finance much of the cost construction and initial operation of project
- Banks: Barclay’s Bank, Nation’s Bank, and the Deutsche Bank to provide a portion of the construction financing and USD 40 million revolving credit facility.
- Concessionaire: Toll Road Investors Partnership II (TRIP II)
- Concession Period: 40 years (BOT)

6.1.1 Pre-Construction Risk

TRIP II’s unsolicited, sole-source proposal and the statutory process for reviewing and approving it had been long and hard.

There were no competitive proposals to independently confirm to the state, to financing banks, and to TRIP II that the project was financially viable.

Prior to the start of construction, these risks had loomed large to the banks and the State, and consumed a great deal of energy, time, and resources for which the sole source developer paid, not the State.

The private sector acquired the land and owns it, then transfers it to the public sector after the concession period at no cost.

6.1.2 Traffic Forecast Risk

Independent consultants prior to the commencement of construction made a variety of traffic forecasts.

In part, these forecasts were based upon the economic boom of the 1980’s, and did not anticipated the dip in the economy of 1991.

Nor did these forecasts anticipate that it would take four years to (a) obtain approvals from the Virginia Department of Transportation (VDOT), the State Corporation Commission, cognizant state and federal permitting and environmental authorities, (b) complete an appropriate preliminary design for approval purposes, and (c) assemble financing.

6.1.3 Commercial Risk

When the facility was opened in September 1995 the initial, introductory fare was
USD 1.75 for the last four months of 1995.

The toll rate was scheduled to be raised to USD 2.00 in January 1996.

By the end December 1995, paid traffic on the facility was approximately 10,500 per day (half the 1989 projection), with a growth rate of approximately 1% per month. The decision was made not to raise the fare to USD 2.00 in January 1996 and in fact, the fare was lowered to USD 1.00 in March 1996.

Ridership doubled to 21,000 per day by July 1996 with a steady increase of paid users of approximately 1% per month.

Gross toll revenues were sufficient to keep the road operating properly, but were not enough to make debt service payments.

The distribution priority of gross toll revenues is payments of maintenance and operations costs and fixed lease charges, cover debt, and, if available, to pay return.

The parties have struggled for several years to restructure the project on mutually acceptable terms.

6.1.4 Conclusion and Comments

This project has faced some financial difficulties. The acquisition of the land has lasted longer than planned, and initial cost estimates proved to be too low (World Road Association, 2000).

Furthermore, the traffic estimates were too optimistic.

In the Dulles Greenway Project, the traffic forecasts upon which financing decisions were made did not accurately address the issue of toll sensitivity, and motorists appeared to discouraged by the initial toll charge, which was more than double the rate of the connecting Dulles Toll Road.

The financial situation of the project is therefore critical and required important restructuring of the debt.

The project was apparently refinanced in April 1999 through the sale of USD 320 million in zero-coupon bond.

The refinancing of the original 11% loan are expected to permit the Greenway’s owners to pay debt service from toll revenues for the first time.
Daily traffic on the facility is now up to 34,000 transactions per day, a substantial increase over the prior year, but the project’s financial future remains cloudy.

6.2 The M1/M15 Motorway (Hungary)

With the need to reduce public spending and improve its road infrastructure, Hungary turned in the early 1990s to the development of a toll motorway network on a BOT basis.

The M1/M15 Motorway, the first motorway concession in the Central and Eastern European Countries (CEECs), involves 43km on M1 (the last missing link of the 260km motorway between the Hungarian and the Austrian capitals) and 14 km on M15 (A Branch toward Bratislava).

- Scope of the project: 43 km long (The M1), 14 km (The M15)
- Financial Closure: December 1993
- Construction Start: January 1994
- Opened date: January 1996 (The M1), June 1998 (The M15)
- Project cost: approximately USD 320 million (ECU 329 million)
- Financing structure: EBRD plus 11 Western European and 2 Hungarian banks (Equity 17%, long-term debt 81%, generated cash 2%, extra standby facility 18%)
- Concessionaire: ELMKA (Elso Magyar Koncesszios Autoplaya Rt., First Hungarian Motorway Concession Co., Ltd) involved French, Austrian, and Hungarian operators, contractors, oil companies, and banks.
- Concession Period: 35 years (BOT)

6.2.1 Government Support and Profit Sharing

Government support for the project included preliminary design, building permits, and environment clearance.

- Land acquisition, amounting to 5% of project costs
- Undertaking of no tolls on the existing 126 km of motorway prior to 2005
- Acceptance of a phased approach, e.g., M15 second carriageway
- Some restrictions on heavy goods vehicle movements on a parallel road

There was no state guarantee for traffic or cash flow levels, and 15% of the profits
were to be paid to the Government’s Road Fund.

The State budget was to be received sizable tax revenues in form of Corporate Income Tax, Concession Fee and VAT on tolls.

**6.2.2 Construction Risk**

As the construction of the remaining sections of the M1 did not pose specific problems (no big structures required, flat land with little ground risk, no particular archaeological risk, no specific environmental issues), the contractor was able to broadly accept these risks and offer a turnkey, lump sum and fixed price for the construction works.

The acquisition of the site was paid and performed by the road administration.

Construction cost represented 65% of total project cost.

The operation during the implementation was 2%

The project development costs and other company costs were 18% and financing costs including interests during construction and other fee were 15% (M. Muranyi, 1999).

After 22 months of construction, the M1 toll motorway section was opened on January 4, 1996, on schedule and within the budget.

But the M15 toll motorway section was opened in June 23, 1998 (sixth months later than scheduled originally for the end of 1997).

The reason was problems that occurred on the M1 motorway.

**6.2.3 Commercial (Traffic and Revenue) Risk**

There was no government guarantee for a certain traffic or cash flow level.

The acceptance by the private sector of the full traffic risk was driven by a combination of tender requirement (the Ministry did not want to accept any traffic risk), competition (showing low projections would mean losing the tender) and the relatively high traffic flows indicated by the various studies.

But traffic modelers had little idea how to predict the level of demand predict the
level of demand price elasticity in Central Europe (W. Hook, 1999).

After the M1 was built, traffic (only 55%) and revenue (30% less than the target) were below the projection.

The reasons of these shortfalls are as follows (TIMÁR, A., 2002):

- The substantial slow-down of traffic growth in the whole corridor.
- The Balkan wars, the cancellation of the Budapest World Exposition planned in 1996
- The economic recession in Hungary (very low domestic purchasing power and high inflation)
- The long waiting times experienced by commercial vehicles on the Austrian-Hungarian border (EU border since 1995) i.e. at the end of the relatively short tolled section of the M1 motorway
- Errors committed in structuring the project, traffic modelling and forecast, tough terms and conditions of borrowing (prevailing in time of financial closing, end of 1993)

In addition, most Hungarian motorists chose to take slower, parallel not tolled routes instead of using the M1.

6.2.4 Legal Risk

In response to a legal action (November 1996) brought by the head of the legal committee of the Hungarian automobile club, in May 1998, a court of appeal upheld a lower court ruling that tolls, amounting to about a day’s salary for an ordinary worker, were too high and therefore ordered a 50% reduction in toll rate, apparently without any government compensation to the concessionaire.

The reluctance of the Hungarian authorities to contractual private partner’s case during the litigation, contributed to the hardship of the concessionaire.

6.2.5 Financial Risk

The collection system was “semi-open”. The initial toll rate was defined in the concession contract on the basis of the revenue maximization principal.

Toll rates are automatically escalated according to inflation, domestic CPI and the
exchange rate differential.

However, the revenue maximizing tolls charged on the M1 motorway (e.g. US$ 0.15/km for cars and US$ 0.45/km for heavy goods vehicles) were rejected by the Hungarian motorists as being excessively high and Hungary underwent a period of inflation.

Despite the good willingness-to-pay of the Western based foreign road users, the traffic and toll revenues on the tolled section of the M1 motorway fell by far below forecast.

6.2.6 Political and Default Risk

A new coalition government led by the Federation of Young Democrats (Fidesz)-Hungarian Civic Party was said to be considering nationalizing the highway, although banks thought that some restructuring of the existing concession was more like (e.g., doubling the length of toll concession by adding the existing section of M1 to Budapest, although this option would require new equity to construct toll plazas and make improvements to “justify” tolling an existing road).

At that time the Prime Minister has stated that existing tollgates on motorways should be demolished.

He has expressed a preference for the Austrian or Swiss approach by which an annual road fee is charged and a sticker on the windshield provides proof of payment.

Because of above-mentioned complicated reasons, the concession company (ELMKA), which was unable to meet its debt payments, was taken over by the Hungarian government in June of 1999.

Eventually most of the initial investors lost their equity investments.

6.2.7 Conclusion and Comments

Whereas the Ministry claimed victory: it brought this vital piece of infrastructure back into Hungarian hands whilst accepting only a part of the debt at very favourable conditions and could now reduce the toll rates (even replace them with a vignette), it remains doubtful where this was the best solution for Hungary (the World Bank Tool Kit).
Certainly, tolls were reduced, but this meant that significant income from foreign sources fell away.

Taking on the M1 debt meant that the motorway construction budget was in trouble.

Of the ambitious motorway program outlined in 1991, only parts were realized and other the early completion of other parts remains doubtful because of the less participation of international funding sources.

The M1/M15 experience shows that even initially successful projects can quickly come up against disaster.

It is true to say that the traffic projections were the source of all problems.

However, the fact that the public sector did not wish to step in and find a viable PPP solution together with the private sector caused possibly more harm than good to the Hungarian state and taxpayer.

Compared with M3 project that was implemented as a public concession, the risk transfer undertaken on the M1 project created significant benefits to the Hungarian taxpayer as:

- The construction was completed on time and within budget,
- Its operation and maintenance during the short period thereafter were effective and of the highest standard, and
- During the critical economic period following its opening to the west, Hungary benefited from the M1 whilst not contributing to its financing.

6.3 The M5 Motorway (Hungary)

The M5 motorway (constructed section: 97 km, 35 year concession, BOT) concession company (AKA Rt.) is comparatively healthy.

It provides a connection to the southern Europe by route E75 (to Serbia) and by route E68 (to Romania).

It is also connected to the western European motorway net by M0 (36km), which is the by-pass of Budapest and by M1 (169 km), which connects the capital also to the Austrian border.

The equity of the Concession Company is 20% of the overall Project cost (FRF 2,242 Mil. Or US$ 450 Mil.)
6.3.1 Government Support and Profit Sharing

The most important elements of the governmental contribution are:

- Preliminary design including building permits and environmental clearance for a non-tolled motorway;
- Land acquisition (including additional lands, needed to build toll plazas) and site delivery free of charge at dates agreed upon and fixed by the concession contract;
- Accepting the phase construction approach requested by the bidders and potential lenders;
- Providing existing sections for renewal, tolling, maintenance and operation;
- Providing a stand-by type, semi-annually and totally capped operational subsidy, disbursed from the road fund, available during the first six and half years of operation as a partial cash-flow deficiency guarantee.
- Initiating traffic engineering measures aiming to restrict through traffic of heavy freight vehicles across urban areas alongside the main road parallel to the M5 Motorway.

The 97 km long M5 Projects contain an in-kind government contribution in the form of a 56 km formerly existing but now tolled section and Government guaranteed stand-by operational subsidy.

**Table 6.1 Phased Implementation Section of the M5 Motorway in Hungary**

<table>
<thead>
<tr>
<th>Section</th>
<th>Distance (km)</th>
<th>Before Implementation</th>
<th>After Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>17.4 - 44.3 (26.9)</td>
<td>Motorway</td>
<td>Upgraded Motorway</td>
</tr>
<tr>
<td>1a</td>
<td>44.3 - 73.7 (29.4)</td>
<td>Semi-Motorway</td>
<td>Dual Two-Lane Motorway</td>
</tr>
<tr>
<td>1b</td>
<td>73.7 - 90.4 (16.7)</td>
<td>-</td>
<td>Dual Two-Lane Motorway</td>
</tr>
<tr>
<td>1c</td>
<td>90.4 - 113.8 (23.4)</td>
<td>-</td>
<td>Dual Two-Lane Motorway</td>
</tr>
<tr>
<td>Total</td>
<td>(96.4)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Under the concession contract term, the government is to provide the concession company with an operational subsidy to the company’s cash flow deficiencies, up to an overall cap of 1993 value equivalent to XEU 85 million (Hungarian Forint 9 billion).

Aggregating all elements, the governmental contribution could be estimated as being
around one third of total costs, making the M5 Toll Motorway Project a Public/ Private Partnership, a commercially enhanced BOT type operation (GAZAL, D. and SIPOSS, A. G., 1997).

In return, 28.6% of any AKA dividends will be distributed to the government as profit sharing.

6.3.2 Financial Risk

In the case of the M5 Motorway, the concession contract contains the toll increase formula.

The Base Rate Toll (BRT) shall be escalated no more frequently than at 6 monthly intervals, provided that the average annualized inflation rate for the preceding period does not exceed 25% per annum. Should the inflation rate exceed this rate, then the BRT shall be escalated at less than 6 monthly intervals.

The BRT shall be escalated as follows:

\[ \text{Ap} = \text{Bp} \times \text{Ip} \times \text{Cap} \]  
\[ \text{(6-1)} \]

Where
- Ap is the Adjusted Toll;
- Bp is the Base Rate Toll (BRT) escalated to the preceding period;
- Ip is the Inflation Adjust Factor for the Preceding Period,

Where
\[ \text{Ip} = \frac{\text{CPI}_{\text{In}}}{\text{CPI}_{\text{O}}} \]  
\[ \text{(6-2)} \]

And
\[ \text{CPI}_{\text{In}} \] is the Hungarian Consumer Price Index published for the last month of period;
\[ \text{CPI}_{\text{O}} \] is the Index Published for the Last Month of the Preceding Period;

Cap is the Currency Adjustment factor, which will equal to or greater than 1,

Where
\[ \text{Cap} = \text{Pa}(n) \times \frac{\text{Ca}(n)}{\text{Ca}(o)} + \text{Pb}(n) \times \frac{\text{Cb}(n)}{\text{Cb}(o)} + \ldots \]  
\[ \text{(6-3)} \]

And
\[ \text{Pa}(n), \text{Pb}(n) \text{ etc are the percentage of the outstanding debt at the end of} \]
period n applicable to currency a, b etc;
Ca(n), Cb(n) etc are the exchange rate with HUF(Hungarian Forint) applicable in each currency, as at the end of period n;
Ca(o), Cb(o) etc are the exchange rate with HUF applicable in each currency, as at the end of the preceding period.

The exchange rates included in the formula set forth in above will be those published by the National Bank of Hungary. The CPI will be that, which is published by the Hungarian statistical office.


If the Hungarian Central Statistical Office should cease to publish a CPI, then the Ministry and the Concessionaire shall consult in order to define a new method of escalation.

The tolls determined above shall be adjusted to include VAT, or any other tax or levy raised by the central government or local public authorities, which may become applicable to the toll by virtue of any law, decree, regulation or similar government action.

The Concessionaire has the right to adjust the tolls immediately due to changes in the rate of taxation envisaged above.

If the Concessionaire should fail to increase tolls or implement increases at a lower rate than the maximum permitted due to any reason whatsoever, this shall not create a precedent for future increases, and shall not limit the ability to levy future increases at the maximum rate possible.

The Concession Company shall inform the Ministry and the general public of the new toll rate, by publication in 2 Hungarian newspapers of national circulation no later than 15 days before the date of effect of the new toll rate.

The toll rates were automatically escalated without any prior consent of the government according to domestic CPI and the exchange rate differential.

6.3.3 Traffic Revenue and Political Risk

The traffic of the motorway was near expectation.
But right after the opening to traffic of the already existing and at that time tolled sections the inhabitants of settlements along the parallel road began a protest against the high toll level as the diverting traffic at once burdened the free national road. Mainly the local users and truck drivers diverted the toll road.

Because of political considerations, negotiations started between the government and concessionaire aiming to decrease the toll.

By the agreement about subsidised preferential toll rate for local residents, frequent users, and fleet users, the government offers cash support to the concessionaire to compensate the loss of revenue as a consequence of not commercially based discounts (see table 6.2).

**Table 6.2 Preferential Toll Rate of the M5 Motorway in Hungary**

<table>
<thead>
<tr>
<th>Classification of Users</th>
<th>Discount Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Local Residents</td>
<td>20%</td>
</tr>
<tr>
<td>• Agricultural Producers in the Four Counties around Road</td>
<td></td>
</tr>
<tr>
<td>• Fleet Owners</td>
<td></td>
</tr>
<tr>
<td>• Monthly Tickets for Car-pools (4 passenger)</td>
<td></td>
</tr>
<tr>
<td>• Vouchers for Users of the Southern Food Market in Budapest paid for by Food Market</td>
<td>30-40%</td>
</tr>
<tr>
<td>• Regular Users</td>
<td>40%</td>
</tr>
</tbody>
</table>

As defined in the concession contract, the implementation of the M5 motorway project was divided in two phases, the phase 1 motorway and the subsequent phase of the motorway.

Implementation of the subsequent phase (60.7km) of the motorway, meaning the section between the Kiskunfélelegyháza south interchange (113.8 km) and the border of the Hungary with Serbia (174.5 km), is excluded from the project but covered in the concession contract as amended.

Subject to certain trigger mechanisms and subject to the approval by all project lenders, construction of the subsequent phase of the motorway must have been completed by 2003, or the concession company will lose its concession right relating to the subsequent phase of the motorway.
The concession company wants to construct the subsequent phase of the motorway if the Hungarian government gives the same condition and similar subsidy applied in the case of the M5 motorway project already completed.

6.3.4 Conclusion and Comments

The M5 motorway project seems like a mixed application of “shadow toll” and “users pay” policy because the concession company receives toll from road users and an operational subsidy to the company’s cash flow deficiencies from the government (TÁNCZOS, K. and KONG, G. S., 2001).

Nevertheless, the drivers using this motorway have expressed dissatisfaction with the high toll fees, which is about US$ 9 (Hungarian Forint 2,550, April 2002) per ride in the passenger car.

For the time being, the Hungarian government seems to avoid PPI projects due to their high toll charges and political reasons.

The chambers of commerce were leading proponents of the permit system. They also preferred to use available highway revenues on priority corridors towards Western Europe, and did not support spending on new highways to the East (HOOK, W., 1999).

From Jan. 2000, Hungary is adopting the vignette system (considerably cheap price), which is the licensing of motorway access in all toll motorways (M1, M3) except the M5.

In this system, the vignette buyers can use motorways without limitation by attaching the valid sticker on their cars.

The government’s conception seems to introduce this vignette system for all Hungarian motorways (including M5 if possible).

Because of the inconsistency with the national motorway vignette system the government restrains the extension of the route and buyout is under negotiation in 2001 (SCHARLE, P., 2002).
6.4 Incheon International Airport Expressway (South Korea)

The Incheon International Airport Expressway (IIAE) provides an important transportation link between Seoul metropolitan area and Incheon international airport. The IIAE is Korea's first privately funded project for building and operating expressway by PPI Act.

- Scope of the project: 40.2 km long (6-8 lanes)
- Financial Closure: December 1995
- Project cost invested by private sector: US$ 1,230 million (Korean Won 1,476,600 million)
  - Equity (29.4%), Loan (70.6%)
  - Not included government support about US$ 176 million (Korean Won 228,900 million) for land acquisition cost in project cost
- Concessionaire: The New Airport Highway Co (SAMSUNG Corporation plus 10 domestic companies)
- Concession Period: 30 years (BTO)

Map 6.1 The Incheon International Airport Expressway in South Korea

This expressway (in Korea a motorway is called an expressway) was opened officially November 21 2000, started collecting toll fees from Dec. 5, 2000. The government began construction on section 1 of connection bridge (The Youngjong Bridge) on December 28, 1993 and made a decision to execute this motorway as private investment project in November 1994.
The concessionaire began the construction on November 29, 1995. The construction took 60 months and operation period (2000. Nov. 29-2030. Nov. 28) is 30 years since the construction was finished.

**6.4.1 Construction and Technology Risk**

The Concessionaire poured into this project about US$ 1,230 million (Korean Won 1,476,600 million), which includes the Yeongjong Grand Bridge (4,420 m long including 550 m of suspension bridge), the Panghwa Bridge (2,559 m long including 540 m in arch trust form) and the Kaehwa Tunnel.

In case of construction facility damage by force majeure risk such as war, earthquake etc., government basically assumes this risk.

For reducing the construction risk, the concessionaire acquired the insurance amount (about US$ 770 million equal to Korean Won 1,000,000 million) on construction project by paying about US$ 8.2 million (Korean Won 10,700 million) to 4 Korean insurance companies.

The Yeongjong Grand Bridge crossing the sea is a self-anchor 2-level, 3-D suspension bridge built for both cars and trains (first of its kind in the world).

In the process of constructing this bridge, construction and technology risk was considered seriously by the government and private sector.

Due to features of the bridge, the product of the latest construction technologies and traditional architecture, included first domestic application of the Pneumatic Caisson method that employed unmanned excavators for erection of the suspension columns.

**Picture 6.1 The Yeongjong Grand Bridge in South Korea**
It was also designed to withstand winds blowing at 55 meters per second and earthquakes that record 6.0 on the Richter scale.

The bridge management system was installed to ensure the safety of the bridge while it is being repaired.

**6.4.2 Financial Risk**

The Concession Company is collecting toll fees for the 30 years. The average traffic volume was 50% of initial estimates.

The toll rate is different from the size of car. The toll is charged about US$ 5 (Korean Won 6,100, Jun. 2001) per ride in the case of small-sized vehicles.

The initial toll rate was defined in the concession contract on the basis of recovering invested cost and profit as below formula.

\[
\text{The present value of invested cost + profit} = \text{traffic volume} \times \text{the present value of toll rate} - \text{the present value of operation cost}
\]

The concessionaire can decide toll rates according to domestic CPI. In case that the traffic volume of previous year is different from that of government suggestion by 20%, the concessionaire can adjust toll rate and negotiate the concession period with the government.

**6.4.3 Government Support and Profit Sharing**

The government’s contribution for this motorway is land acquisition (about 15% of total project cost), and site delivery.

The government recognizes buyout right in the case of defined events listed in the concession contract.

The government shares some risks and profit with the concessionaire.

\[
\text{The government guarantees 90% of the estimated operation revenue prescribed in the concession agreement for 20 years since operation begins when the actual}
\]
operation revenue falls considerably.

- The government also has the excessive revenue redemption when the actual operation revenue exceeds 110% of the estimated operation revenue prescribed in the concession agreement for 20 years since operation begins.
- Increase of foreign exchange rate by more than 20%: financial support (50%) on foreign exchange loss.
- Decrease of foreign exchange rate by more than 20%: refund (50%) on foreign exchange gain.

### 6.4.4 Conclusion and Comments

The drivers using this motorway have expressed dissatisfaction with the high toll rates of the new motorway leading to the airport.

Especially the airport workers who must use this motorway (except ferryboats) protested strongly against the high toll rates to the concession company.

But the concession company’s president insisted, “It is inevitable that users of the new road have to shoulder high charges when considering the huge amount of money we have invested in this project”.

To solve this problem, the Korean government actually compensates the concession company to implement toll discounts for the airport workers until a new railway is constructed (the year 2005).

### 6.5 Lessons to Be Learned by Case Study

The financial reality for PPI project can never be ignored. If the feasibility study shows a given percentage is needed for the given projects as public participation even though politicians can push a project without this kind of support.

The final result can be an unaffordable toll level, while the public opinion can be much more painful and financial consequences on the government can be much more severe (SIPOSS, A. G., 2000).

We can learn the important lessons through the M1/M15 and Dulles Greenway cases. The strength factors of both projects were successful development, tendering,
negotiation, and construction result of toll road projects. They proved that highly complex transactions could be completed, provided the appropriate regulatory and legal framework is in place.

The one of major failure factors was to limit the government’s contribution to handing over the land necessary for these projects.

The allocation of the entire commercial risk occurring very overestimated traffic to the private sector became a fatal error.

In case of the M1/M15 project, however, all commercial (traffic) risk was allocated back again to the taxpayers and lenders were not exposed any more to that type of risk.

We can also learn important facts from the cases of the M5 in Hungary and the Incheon International Airport Expressway in South Korea.

For successful PPI concession projects, the government should be prepared to share risks appropriately with the private sector.

Governments should accept that very few privately financed toll road projects are likely to be financially viable without some form of financial contribution from the public sector as possible.

The contributions should be designed to meet the cash flow requirements of the concessionaire but in a manner that will be economically advantageous for the government.

The reliable traffic forecast as a base of the cash flow prepared by internationally accepted experts is a key issue for PPI projects.

An adequate dispute resolution procedure is required which is to be described in and regulated by the concession agreement.
Chapter Seven: Development of Optimal Risk Mitigation and Allocation Measures

Public financing traditions explain why risk analysis has been neglected in the past, all risks being internalised by the public sector without proper identification or assessment.

But PPI toll road projects include many components and participants, each with varying degrees of risk and profit participation (see figure 7.1).

**Figure 7.1 Sample of Toll Road BOT Contract Structure**

A.

Source: PADECO Co. Ltd, 1999
Risk in PPI is a fundamental feature of any public/private partnership and it substantially influences the overall project cost.

The Risk analysis and management procedure shall consist in the following phases subject to negotiations among all project actors.

**Figure 7.2 Risk Analyses and Management Procedure**

- **Risk Identification**: set up the list of project risks and identify those with the most potentially adverse impact.

- **Risk Quantification**: Having identified a range of risks, the next step is to quantify the probability of the risk occurring and the likely impact or consequence of the project, or to the amount at stake.

- **Risk Priority**: The output from risk quantification should be a table, which prioritises the risk.

- **Risk Mitigation and Allocation**: Having identified, quantified and prioritised the risks, we need risk mitigation and allocation measures which define ways to address adverse risk and enhance opportunities before they occur.

As a result of the previous steps, each actor adjusts his expected rate of return based on his own criteria.

So such projects must satisfy government and public interests while permitting a satisfactory return to the private investors, constructors, and operators.

Governments should be prepared to share risks with the private sector and should accept that very few privately financed toll road projects are likely to be financially viable without some form of financial contribution from the public sector as possible.
The primary allocation of risk is determined through the concession agreement and the construction, operation, finance and revenue packages.

### 7.1 Risk Identification

Risk identification is a key feature of modern decision making, for both public and private sector.

This is probably the hardest and most important part of the risk management process, because if we cannot identify a risk, it will be excluded from further analysis and therefore we will not respond to it.

The process of risk identification should not be a one-time event, but rather a continuous process, its frequency depending on the level of risk on the project and schedule of meetings.

Although projects by nature have many special, often unique characteristics, some of the key factors during the different stages of any project can be generally predicted and are likely to include the following (MARK, A. L., 1995).

**Table 7.1 Key Risk Factors during the Different Stages of PPI Toll Road Project**

<table>
<thead>
<tr>
<th>Pre-Completion</th>
<th>Operating Period</th>
<th>Pre-and Post-Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Cost overruns</td>
<td>· Revenue</td>
<td>· Interest rate fluctuations</td>
</tr>
<tr>
<td>· Construction delays</td>
<td>· Foreign exchange availability</td>
<td>· Exchange rate depreciation</td>
</tr>
<tr>
<td>· Variation from design specifications</td>
<td>· Design and latent defects</td>
<td>· Change in regulation</td>
</tr>
<tr>
<td></td>
<td>· Technology</td>
<td>· Losses from uninsured events by force majeure</td>
</tr>
</tbody>
</table>

### 7.2 Risk Quantification

Risk quantification is primarily concerned with determining what areas of risk warrant a response and where resources are limited.

We cannot know what the future holds, but we need to be able to make informed, realistic and justifiable decisions in the face of uncertainty.

Assessing and quantifying risks provide us with the means to understand, value and manage the risks inherent in an uncertain world.
Risk quantification leads to quite a different decision framework (see figure 7.3).

Figure 7.3 Risk Quantification Decision Process

To deal with this issue more efficiently, I strongly suggest the next theories and techniques to be used:

7.2.1 Probabilistic Techniques

Mathematically, risk analysis models manipulate probabilities and probability distribution, in order to assess the combined impact of risks on the project.

The exact manner in which this done depends on the purpose of the analysis.

Effective and efficient performance of risk analysis involves a number of contributing elements.

These include models, methods and computer software, as well as less tangible skill-related elements such as methodology design, specialist expertise and study team management (CHAPMAN, C. B., and COOPER, D. F., 1987).
We can use standard risk management techniques such as the Monte Carlo Analysis, Beta Factors, other models to derive predicted project elapsed schedules or cost patterns to a database of simulated outcomes. Or we could look up an historical database of records (if one exists) to project result. Either method will give us a probability distribution that points to likely trends.

One of the key points is to understand what type of probability distribution we are faced with.

This directly affects how the average mean project cost (or completion time) is calculated. Project managers can be under the wrong assumptions about how their data is distributed.

The simplest functions are those such as Triangular (min, most likely, max) or Uniform (min, max), which take arguments specifying the minimum, most likely or maximum possible value for the uncertain inputs. More complex functions take arguments specific to distribution – such as Beta (alpha, beta) etc. (Palisade Corporation, 2000)

### 7.2.1.1 Normal Distribution

The model shows that a road project has an average (median) outcome of 36 months’ duration, or total costs of US$ 36 billion (figure 7.4)

**Figure 7.4 Example of Normal Distribution**
Thus, any directive or desire to drive the project at high speed or low cost could be an extremely risky option.

The above-mentioned modeling of the data leads us to conclude that any proposal to complete the project within 30 months or with project costs of US$ 30 billion is very optimistic.

The chances of this to occur are very small, so your project or you as project manager are probably going to end up with a problem.

**Figure 7.5 Example of Time and Cost Relationship**

![Graph showing the relationship between time and cost]({{site.baseurl}}/images/figure7_5.png)

We can get a good picture of how risk will appear by looking at how the probability is distributed (see figure 7.5). Looking at the nature of the project, what is the likely progression? (CHONG, Y. Y. and BROWN, E. M., 2000).

Let’s take a four-year project with a US$ 50 billion budget. Some project managers might assume that there will be a fairly straight-line progress, as in line A. In fact, the nature of the project industry, or the way you manage a project, could mean that you will either:
· Start rapidly on the project, as in line B, and spend a lot of money in the early stages, then slow down in the final phrases. This could be due to a lack of the relevant personnel, waiting for parts or suitable operating conditions, or favorable testing and approval or,
· Commence slowly, spend rapidly in the middle project stages, then curb expenditure towards the end. This is a more usual operating manner, depicted in line C.

You will need to be aware of the style and inertia you are likely to experience during the project, which will have a considerable impact on how the risk factors will affect your project.

7.2.1.2 Triangular Distribution

The triangular distribution is the most commonly used distribution for modeling expert opinion.

It is defined by its optimistic (a), most likely (b) and pessimistic (c) values.

Nobody should assume that a cost risk could be accomplished without gathering more data. Gathering data can be a difficult task but the rewards are valuable.

7.2.1.2.1 Data Requirements

A cost risk analysis consists of looking at the various costs associated with a project, their uncertainties and any risks or opportunities that may affect these costs.

Risks and opportunities are defined as discrete possible events that will increase and decrease the project costs respectively.

They are both characterized by estimates of their probability of occurrence and the magnitude of their impact. The distributions of cost are then added up in a risk analysis to determine the uncertainty in the total cost of the project.

Suppose that the risk analyst has chosen well the various project experts who should be interviewed.

These experts will probably include the project team and team leaders.

They may include experienced project professionals from the company who are not currently assigned to this project. Outside experts are sometimes included, although this is rare except in cases of public projects.
When these people get into a room, the risk analyst asks first about three numbers for each cost component:

- **The pessimistic cost estimate.** This assumes that everything goes wrong, including failing to achieve the baseline plan.
- **The optimistic cost estimate.** This assumes that everything goes well, and the work will cost less than baseline estimate.
- **The most likely cost estimate.** The temptation is to assume this is the baseline estimate. This is not always so. Often the baseline estimate is a political document, put together to impress the customer. Each estimate is so optimistic that it cannot be achieved without a great deal of luck and maybe a lot of unpaid overtime hours.

The rationale for each of these three is explored and recorded in the notes of the meeting. The rationale is most important because it points to risk mitigation, which is also discussed in the risk interview.

The optimistic and pessimistic ranges are not often symmetrical about estimate. In fact, they exhibit a greater likelihood for overruns than for underruns.

This is in part because there is a natural barrier (zero) to the lowest cost possible and there are many ways the project can run into trouble on the high side.

In the example above, it is assumed that the baseline estimate is the "most likely" cost. In fact, many estimates are not the most likely when the estimators are questioned closely. Sometimes, the risk interview turns up some baseline estimates that should be changed in order to represent the most likely cost.

This is one clear benefit of a risk interview, or indeed of any honest and careful scrubbing of the baseline. But, in this example it will be assumed that the baseline was carefully estimated without being "shaded" or biased in any way, and that new information has been recently incorporated in it.

### 7.2.1.2.2 The Application of Triangular Distribution

The next item the project risk analyst must discover is the probability distribution shape. Often the triangular distribution is used, but sometimes a different distribution such as the lognormal is assumed.
- Triangular distributions can be completely described by 3-point estimates that are the main purpose of the risk interview. Participants can describe and estimate the low, most likely and high range estimates. It is much more difficult to describe the shape of the curve.

- It is easy to understand and calculate some of the key information about a triangular distribution. For instance, the weighted average or expected cost is found by the equation:

  \[ \text{Expected Value} = \frac{(\text{Low} + \text{Most Likely} + \text{High})}{3} \]

The triangular distribution has a very obvious appeal because it is so easy to think about the three defining parameters and envisage the effect of any change.

The triangular distribution is often considered to be appropriate where little is known about parameter outside an approximate estimate of its minimum, most likely and maximum value.

Suppose that the interview has occurred and the following estimates are secured.

<table>
<thead>
<tr>
<th>Task</th>
<th>Optimistic</th>
<th>Most Likely</th>
<th>Pessimistic</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task A</td>
<td>550</td>
<td>600</td>
<td>740</td>
<td>630</td>
<td>[1616.67 ]</td>
<td></td>
</tr>
<tr>
<td>Task B</td>
<td>650</td>
<td>750</td>
<td>790</td>
<td>730</td>
<td>[866.71 ]</td>
<td></td>
</tr>
<tr>
<td>Task C</td>
<td>900</td>
<td>1090</td>
<td>1130</td>
<td>1040</td>
<td>[2517.02 ]</td>
<td></td>
</tr>
<tr>
<td>Total Estimate</td>
<td>2100</td>
<td>2440</td>
<td>2660</td>
<td>2400</td>
<td>70.71</td>
<td>[5000.57 ]</td>
</tr>
</tbody>
</table>

The mean and standard deviation and variance of the triangular distribution are determined from its three parameters (VOSE, D., 2001):

\[
\text{Mean} = \frac{(a + b + c)}{3}
\]

\[
\text{Standard deviation} = \frac{(a^2 + b^2 + c^2 - ab - ac - bc)}{18}
\]
Variance = $\frac{(a^2 + b^2 + c^2 - ab - ac - bc)}{18}$

From these formulas, it can be seen that the mean and standard deviation and variance are equally sensitive to all three parameters.

Let us take an example of the task A above in table 7.6.

**Figure 7.6 Triangular Distribution (Unit: 1,000 US$)**

The triangular distribution offers considerable flexibility in its shape, coupled with the intuitive nature of its defining parameters and speed of use.

It has therefore achieved a great deal of popularity among risk analysts. However, $a$ and $c$ are the absolute minimum and maximum estimated values for the variable and it is generally a difficult task to make estimates of these values.

Some computer-aided techniques (@Risk, Crystal Ball etc.) offer a triangular distribution that attempts to reduce this problem.

**7.2.1.2.3 Risk and Impact Analysis**

From the table 7.2, the following table 7.3 explains the contingency and ranks the cost elements by their contribution to it.
Table 7.3 Component Contribution to Construction Cost Risk at the Mean

<table>
<thead>
<tr>
<th>Task</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Mean – Most Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task A</td>
<td>600</td>
<td>630</td>
<td>30</td>
</tr>
<tr>
<td>Task B</td>
<td>750</td>
<td>730</td>
<td>-20</td>
</tr>
<tr>
<td>Task C</td>
<td>1090</td>
<td>1040</td>
<td>-50</td>
</tr>
<tr>
<td>Total Cost</td>
<td>2440</td>
<td>2400</td>
<td>-40</td>
</tr>
</tbody>
</table>

This analysis is especially important to the project manager who may have no intimate knowledge of any of the many cost elements in a complicated project.

This table indicates that the cost of task A contributes about US$ 30,000 to the contingency needed at the mean.

The costs of task B and C are expected to under run.

7.2.2 Non-Probabilistic Techniques

Non-probabilistic techniques include conducting sensitivity analysis of cash flow projections and break-even analysis.

7.2.2.1 Sensitivity Analysis

It is important to conduct sensitivity analyses with respect to traffic and traffic diversion as well as other key variables (e.g. toll rates, project costs, implementation period, and a combination of these factors) in order to assess the effects on the rate of return of variations.

Sensitivity analysis shows how changes in the values of various factors affect the project’s decision criteria.

In stage 1, we decide upon the plausible range values for uncertain variables. Some factors (e.g. future exchange rates) may require wide ranges, (+/- 50%) while others may require narrower ranges.

In stage 2, we consider whether sensitivities for the various factors are related in any way. Then combine assumptions.
The experts (who are working at the Department of Transport Economics at the Budapest University of Technology and Economics) have developed a new software program (so-called INNOFINance) supporting instrument for financial planning and implementation of large scale projects (TÁNCZOS, K. and BÉKEFI, Z., 1997).

This is a useful program to evaluate financial feasibility and sensitivity analysis by calculation of several indicators, e.g.

- Net Present Value (NPV), Internal Rate of Return (IRR), Annual Debt Coverage Ratio (Annual DCR), Interest Coverage Ratio (ICR), Return on Equity (ROE), Project Returns etc.
- It examines the impact of increasing or decreasing the values in any income or cost time series.
- It also examines shortening or lengthening (rush or normal scheduling) of construction

The model is able to reflect the partial and the total sensitivity of a complex project.

**7.2.2.2 Break-Even Analysis**

Investors and lenders can also consider the minimum toll rate or traffic volumes required before the project begins to lose money.

Lenders are interested in the toll rates in future years or traffic volumes that would lead the project to break-even on a cash flow basis, after debt service. These break-even toll rates, or traffic volumes can then be compared to the expectations of future toll rates or traffic volumes.

Investors will look at the present value of the inflows and the present value of the outflows and determine the toll level (or traffic volume) at which the net present value equals zero.

**7.2.3 Attitudes to Risk**

All decision making involves the future. We can only make decisions about the future; no matter how much we may regret it, we cannot alter the past. Financial decision-making is no exception to this general rule.
There is only one thing certain about the future, which is that we cannot be sure what is going to happen.

Sometimes we may be able to predict with confidence that what actually occurs will be one of a limited range of possibilities.

We can categorize individuals largely who want to invest PPI projects into (a) risk-averse investors, (b) risk-loving investors, and (c) risk-neutral investors.

A risk-neutral investor views equally entering a wager whose expected value is zero, and doing nothing.

Figure 7.7 shows the range of possible outcomes for two investment projects A and B.

**Figure 7.7 A Graph of the Probabilities of the NPV for two Projects each having Equal Expected NPVs**

Both have expected values of US$ 200,000 (the outcomes of each are symmetrically arrayed around this value); in fact US$ 200,000 is the single most likely outcome in each case.

Both of these projects would be acceptable to the investor as they both have positive NPV, irrespective of where in the range the actual outcome falls.

Since most of the human race seems to be risk-averse, project A would be most people’s first choice if they had to choose between the projects.
This is despite the fact that project B holds the possibility of an NPV as high as US$ 400,000 whereas project A’s maximum is only US$ 300,000.

The risk-averse investor’s eyes would be drawn to the lower end of the scale where that person would note that project A gives a guaranteed minimum NPV of US$ 100,000 whereas project B’s outcome could be as low as zero.

To the risk-averse, the so-called downside risk looms larger than the upside potential.

By contrast a risk-lover would be more attracted to project B.

A risk-neutral investor would be unable to distinguish between these two projects.

### 7.2.4 Risk and Return

We may even feel able to describe statistical probabilities to the likelihood of occurrence of each possible outcome, but we never are completely certain of the future.

Risk is therefore an important factor in all financed decision making, and which must be considered explicitly in all cases.

Intuitively we expect returns to be related to risk in something like the way shown in Figure 7.8.

![Figure 7.8 Relationship between Return and Risk](image)

In investment, for example, investors require a minimum rate to induce them to invest at all but they require an increased rate of return, the additional of risk premium, to compensate them for taking risk (MCLANEY, E. J., 1997).
Much of project finance is concerned with striking the appropriate balance between risk and return.

In project finance, as in other aspects of life, risk and return tend to be related.

**7.3 Risk Priority**

A risk priority is to identify the areas of risk that should be addressed first.

**Table 7.4 Objective, Risk, Probability, Consequence, Priority**

<table>
<thead>
<tr>
<th>Component</th>
<th>Objective</th>
<th>Risk</th>
<th>Probability</th>
<th>Consequence</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example, in PPI projects the public sector usually doesn’t consider construction risks as seriously as the private sector because the latter generally assumes these risks through the concession contract in most cases.

But in the case of revenue shortfall risk caused by traffic, both of them could be seriously affected due to the possibility of default of project.

So, the parties involved in PPI projects must make a table, which identifies, quantifies and prioritizes the risk.

**7.4 Risk Mitigation Measures**

Each actor for implementing PPI projects can use techniques and instruments available to reduce their exposure to risk.

The main instrument consists of adjusting a suitable contractual framework. Other instruments are made available to the various project actors by specialized institutions.

Having identified, quantified and prioritized the risks, we now need to develop a risk response plan, which defines ways to address adverse risk and enhance opportunities before they occur.

The levels of risk should be compared against pre-established criteria, and then ranked to establish management priorities.

There is a range of responses, which should be developed in advance during the planning phase:
· Eliminating risk
· Mitigating risk
· Transferring risk
· Accepting risk

These are not mutually exclusively. Our response may use a combination of them all. A natural sequence would be to first try and eliminate the risk completely. Failing that, we should at least mitigate it.

And for the remaining risk the options are to try and transfer to another party and /or accept it with a contingency.

I mainly deal with the issue of risk mitigating measures because the other things are frequently used measures in many areas.

To mitigate a risk means reducing the risk probability and impact.

If we want to analyze the uncertainty and risk of project, we must gather the useful information and data about it.

Data collecting and processing need time and money so we have to consider the relationship between the cost and information quantity (TIMÁR, A., 2002).

**Figure 7.9 Theoretical Relation of Uncertainty and Cost of its Mitigation**

Source: TIMÁR, A., 2002
All these responses cost money, so a benefit/cost analysis should be performed, as it may be more cost effective to accept risk rather than taking expensive steps to eliminate it (see figure 7.10).

**Figure 7.10 Benefit/Cost of Reducing Risk**

7.4.1 Public Acceptance for Tolling

In many countries, free access to all public roads constitutes a traditional element of freedom. Tolling is considered therefore as an exceptional and only temporarily acceptable measure.

It hampers the freedom of mobility and therefore limits the liberty of the citizens. It has to be emphasized therefore that implementation of road tolling requires acting with extreme precautions and needs appropriate political support.

It is imperative, therefore, that the public be informed.

The information provided should explain the government’s strategy and policies, reasons for the change, conditions under which PPI will take place, uses for the revenues obtained, and particularly the benefits obtained from private participation, and the costs and risks of the process (VIVES, A., 1997).
In the case of Hungary, there was no effective communication with the Hungarian public back in 1991, and this caused many problems later when formerly free sections became toll facilities, and the public protested against paying the tolls (both in the case of the privately operated M5 and the publicly operated M3 toll road).

Some specific features of best practice of tolling are listed as follows:

- The government willingness must be stated clearly,
- Road users became customers of a service provider (and they are entitled to receive good quality service against payment),
- Service value related pricing, as a tolling principal, is important. The toll should either be levied accordingly to the distance covered on a road or according to the time spend on it.
- The toll should be introduced as a price for a new or improved service associated with a newly built or a substantially upgraded infrastructure,
- The toll collection should not start before improvement of the service becomes perceivable,
- The initial general/overall level of service will not be deteriorated for the benefit of the users of the tolled infrastructure,
- The economics of the operation should be properly explained to the public and made them understood and accepted.

7.4.2 Government Financial Support

Governments should seek to minimize the need for public financial support for toll road concessions in order to maximize the benefits of the PPI projects relative to their costs.

In some cases government risk assumption and financial support may be necessary to support a project that would otherwise be unable to close financing because of weak projection economics or unfavourable country and concession environment.

Government financial support may be appropriate, however, if it helps mobilize large amounts of private capital.

Government support should be defined upfront as a maximum so that the private sector can prepare realistic bids.
The figure 7.11 compares various types of Government support to PPIs.

**Figure 7.11**

![Diagram showing various government support options](source: Private Financing of toll Roads, Fishbein and Babbar, 1996)

### 7.4.3 Mitigating Commercial Risk

The traffic and revenue forecasts are the underpinnings of the project and dictate project viability and the level of government support that will be required. These are perhaps the greatest risks faced by toll road projects. These are defined as risks associated with insufficient traffic levels and toll rates too low to generate expected revenues.

We can use some methods to forecast traffic volume range from simple time series model to a new dynamic behavioral model providing several features such as full dynamism based on an event-driven paradigm, multi-modal network representation, and the use of an explicit behavioral theory etc. (CORNELIS, E., TOINT, P. L., 1998).

Traffic and revenue projections are typically developed as follows:

- Traffic surveys are carried out in the corridor of the proposed toll road, usually comprising some (but rarely all) of traffic counts classified by vehicle type, origin-destination surveys, stated or revealed preference surveys to establish users’ willingness-to-pay tolls, and journey time surveys.
· Other data are collated on land uses (current and projected), historic traffic, and economic growth.

· A traffic-forecasting model is developed, validated to base year conditions, which produces traffic and revenue forecasts for a few specific future years, for a range of scenarios.

· A revenue stream for the project concession period is developed by interpolation and extrapolation of the model revenue forecasts.

The forecasts require assumptions about generated traffic - new traffic not previously made in the corridor, and resulting from the expressway – this may result in a significant addition (e.g., 10 percent – 20 percent) to traffic determined by the model. (The Asian Development Bank, 2000).

The treatment of traffic and revenue risk ranges from full private sector assumption of the risk to government-provided minimum traffic and revenue guarantees.

The risk mitigation measures are as follows:

· The independently verified ridership study.

· Cash support in the form of guarantee of x% of traffic revenue.

· Toll adjustment mechanism: for example, tolls will be allowed to increase semiannually in accordance with consumer price index (CPI).

· Extension of the term of the concession: if the actual traffic volumes on the highway fell short of those specified in the concession, the concessionaire will be entitled to request an extension of the term of the concession to permit recovery of its investment.

· Setting up “toll ring”: in Norway, exceptionally, “toll ring” have been set up, in association with private finance, around Bergen and Oslo. This has been possible because of the geography and size of the cities. With 6 toll stations in Bergen, and
18 in Oslo, it has been possible to leave virtually no scope for traffic diversion to avoid the tolls, making the situation more like the “monopoly” bridge or tunnel (MUNRO, A., 1991)

There are also some solutions to make partners more aware of their responsibilities than a minimum revenue guarantee (system in which the private sector cannot lose) or of minimum traffic (which is either an illusion if the tariff is fixed by the public sector or a deficiency payment) as follows:

· Using shadow toll charges borne by the public authorities: Under a shadow toll scheme the users do not pay on the spot for the usage of the infrastructure, therefore eliminating motorist’s resistance to paying tolls and the opportunity to divert to alternative routes. And no expenses associated with toll collection are incurred. This reduces a considerable element of commercial or traffic risk (the “avoidance risk”).

· Payment of a fixed rent by the public authorities: this eliminates any commercial risk to the private sector but requires other incentives for the operator to deliver a high level of service.

· A contractual clause providing for regular meetings between public and private actors (the first can reasonably be set up two or three years after opening the infrastructure), for the purpose of setting an authorized charge level. This eliminates the traffic study contingency, maintaining only the uncertainty of a forecast, but based on known data.

7.4.4 The Rapid Appraisal Method (RAM)

The RAM has been designed to operate in conjunction with a structured Concession Agreement to perform a deterministic risk analysis for any type of BOOT (Build-Own-Operate-Transfer). The RAM is used to quickly appraise the commercial viability of BOOT projects. It is based on the project classification, the project packages and deterministic affects of risks.

The RAM has obvious limitations in that it is deterministic and relies heavily on the user’s judgment and ability to assess and pay for the likely effects of risk (MERNÁ, T. & ADAMS, C., 1994).
7.4.4.1 Project Classification

Project classification is the basis for identifying project data requirements, the number of secondary contracts and organizations to be involved and many of the elemental and global risks to be considered in the appraisal.

7.4.4.2 Preliminary Estimate

The next stage of the RAM is to determine the profitability of the project based on the estimated costs of construction, operation and maintenance, finance and revenue generated.

This is calculated in the Preliminary Estimate, the purpose of which is to establish an initial estimate of profitability, as follows:

\[
\text{Profit } p_1 = R - (C + O + F) \tag{7-1}
\]

(Where \( p_1 \) is the profit, \( R \) is the revenue, \( C \) is the cost of construction, \( O \) is the cost of operation and maintenance, and \( F \) is the cost of finance)

The estimated cost/profit ratio is expressed as

\[
\text{r}_1 = \frac{(C+O+F)}{R - (C+O+F)} \tag{7-2}
\]

The profit and cost/profit ratio are the first guides to commercial viability of the concession project.

If the estimated profit and cost/profit ratio of the project estimate are acceptable to a Private Sector the next stage of the appraisal is to determine the Component Estimate.

7.4.4.3 Components Estimate

The major components of each of the packages can be expressed as:

Construction: \( c_1, c_2, \ldots c_n \)
Operational: \( o_1, o_2, \ldots o_n \)
Financial: \( f_1, f_2, \ldots f_n \)
Revenue: \( r_1, r_2, \ldots r_n \)
(Where \(c_1, c_n; o_1, o_n; f_1, f_n\) and \(r_1, r_n\) are the components of the construction, operation, financial and revenue packages respectively)

Initially the major components of the construction package are identified and allocated costs. Next the operational components necessary to meet the requirements determined under the construction package are identified and allocated costs.

The financial components required meeting the cost of the construction and operational packages are then determined.

Finally a revenue estimate is prepared based on the components of the revenue package.

The next stage is to re-determine the project cash flows and profitability, \(p_2\), as follows:

\[
p_2 = R - (C + O + F) \quad (7-3)
\]

And the cost/profit ratio \(r_2\) is:

\[
r_2 = \frac{(C + O + F)}{R - (C + O + F)} \quad (7-4)
\]

At this stage of the appraisal only the components costs and durations are considered. The effects of risk on the commercial viability of the project are only considered if the Component Estimate is acceptable.

A project cash flow is prepared based on the cost of each component and timing over the concession period from which the IRR, NPV and payback period are calculated.

The RAM calculates the payback period at which a positive cash flow is achieved. However financial costs associated with interest payments will often be extended to the end of the concession period, as for the costs of operation.

The private sector determines a Minimum Acceptable Rate of Return (MARR) for identified project.

The MARR for private companies is usually higher than that of public agencies as private companies usually pay a higher rate of interest than the public sector. If the IRR of the component estimate is greater than the minimum acceptable rate of
return MARR than the effect of elemental and global risks are considered on the basis of the component estimate.

If the IRR is equal to or slightly less than the MARR then the effects of inflation and the provision of the concession agreement on the overall project may be considered. If for example a project had a short construction period and toll levels were to be set by the private sector with freedom to increase toll levels then a further appraisal could be carried out. If the allocation of risks gave little or no scope for increase in revenue then no further appraisal would be sanctioned and the project abandoned.

### 7.4.5 Fixed Price Contract

This is also called lump sum price. This contract requires the contractor to complete the scope of work for a fixed price, which is named in the contract. This contract will include all the costs associated with labor, material, plant, inflation and risk. A detailed scope of work is required from the public sector before the private sector can tender. This effectively prevents fast tracking between design and construction (BURKE, R. 2001).

Once the project has started, any changes in the scope of work will have to be negotiated. This type of contract is becoming more popular with the public sector because it passes much of the project risk onto the private sector.

The inflation risk, however, is often accepted by the public sector in the form of an escalation clause.

### 7.4.6 Risk Insurance Policies

Insurance programs for PPI projects are normally coordinated and purchased through a single source, most commonly the private sector. A third party accepts insurable risks for the payment of a premium.

The premium is now the quantified impact of this risk on the project.

#### 7.4.6.1 Political Risk Insurance

Political risks are those associated with a particular jurisdiction and its political environment generally.
Potential lenders to or investors in a project will invariably assess the risks associated with implementing the project in a particular jurisdiction.

Political changes that occur during the life of a project in the host jurisdiction could have a serious and adverse impact on the ability of the concessionaire to repay its debts and to provide its investors with the required rate of return on their investment.

The type of jurisdiction-related or ‘political’ risks with which the parties to a project might be concerned fall into the broad categories (expropriation, exchange control, war/political violence etc.).

Various national and multilateral agencies establish programs for political risk minimization in so-called political risk insurance programs. Major national agencies are as follows (see table 7-5):

**Table 7-5. Coverage of Commercial and Political Risks by Official Export Credit Agencies (ECAs)**

<table>
<thead>
<tr>
<th>ECA</th>
<th>Pre-completion</th>
<th>Post-completion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Political risk</td>
<td>Commercial risk</td>
</tr>
<tr>
<td>ECGD</td>
<td>100</td>
<td>0-100</td>
</tr>
<tr>
<td>Hermes</td>
<td>90-95</td>
<td>85-95</td>
</tr>
<tr>
<td>Eximbank</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>COFACE</td>
<td>95</td>
<td>0-95</td>
</tr>
<tr>
<td>J-EXIM</td>
<td>0-100</td>
<td>0-100</td>
</tr>
<tr>
<td>MITI</td>
<td>95</td>
<td>0-60</td>
</tr>
</tbody>
</table>

* the Export Credits Guarantee Department (ECGD) in UK
* Hermes Kreditversicherungs-Aktiengesellschaft (Hermes) in Germany
* the Export/ Import Bank (Eximbank) in the United States
* Compagnie Francaise d’Assurance pour le Commerce Extérieur (COFACE) in France
* the Export-Import Bank of Japan (J-EXIM) and the Export-Import Insurance Division, Ministry of International Trade and Industry (MITI) in Japan.

Source: Project Finance (SAPTE, W., 1997)

In addition to the official ECAs, a number of development finance institutions (IBRD, MIGA, EBRD, ADB etc.) are able to provide political risks.
Table 7-6. Political Risk Insurance Programs Compared

<table>
<thead>
<tr>
<th>Programs</th>
<th>IBRD</th>
<th>OPIC</th>
<th>MIGA</th>
<th>US EXIM</th>
<th>AIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term (years)</td>
<td>15</td>
<td>20(+5)</td>
<td>15(+5)</td>
<td>Constr.+12</td>
<td>10</td>
</tr>
<tr>
<td>Amount/Project</td>
<td>No Limit</td>
<td>$200MM</td>
<td>$75MM</td>
<td>No Limit</td>
<td>$120MM</td>
</tr>
<tr>
<td>Amount/Country</td>
<td>No Limit</td>
<td>15% of Portfolio</td>
<td>$325MM</td>
<td>No Limit</td>
<td>$500MM</td>
</tr>
<tr>
<td>Equity</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Loans</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (limited)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>% Cover</td>
<td>100</td>
<td>90-100</td>
<td>90</td>
<td>100</td>
<td>Up to 90</td>
</tr>
<tr>
<td>Cost (p.a)</td>
<td>0.4-1%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>0.6-1%</td>
<td>3/4-3.5%</td>
</tr>
<tr>
<td>Key Advantages</td>
<td>Lowest Cost, Tailoring, Best Coverage</td>
<td>Long Term</td>
<td>Long Term</td>
<td>Low Cost</td>
<td>Flexibility, Tailoring</td>
</tr>
</tbody>
</table>

* International Bank of Reconstruction and Development (IBRD)
* Overseas Private Investment Corporation (OPIC)
* Multilateral Investment Guarantee Agency (MIGA)
* American International Group Inc. (AIG).


7.4.6.2 General Insurance

The main risk transfer options open to the concessionaire can be summarized as the transfer of risk through the agreement, providing adequate insurance protection.

There are a number of significant insurance policies in the context of concessions.

It is useful for these programs to fall into three distinct phases; pre-construction, construction and operation. The main policies to consider for each phase are illustrated in table 7.7 (METHLEY, M., 1994)
Table 7.7 Insurance Policies at Major Stages of PPI Toll Road Project

<table>
<thead>
<tr>
<th>Pre-Construction</th>
<th>Construction</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Material Damage</td>
<td>· Construction “All Risks”</td>
<td>· Material Damage</td>
</tr>
<tr>
<td>· Third Party Liability</td>
<td>· Third Party Liability</td>
<td>· Third Party Liability</td>
</tr>
<tr>
<td>· Employers Liability</td>
<td>· Employers Liability</td>
<td>· Employers Liability</td>
</tr>
<tr>
<td>· Motor</td>
<td>· Motor</td>
<td>· Motor</td>
</tr>
<tr>
<td>· Business Interruption</td>
<td>· Delay in Start-Up</td>
<td>· Business Interruption</td>
</tr>
<tr>
<td>· Professional Indemnity</td>
<td>· Plant “All Risks”</td>
<td>· Money</td>
</tr>
<tr>
<td></td>
<td>· Political Risks</td>
<td>· Political Risks</td>
</tr>
<tr>
<td></td>
<td>· Professional Indemnity</td>
<td></td>
</tr>
</tbody>
</table>

7.4.7 Other Risk Mitigation Measures

There are some other risk mitigation measures as follows:

7.4.7.1 Monte Carlo Simulation

Monte Carlo simulation refers to the traditional technique for using random or pseudo-random numbers to sample from a probability distribution.

Today, Monte Carlo techniques are applied to a wide variety of complex problems involving random behavior (Palisade Corporation, 2000).

When we use the word simulation, we refer to any analytic method meant to imitate a real-life system, especially when other analyses are too complex mathematically or too difficult to reproduce.

Without the aid of simulation, a spreadsheet method will produce only a single outcome, generally the most likely or average scenario.

Spreadsheet risk analysis uses both a spreadsheet model and simulation to automatically analyze the effect of varying inputs on outputs of the modeled system.

One type of spreadsheet simulation is Monte Carlo simulation, which randomly generates values for uncertain variables over and over to simulation.

Monte Carlo simulation frees us from the constraints of estimates and best-guess values.
7.4.7.2 Time-Series Forecasting

Time-series forecasting is a forecasting method that uses a set of historical values to predict an outcome.

It can be viewed as the representation of the outcomes of random variable of concern over a fixed period time, usually taken over the last year comprising a time series. The behavior of a time series can be displayed in graphical form, bar graphical form, or tabular form, where the first method is generally most descriptive of the pattern of behavior of the series.

Because a time series is a description of the past, a logical procedure for forecasting the future is to make use of these historical data. If history is to repeat itself- i.e., if the past data are indicative of what we can expect in the future- we can postulate an underlying mathematical model that is representative of the process. This method will be useful for predicting future traffic volume of a new road project by investigating the neighboring road traffic.

7.4.7.3 The Use of Delphi Group

Many companies attempt to even out biases or personal errors by asking for opinions. An estimation of risk probabilities can thus be done using a ‘Delphi’ peer group of experts. The group is asked for their subjective evaluations of the risk, listed in order. It is hoped that their biases will be cancelled out by other experts’ opinions (CHONG, Y. Y., and BROWN, E. M., 2000).

Their responses can be tabulated into data that give us a picture of what we think the future cost (or schedule) is going to be. A fundamental question is to ask whether the probability distribution is skewed left or right. That is to say, do the estimates indicate that the downside risk is greater, i.e. the schedule in the worst case is likely to see a large cost overrun, or be extremely late.
7.5 Optimal Risk Allocation and Sharing Measures

Risk allocation and sharing mean to distribute the various risks among the project’s public and private actors.

PPI toll road projects include many components and participants and face a broad range of risks some of which are common to many other businesses while others are unique.

Risks that are related to private investment project implementation shall be classified depending on the attributable cause as risk attributable to the government, risk attributable to the concessionaire, and force majeure situation.

7.5.1 Guidelines of Optimal Risk Allocation and Sharing

Some generic definition of optimal risk allocation has been suggested. For, example, “risk should be allocated to whoever is able to manage it” (Private Finance Panel, 1995), “a particular risk should be borne by the party most suited to deal with it, in terms of control or influence and costs” (UNIDO, 1996).

Optimal allocation of risks is not the same as maximizing the transfer of risks to the private sector (see figure 7.12).

Figure 7.12 Optimal Risk Transfer and Best VFM

Source: Treasury Taskforce, 1997
In some cases a risk can be shared, where management of the risk is best shared.

Other things being equal, risks should be allocated to agents who have the most influence or control over risky outcomes and who can bear the risks at the lowest cost. Because they are the least risk averse, can most easily insure or hedge against the risks, or can spread the risks among many people.

However, these two factors often push in different directions—the group or organization that has the most control over the outcome may not be the one most capable of taking the risk.

Other factors to consider are where the party assuming a risk has an incentive to reduce the risk and where there are alternatives to government guarantee.

The parties responsible for the risk depending on the type and attributable cause shall be clearly outlined and concluded in the concession agreement.

- Those risks that are foreseeable and can be insured shall be handled by insurance as much as possible.

Those losses or added expenses that are not covered by insurance shall be allocated through negotiation by and between the negotiating parties.

- Risk attributable to government shall be borne by government and risk attributable to the concessionaire shall be borne by the concessionaire.

- In force majeure situations, the allocation ratio shall be mutually agreed and decided upon the characteristics of the situation.

- Neither government nor the concessionaire may request additional tariff adjustment or compensation for after loss on the grounds of their own risk allocation.

As I studied and reviewed most cases of PPI projects, I suggest typical example of risk allocation and sharing as follows (except DBFO projects):
Table 7.8 Typical Example of Risk Allocation and Sharing

<table>
<thead>
<tr>
<th>Risk</th>
<th>Government</th>
<th>Concession Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Land Acquisition/Permissions</td>
<td>■</td>
<td>(Detail Design)</td>
</tr>
<tr>
<td>- Design</td>
<td>■ (Basic Design)</td>
<td></td>
</tr>
<tr>
<td>- Construction Time/Cost</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Operations &amp; Maintenance Cost</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>- Traffic Revenue</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Financing</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Inflation Rate</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>Foreign Exchange Rate</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Change of Law</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Default &amp; Force Majeure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- By Government</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>- By Concession Company</td>
<td></td>
<td>■</td>
</tr>
</tbody>
</table>


7.5.2 Optimal PPI Concession Design

The concession agreement is a private law act, regulating risk sharing between the principal and prompter. The risks inherent in a project affect its financing and the allocation of risks should be considered before the structure of the project is determined (TIMÁR, A., 1994).

PPI projects are composed of two parties – the public and the private partner – bound by a contract that defines the rights and responsibilities of each partner. The contract is formed through a bargaining process.

The concession is a key element for implementation of PPI projects so we must consider the optimal concession design before signing the contract.

If the PPI project is to be established in a well-known environment, where all the relevant data sets are available, the use of a specially developed, advanced model is suggested.
The following is a typical example:

i. Bid competition in terms of the proposed contract that will minimize the government’s financial exposure

\[
\min_{t,\text{contract}} f(\text{contract}) \tag{7-5}
\]

Where, \( t = \) toll level, \( f = \) financial exposure of the government which is a function of the terms of the contract

ii. Commercial viability index (c), which is a function of the project attributes and the contract terms and the toll/tariff level (t) must be greater than equal to a benchmark level (C).

\[
c(\text{project, contract, t}) \geq C \tag{7-6}
\]

iii. Contingent expenses (e) of the government which is a function of the contract terms and must be less than or equal to a pre-specified maximum allowable contingent expense (E).

\[
e(\text{contract}) \leq E \tag{7-7}
\]

iv. Toll/tariff level of the project which must be less than or equal to a pre-determined maximum socially acceptable level (T).

\[
t \leq T \tag{7-8}
\]

In the 9th World Conference on Transport Research held in Seoul, the optimal PPI contract design model was suggested (Espada I. C, Ieda H, Shibasaki R, 2001).

It is illustrative to begin with a simple project.

Consider a certain project with only one project item V, with two possible values V1 and V2.

The project has therefore two project states (PSs), PS1 if \( V = V1 \) and PS2 if \( V = V2 \) with probabilities \( p1 \) and \( p2 \) respectively. Profit gained from the project, given system
state, \( x \), is equal to \( pt(PSx, t) \), which is assumed to be attributed to the private sector, at first.

The contract defines a set of actions to be undertaken given certain conditions. Thus, if \( Vx \) occurs the government will transfer a (positive or negative) subsidy, \( sx \).

The payoff received by the private sector given system state, \( x \), is therefore equal to \( pfx = pt(PSx, t) + sx \).

The mechanics can be illustrated by the following.

**Figure 7.13 PPI Contract Mechanism**

\[
\text{Based on this mechanism, equation (7-5) can be formulated as follows:}
\]

\[
\min_{f, s1, s2} f = p1 \ s1 + p2 \ s2
\]  

(7-9)

The complex data requirement of the above described model results only limited applicability with special respect to the Central Eastern European Countries (CEECs) and Asian regions.

The concession contract must include at least briefly the following elements:

- Technical conditions: technical features; foreseeable phasing; increase in capacity, widening; derogation from norm; etc.

- Financial conditions: authorization of foreign capital transfers abroad (where such controls are in force): fiscal rules, depreciation rules; etc.
• Toll levels and rates: toll structure; toll flexibility (all variants are possible), indexing of tolls, demand management pricing; exemption from payment; etc.

• Legal conditions: possibility of pledge to creditors; conditions of termination; duration of the concession; etc.

• Distribution of risks: definition, allocation, procedures of dispute settlement; etc.

It is very likely that conditions will change over the duration of the concession; this requires some flexibility in the contract to allow for such changes and for changes in the financial and organizational arrangements and in the development of the project (World Road Association, 2000).

7.5.3 Determination of the Expected Returns and Risks

PPI project needs the utilization of a series of financial and economic techniques and tools. Its objective is to maintain stable the relationship between risk and expected return, throughout the maturity of the contract.

The clauses of risk and return should be incorporated in the contract from the very beginning in the request for proposals (RFP) and in the PPI concession.

7.5.3.1 Basic Principal for Determining the Expected Returns and Risks

The presence of risk means that more than one outcome is possible. A simple prospect is an investment opportunity in which a certain initial wealth is placed at risk, and there are only two possible outcomes. For the sake of simplicity, it is useful to begin our analysis and elucidate some basic concepts using simple prospects.

In this point, I present a simplified example for determining the optimal risk premiums (BODIE, Z., KANE, A., and MARCUS, A. J., 1999) more extended introduction of the limited road project situation.

Take as an example initial wealth, W, of US$100,000, and assume two possible
results. With a probability \( p = 0.6 \), the favorable outcome will occur, leading to final wealth \( W_1 = $150,000 \). Otherwise, with probability \( 1-p = 0.4 \), a less favorable outcome, \( W_2 = $80,000 \), will occur. We can represent the simple prospect using an event tree:

**Figure 7.14 The Simple Prospect using an Event Tree**

\[
\begin{align*}
W &= $100,000 \\
\text{P=0.6} & \quad W_1 = $150,000 \\
\text{1-P=0.4} & \quad W_2 = $80,000
\end{align*}
\]

Suppose that we are offered an investment portfolio with a payoff in one year that is described by a simple prospect. How can we evaluate this portfolio? First, we could try to summarize it using descriptive statistics. For instance, our mean or expected end-of-year wealth, denoted \( E(W) \), is

\[
E(W) = pW_1 + (1-p)W_2 = (0.6 \times 150,000) + (0.4 \times 80,000) = $122,000 \quad (7-10)
\]

The expected profit on the $100,000 investment portfolio is $22,000 ($122,000 - 100,000). The variance, \( \sigma^2 \), of the portfolio’s payoff is calculated as the expected value of the squared deviations of each possible outcome from the mean:

\[
\sigma^2 = p[W_1 - E(W)]^2 + (1-p)[W_2 - E(W)]^2 = 0.6(150,000 - 122,000)^2 + 0.4(80,000 - 122,000)^2 = 1,176,000,000 \quad (7-11)
\]

The standard deviation, \( \sigma \), which is the square root of the variance, is therefore $34,292.86.

Clearly, this is risky business: The standard deviation of the payoff is large, much larger than the expected profit of $22,000. Whether the expected profit is large enough to justify such risk depends on the alternative portfolios.

Let us suppose Treasury bills are one alternative to the risky portfolio. Suppose that at the time of the decision, a one-year T-bill offers a rate of return of 5%; $100,000 can be invested to yield a sure profit of $5,000. We can draw the decision tree.
Figure 7.15 The Comparison of A and B Prospects using an Event Tree

Earlier, we showed the expected profit on the prospect to be $22,000. Therefore, the expected marginal, or incremental, profit of the risky portfolio over investing in safe T-bills is:

\[
$22,000 - $5,000 = $17,000 \tag{7-12}
\]

meaning that one can earn a risk premium of $17,000 as compensation for the risk of the investment.

The question of whether a given risk premium provides adequate compensation for the investment’s risk is age-old. Indeed, one of the central concerns of finance theory is the measurement of risk and determination of the risk premiums that investors can expect of risky assets in well-functioning capital markets.

7.5.3.2 The Capital Asset Pricing Model (CAPM)

The total risk has two components, which are known as systematic risk and non-systematic risk. The systematic risk is an exogenous factor that is not under the control of the investor, and reflects the sensibility or volatility of the expected return on the project in relation to the overall market; in other words, it is an elasticity measure that determines how changes in the economy affect the profitability of the project.

This type of risk is measured by means of a factor denominated Beta (\(\beta\)), which is covariance between the profitability of the project and that of the overall market,
divided by the variance of the overall market.

On the other hand, the non-systematic risk is an endogenous factor to the project, which is susceptible of being controlled through diversification. It plays an important role in the financial and operative leverage that can be achieved by the firm.

In this respect, a public works contract can be analyzed as a project with cash flows with given expected returns and risks.

In general, the profitability of a project $E(R_p)$ is defined in the Capital Asset Pricing Model (CAPM) as:

$$E(R_p) = R_f + \beta_b \times (R_m - R_f)$$  \hspace{1cm} (7-13)

Where $R_f$ is the risk-free rate of return, $R_m$ is the return of the overall market, and $\beta_b$ is the marginal contribution to the portfolio risk of the project.

Alternatively, this equation can be rewritten as:

$$E(R_p) = R_f + \beta_b \times PR$$  \hspace{1cm} (7-14)

Where $PR$ is the risk premium and is defined as $R_m - R_f$.

A modification to this model for countries with high country risk implies the modification of the traditional CAPM model.

This modification is denominated “Zero Beta CAPM”, where, instead of employing the risk-free rate of return and zero variance, a risky rate of return with minimum variance is used given the conditions of the country.

This change entails adding up to the standard risk free rate a term that reflects a risk-premium according to country risk (HINOJOSA, S. A., the World Bank Tool Kit).

7.5.4 Optimal Risk Allocation and Sharing Measures

The classification of these risks and their clear allocation between the public sector (government; the concession awarding party) and the private sector (concessionaire, lenders and investors) are in the heart of the PPI project.
7.5.4.1 Construction Risk

The concession agreement should establish clearly the scope of the concessionaire’s responsibility for designing and constructing the project.

In most cases the concessionaire will be expected to assume a full “turnkey” obligation to develop the project in accordance with the promoting authority’s requirements.

This is because the concessionaire will sub-contract all of the works to highly experienced contractors who should be willing to undertake the works on a turnkey basis.

Therefore the Private Sector will be best able to control risks (completion, quality, cost overrun and construction delay) during the construction phase.

If substantial changes to the specification of the project are requested by Government before or during construction it is more efficient that Government bear these risks.

7.5.4.2 Operational Risk

The Private Sector generally assumes operation (accident damage, latent technical defects, cost overrun, employee dishonesty) risks.

Obviously the risk that facilities and services can be provided throughout the contract term to the agreed output specification will initially rest with the Private Sector under the concession agreement.

Clearly risks, which are wholly with the control of the Government, will not generally be transferred to the Private Sector and their occurrence will therefore entitle the Private Sector to financial compensation.

7.5.4.3 Commercial Risk

The risks of traffic shortfall and construction of competing facilities will be determined by the terms specific to the concession and those associated with the
project’s characteristics.

The Government generally assumes the risk of price control policy (tariffs) for public interests.

The other risks of revenues belong to the Private Sector if not specified in the contract agreement.

### 7.5.4.4 Financial Risk

For the allocation of financial risks (inflation, interest rate, exchange), different approaches exist. In case the concession is considered as an ordinary private commercial operation, and the bulk of the financial risk stems from inflation, interest rate and/or exchange rate risk has to be borne by the Private Sector.

Taking into consideration the long duration of the contract and eventual impact of these unforeseeable factors on the revenue to be generated by the project, it is better to reach a binding agreement on certain reference points and forecasts and include price escalation-and a fair profit-sharing formula in the contract.

### 7.5.4.5 Legal Risk

The legal risks (permits and licences, litigation) must be evaluated with particular care having regard to the fact that one of parties to the contract retains a large discretionary power. Furthermore, in many countries the law is in transformation.

The legal framework is not settled. It will therefore be important to consider adopting for contractual purposes other legal systems such as those provided by a case study or common law.

### 7.5.4.6 Environmental risk

The environmental risk is one of the major risks faced in the construction of PPI toll road projects and provision of related services.

The Private Sector normally assumes this risk, but there may be some sharing of that risk when changes in environmental regulations require a significant capital investment.
on the part of the concessionaire or limit its ability to deliver the required availability and quality of service.

### 7.5.4.7 Political Risk

The political risks (expropriation, termination, limitation of currency convertibility etc.) can affect the project in any of its stages.

An extreme instance of political risk is expropriation, or severe restrictions on the repatriation of project funds.

While political risk tends to be exogenous and largely uncontrollable, if the structure of the project involves a direct or indirect government stake, this could influence actions and mitigate political risk to some extent.

Both the Government and the Private Sector generally assume political risks by the terms specific to the concession.

### 7.5.4.8 Force Majeure Risk

The Force Majeure risks refer to major events that have a dramatic negative impact on project value. Political events such as war, riots or general strikes, and “acts of God” such as earthquakes, fires or floods fall into this category.

In the case of Mont Blanc Tunnel (11.6 km), there was a fire incident in March 1999 in which 39 people died.

Control of the tunnel, one of Europe’s most important transport links, was formerly in the hands of two separate groups (French and Italian), each responsible for the sections up to the border between the two countries.

At the time of the fire, rescue efforts and fire fighting operations were hampered by lack of communication and coordination between the groups.

Some Euro 300 million (about US$ 266 million) has been spent on repairs to make the French-Italian crossing safer, and this includes extensive control systems, new safety equipment and a new administration organization (World Highways, 2001).

The method for allocating the risk of force majeure risk varies from contract to contract.

The Force Majeure relief typically applies only to specific, well-defined events listed
in the contract; is available only if contract performance is substantially and adversely affected; applies only to extraordinary events, not normal business risks or insurable events; and the relief is limited to the effects of the force majeure.

### 7.5.4.9 Summary of Optimal Risk Allocation and Sharing Measures

I set out below the table 7.9, which summarizes some of the key risk areas for typical infrastructure projects and typically how the risks can be allocated.

However, this is only a general guideline and would need to be adapted for the particular aspects of any specific projects:

**Table 7.9 Risk Allocation and Controlling Method**

<table>
<thead>
<tr>
<th>Risk Classification</th>
<th>Risk Allocation</th>
<th>Method of Controlling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction-Cost Overruns</td>
<td>Concessionaire/Engineering Procurement Construction (EPC) contractor</td>
<td>- Fixed-price, lump sum, turn-key contract  &lt;br&gt;- Completion guarantees  &lt;br&gt;- Insurance program</td>
</tr>
<tr>
<td>Construction-Completion</td>
<td>Concessionaire/EPC contractor</td>
<td>- Fixed date for completion,  &lt;br&gt;- Liquidated damages for delay due to EPC contractor fault, with penalties/termination clauses  &lt;br&gt;- Insurance program</td>
</tr>
<tr>
<td>Operation</td>
<td>Concessionaire/Operator</td>
<td>- Proven track record of operating similar projects,  &lt;br&gt;- Operation &amp; Maintenance agreement defining levels and standard of service provided, bonuses, penalties and performance bond  &lt;br&gt;- Insurance program</td>
</tr>
<tr>
<td>Traffic Volume</td>
<td>Concessionaire/Operator</td>
<td>- Independently-verified ridership study  &lt;br&gt;- Cash support in the form of guarantee of x% of traffic revenue</td>
</tr>
<tr>
<td>Risk Classification</td>
<td>Risk Allocation</td>
<td>Method of Controlling</td>
</tr>
<tr>
<td>---------------------------------------------------------</td>
<td>-----------------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Failure of tariff adjustment mechanism (not fault of Concessionaire)</td>
<td>Local/Central Government</td>
<td>- Concessionaire compensated to cover expenditure and agreed rate of return</td>
</tr>
<tr>
<td>Foreign Exchange Fluctuation</td>
<td>Concessionaire/EPC contractor</td>
<td>- Fixed price EPC contract such that project would not suffer from shortage of cash or be burdened with oversupply of funds</td>
</tr>
<tr>
<td></td>
<td>Local/Central Government</td>
<td>- Local currency denominated debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Currency hedging arrangements and debt service reserve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Support in the form of payments to concessionaire based on exchange rate deviations from an agreed base case</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>Concessionaire</td>
<td>- Fixed interest rates to the extent feasible or economic; and contingency amounts</td>
</tr>
<tr>
<td>Inflation</td>
<td>Local/Central Government</td>
<td>- Toll adjustment mechanism</td>
</tr>
<tr>
<td>Legal Risk (permit, license, litigation etc.)</td>
<td>Concessionaire</td>
<td>- Case study or common law, Concession agreement.</td>
</tr>
<tr>
<td></td>
<td>Local/Central Government</td>
<td>- Compensation to cover the impact of change in law on project revenues</td>
</tr>
<tr>
<td>Force Majeure (war, riot, general strike, earthquake, fire, flood etc.)</td>
<td>Concessionaire Local/Central Government</td>
<td>- Concessionaire to maintain a program of insurances to include insurable force majeure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Termination</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Compensation by the terms specific to the concession</td>
</tr>
<tr>
<td>Political Risk (expropriation, termination etc.)</td>
<td>Concessionaire Local/Central Government</td>
<td>- Political risk insurance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Compensation by the terms specific to the concession</td>
</tr>
</tbody>
</table>
Chapter Eight: Government Policy to Facilitate PPI

Policy makers in public authorities responsible for road network development act on behalf of the government.
As such, they are entrusted with the role of protecting the interest of the community. Such a responsibility is particularly important when conducting the PPI projects.

PPI projects can provide significant benefits to the government and to the host country, in particular efficiency gains in the construction and operation of infrastructure projects and provision of additional finance for infrastructure investment.

Achieving these benefits requires from government a policy framework for PPI projects, clear criteria for selecting concessions, and efficient and effective procedures for requesting bids and awarding contracts.

Above all, the government must be committed to a particular PPI project and certain of its economic viability before it asks the private sector to spend time and money preparing bids.

The government should prepare optimal risk allocation and sharing measures with the private sector to carry out PPI projects successfully.

I strongly suggest government policies to facilitate PPI projects as follows.

8.1 The Institutional and Market Conditions

As stated already, private finance assumes competition.
Companies must operate under equal conditions and markets should be free of state monopolies. A distinction has been made between competition within the market (between firms within a mode of transport or between firms in different modes) and competition for the market (different firms compete for the right to provide a service for a period of time, or to build and operate infrastructure under a concession agreement).

When considering competition, two types of transport infrastructure projects are relevant:
The introduction of private initiative by extending existing facilities
Entirely new projects or greenfield investments.

With respect to the first, the market, which the private company enters should be commercialised and/or privatized, with government regulations, which allow for completion.
Deregulation of infrastructure, facilities and operations into separate entities could be a condition.
Greenfield-type projects could be introduced through competition for concessions.
This could be achieved without changing market conditions and ownership structures completely.
This is why BOT-type financing arrangements are sometimes preferred by countries in an early stage of transition.

To ensure the success of PPI projects for all parties involved, it is important that their rights and obligations are embedded in an adequate legal framework for the country where the project is to be constructed and operated: primary legislative acts, foreign investment legislation (guaranteed repatriation of profits and other investment protections), currency control legislation and concession legislation etc.

8.2 The Game and Negotiation Theories

The gaming perspective makes it possible to identify and define more clearly several cloudy, uncertain or misinterpreted situations, positions or actions experienced in the public private partnership implementations.
The conceptual identification of positions, motivations and further characteristics is not only possible but helps all partners to understand better the structure, the rules and roles given in the procedure they are involved in. The use of the gaming perspective in PPI issues seems to enhance the “fair play” (SCHARLE, P., 2002)

Game theory, the study of rational behavior in situations involving interdependency is an established research field that offers valid insight into strategic bargaining in competitive situations like PPI projects.
An important aspect of the game theory is the examination of the effectiveness of the theory in negotiations within large-scale projects.
In applying game theory, it is critical to look at the concession process and payoff
functions.

The payoff function of a participant represents the level of participant satisfaction with the outcome, which tends to be higher when fewer concessions are made.

While the game theory represents the quantitative aspects of the relationships, negotiation theory represents the qualitative aspect of negotiations.

Negotiation theory is the study of the exchanges between parties designed to reconcile their differences and produce a settlement.

This theory aims to assist during the negotiation process so that the qualitative characteristics of a negotiation are taken into consideration.

The dispute resolution continuum in Figure 8.1 is examined to identify the suitable form for the methodology.

**Figure 8.1 The Dispute Resolution Continuum<adapted from Susskind at MIT, Cambridge, Mass. (1955)>**

This continuum indicates different levels of involvement of the third party and the power of controlling the settlement by the participants.

The continuum is broken down into three distinct categories: unassisted, assisted, and adjudicated.

The collaborative negotiation methodology is aimed at the area of assisted negotiation where participants have control over the outcome.

This area contains three methods: facilitation, mediation, and non-binding arbitration.
Thus, the collaborative negotiation methodology combines game theory and negotiation theory, to assist collaborative groups in reaching and maintaining their own mutual decisions.

Utilizing these two complementary aspects, the methodology can further make it possible to strengthen the partnership between public sector and private sector in PPI projects.

8.3 Well Established Planning Framework

The countries with successful toll road network development usually have a well-established strategic planning framework. Less successful countries exhibit weakness in this area.

France, Italy, Japan, and Spain, on the other hand, regularly update national toll road network development plans that are supported by appropriate legislation.

A strategic planning framework incorporating network analysis is important to optimize the benefits and minimize the costs of toll road development. Components of such planning should include: (i) refining the strategic road network and the most appropriate alignments of the key links; (ii) firming up the appropriate timing of construction of individual links based on corridor studies; and (iii) establishing clear economic and financial viability.

It takes very long time for preparing and implementing PPI projects even though the time period needed is different from case by case or country by country.

In Hungary it took about 2 years from procurement notice to finalization of the financial structure and to starting the M1 motorway construction.

For example, procedures are as follows (TIMAR, A., 1994):

- PQ phase: procurement notice and request for qualification forms (2 or 3 months), short list (3 + 1 months)
- Tendering phase: invitation to tender and elaboration the detailed bids by the tenderers (5 or 6 months), submission of the bids and preferred tenderers (3 months)
- Final discussions: selection of the winner after parallel discussion with preferred tenderers and final discussion signing the concession contract (3 months)
- Founding the company, finalization of the financial structure (min. 2 x 3 months)
- Building and operation time (max. 35 years)
8.4 The Optimal Risk Allocation Principal

It is very important but difficult for PPI projects to create optimal risk allocation methods because individuals differ in amount of risk they willingly accept.

In the case of traffic revenue risk and foreign exchange risk, it is one of good risk allocation methods to share the ‘super-profits’, and provide downside guarantees by government because these risks are very difficult to manage and mitigate by their characteristics.

In other words, where a risk is best managed by the public it should take that risk; with private sector taking these risks which it is better placed to manage.

But best ability of controlling a risk does not mean that the financial impact involved is minimal, even optimal. To solve this problem, government will have to provide an appropriate balance between risk and reward.

8.5 Further Tool Packages for Risk Reduction

I recommend using further tool packages for reducing PPI project risks as follows.

8.5.1 Selection of Criteria for Tender Evaluation

The private sector cannot be expected to invest considerable time and resources to prepare a tender project bid if the process for awarding proposals is not based on explicit competitive criteria.

In PPI projects the commercial and financial elements rather than the technical elements are likely to be the final determinants in winning a concession.

The precise nature and type of facility often varies widely with the number of tenders.

As an example of a detailed evaluation of a toll road project, we can consider five major categories, those being: engineering, environmental, traffic, financial and economic elements.

Having identified complying tenders the public sector then considers the weighting of each project package.

It is not sufficient to use price as the sole criterion for evaluation.
Any evaluation process must include the technical and commercial quality of tender, its effectiveness and efficiencies, any cost savings to the user also to the concession awarding party upon transfer.

Each of these factors may be expressed on the basis of compliance with concession agreement and in a weighting system for each project package.

For example, weighting of concession company selection criteria in four European Countries are as follows:

**Table 8.1 Concession Company Selection Criteria**

<table>
<thead>
<tr>
<th></th>
<th>Shadow Toll</th>
<th>Toll</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UK</td>
<td>Finland</td>
</tr>
<tr>
<td>State Subsidy</td>
<td>Criterion: Lowest NPV of Payments to a concession company</td>
<td>90% for NPV</td>
</tr>
<tr>
<td>Coherence of concession co. financial plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment, toll charges, operating costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completion dates for execution of work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>Technical minimum required: Best non-enhanced solution</td>
<td>10% for technical criteria</td>
</tr>
<tr>
<td>Quality of service/maintenance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** French Highway Directorate, Analysis of highway concessions in Europe, Report for the Western European Road Directors, February 1999
In this case the higher the tender scores, the greater the prospects of a successful project.

A weighting system associated with each package must be clearly identified in the tender documents.

I suggest the risk factors should be included in the tender evaluation and the private sector be informed about the risk evaluation score related to the project before proposal.

Detailed types of risks and classification of attributable causes shall be determined in the concession agreement by taking into account domestic and foreign case studies, effectiveness of risk management, appropriateness of risk allocation, etc.

8.5.2 Advisors for the Public Sector

Public sector employees may have limited experience in business negotiations leading to approved risk allocation.

In addition, projects and financing in toll roads using PPI are increasingly complex.

To achieve better value for money and solve these problems in context of complex and risky projects, private sector advisors’ (financial, technical, legal etc.) assistance

In the case of the M1/15 Motorway project, the European Bank for Reconstruction and Development (EBRD), provided support during the whole tendering procedure (TIMÁR, A., 1994).

With the aim to assist the Bureau for Motorways in Concession (Hungary) in managing the tendering procedure for the M5 Motorway project, foreign financial and legal consultants as well as Hungarian engineering consultant were engaged separately, through competitive tendering.

Knowing the major role of traffic analysis and forecast, a foreign traffic consultant together with a Hungarian legal expert was also invited to assist the Evaluation and Expert Committee.

These experts prepared separate evaluation reports in their own field of competence (using their own costing, economic and financial evaluation models) as well as recommendation (GAZAL, D. and SIPOSS, A. G., 1997).

Reputable international team of advisors engaged by the public sector will give the
private sector confidence in a complex project.

### 8.5.3 Securing Competition for / in the Market

Securing competition for the market is essential because public sector employees do not always represent the interests of the public.

Institutions may need to be restructured, with the objectives of controlling the PPI process in the public interest, avoiding tendencies for corruption, nepotism, cronyism or political pressure, and creating a regulatory body, separate from vested sector interests.

The core requirements are well summarized in “developing best practices for promoting private sector investment in infrastructure (roads)” (The Asian Development Bank, 2000) as follows:

- Developing an acceptable PPI legal framework- the exact nature of which will be country specific.

- Securing competition for the market. Government should identify good projects and then subject those to competitive bidding (rather than the widespread existing practice of accepting unsolicited bids). Where unsolicited bids are accepted, they should be subject to realistic competition.

- Securing competition in the market. This requires:
  - Legally-binding concession agreements which set out clearly the rights and obligations of all parties, and the procedures to be followed in the case of unforeseen events.
  - Establishment of an autonomous and independent regulator, which is also accountable. This likely to be in government, but quite separate from vested sector interests.
  - Encouragement of user groups, maybe empowered through an ombudsman function, to exert pressure on infrastructure providers.

- Granting concessions only after government has determined they are clearly in the
public interest, and can be revoked if this is not met.

Multi-lateral support for government is likely to be beneficial in implementation. The main PPI Center has the brief to assist line agencies prepare, market and negotiate projects, and is staffed accordingly. There are some countries, which have PPI Center to achieve these specific goals.

- PUK (Partnership UK): the United Kingdom.
- The PFI Acting Committee and PFI Promotion Division: Japan.
- The PICKO (Private Infrastructure Investment Center of Korea): South Korea.
- The Coordinating Center for Private Sector Participation (CCPSP; BOT Center): the Philippine

8.5.4 Some Further Measures

There are many policies to facilitate PPI projects as follows:

- Changes in policy directions from a government-centered or government-financed scheme to a private-sector-oriented or private-sector-initiated scheme.
- Promotion of creativity and efficiency from the private sector throughout the stages of planning, design, construction and operation of PPI projects (for example, introduction of preferential treatment system for the private sector, provision of incentives for the reduction of construction period or project costs etc.).
- Promoting public hearing in the planning process and dealing with environmental issues.
- Considering a number of significant insurance policies in the context of concessions (e.g. contractor’s all risks third party liability, employer’s liability, workers compensation, material damage etc.).
- Restructuring domestic systems to meet international standards (mitigation of investment risks by providing a competitive rate of return, minimum operation revenue guarantee, foreign exchange risk reduction etc.).
- Fair and equal treatment of domestic and foreign investors etc.
Chapter Nine: Conclusion, Recommendations, Limitation, and Further Issues

9.1 Conclusion

The main obstacle to carrying out infrastructure projects, apart from technical or environmental considerations, remains the difficulty of mobilizing capital.

If governments are unable to finance infrastructure investments from domestic sources, the following two options are available for seeking from abroad:

- Sovereign borrowing (foreign loans);
- Concession financing (e.g. BOT-type contract).

Foreign loans are essential to most countries in overcoming their initial infrastructure problems, but countries are limited in their ability to borrow abroad. For this reason, many governments turn to concession financing, particularly during the early phases of transport system development (VOGELAAR, H., 1997).

In case of severe constraints on sovereign borrowing (restricting public sector borrowing to a percentage of GDP, among others), the DBFO (shadow toll) has substantial advantages. Although the money borrowed by the private companies is reimbursed from the budget (therefore it is guaranteed by the State), it does not appear in the budgetary balance sheet as public debt. However, repayment reduces the amount of uncommitted expenditure available to fund new road expenditure in future years (World Road Association, 2000).

The experience gained in the complex Public Private Partnership (PPP) implementations in infrastructure is somewhat controversial: both successes and failures occur. Advocates of the partnership assess the progress is slow but convincing. Others argue that some of the techniques (particularly those in that the public and private resources are combined) have immanent weaknesses and the field of their application needs no expansion (SCHARLE, P., and PETHTEL, R., 2001).

In general, it is true that Private Participation in Infrastructure (PPI) projects need much more construction time and high toll charge compared with public funding road.
In spite of these weak points, interest in PPI toll road projects is particularly strong because governments require alternative methods of financing their extraordinary transport needs (TÁNCZOS, K., and KONG, G. S., 2001).

Recent worldwide trend in road projects has been to introduce private capital in many areas to build and operate road infrastructure.

Developed countries, developing countries, and emerging markets all seek, each in its own way, methods to achieve common goals – economic growth, political independence, and more opportunities and higher standards of living for their people.

In Western Europe, it is no surprise, that this need for new infrastructure investment, coupled with widespread efforts to reduce budget deficits in order to satisfy the criteria for economic and monetary union (EMU) under the Maastricht Treaty, has led the central and regional governments of Western Europe to look to the private sector as an alternative source of infrastructure finance (BONAR, M. and FUSS, S., 1997).

In Asia, some countries adopted private sector concessions as main approach for designing, building, financing, and operating toll roads.

Most of all countries’ national expressway (motorway), on which virtually all journeys, is subject to tolls.

PPI will be an important component in toll road project implementation process (KONG, G. S., 2000).

Taking into consideration the financial difficulties of Central and Eastern European governments, it is understandable that they are unable to offer traditionally required financial support or guarantees for potential investors and lenders of a concession company charged with motorway project financing. The assistance of international financial institutions in this respect is therefore vital for success (TIMÁR, A., 1994)

In short, the advantages of PPI are an increase in efficiency in the provision of services, avoidance of political interference in operations, and alternative of public sector budget constraints.

The success of PPI projects depends on a synthesis of the public and private sector strengths, skills and resources, which satisfies the priorities of both parties.

The private sector is to seek a reasonable return on capital investment, sharing of
expertise and assumption of risk.

Fundamental objectives of the public sector in any PPI projects are to secure the best “value for money” and make the projects viable.

However, this deviation in objectives does not exclude a certain degree of commonality in the purposes behind pursuing the partnership, first among them being customer satisfaction.

In an optimal scenario, the result is a “win-win” situation where both parties along with the ultimate beneficiary—the service user—gain from the partnership.

PPI projects almost always comprise a high level of risk due to the magnitude of the financial stakes involved, uncertainties over construction and operation costs, and revenue-related uncertainties.

So, the analysis, mitigation and allocation of a project’s risks are very important to carry out PPI projects successfully.

A partnership-based project organization relies upon a balanced allocation of these risks and enables transferring a certain portion of them onto the private sector when the private sector is said to be better able to shoulder them than the public sector.

To achieve this goal, I suggest the risk factor should be included in the tender evaluation and the private sector be informed of the risk evaluation item and score related to the project before proposal because this can induce optimal risk allocation incentive between the public and the private sector.

However, the private sector desires low risk, which would translate to a high probability of success, profit, or some form of gain.

In road projects, financially viable standalone PPI projects, relying solely on the generated revenues, are extremely rare. To achieve bankability of a socio-economically sound, eligible project, which can potentially be implemented, a partnership has to be set up through public contribution of various kinds.

In this case, a public/private partnership (PPP) type approach (leading to appropriate risk allocation, involving eventual public financial support) is likely to provide the best solution.
This partnership has to take into account all risks and rewards of both parties, should be based on their fair and equitable allocation and provide incentives to maintain and improve efficiency.

If governments wish to encourage and facilitate the PPI projects, they will have to provide an appropriate balance between risk and reward. Developing countries must recognize that a higher level of risk will require a higher prospect of reward.

To extract the maximum possible economic benefits from a privately financed toll road project scheme, a balance needs to be struck between maximising the transfer of risk to the private sector, and thus the incentive to manage that risk effectively, and encouraging a sufficiently attractive risk to reward ratio to encourage private sector involvement and the additional benefits.

9.2 Recommendations

Governments can attract private participation in toll road infrastructure in two ways.

They can offer financial support to investors - in the form of grants, cheap loans, or guarantees – in order to compensate them for low tariffs, unstable macroeconomic conditions, poor performance and other problems.

Or they can address the policy to solve problems that underlie investors’ concerns raising prices to cost-covering levels, ensuring macroeconomic stability, and establishing a sound regulatory framework.

Many governments are still grossly over-optimistic about the extent to which they can obtain the infrastructure development they would like off-budget simply by opening the sector to unsolicited private proposals.

Experiences of PPI projects on an international scale suggest that the private sector has considerable reservations about participating in such projects, and the number of projects that have passed the bidding stage has been extremely disappointing.
Most PPI projects generally need huge initial investment making continued private funding very difficult and take too much time, thus rendering early retrieval hard.

The implementation of PPI road projects requires acting with extreme precaution and needs appropriate government measures.

Risk in PPI projects brings in the uncertainty over an outcome where total investment cost will be greater than the final project benefit or result.

Risk also bears on the likelihood that the project schedule will be longer than planned or not delivered at all.

To deal with these issues more efficiently, my findings and recommendations are listed below.

9.2.1 Establish Standard Cost/Benefit Appraisal Procedure

As a result of my research I suggest establishing especially further developed, and standardised cost/benefit appraisal procedure for PPI road projects, which consider the special characters of this type of projects.

Except for some developed countries, most countries have no official units for measuring benefits and cost items and inconsistent units have been applied.

This often causes different results by individual view of appraiser.

The results of the road projects appraisal have a significant impact on the decision making of the people directly and indirectly concerned, whatsoever the results are from an economic appraisal or comprehensive analysis.

Since this standard procedure is to prevent the decision makers from subjective or risky decision, the objective appraisal criteria should be used, and a reasonable and transparent appraisal procedure should be applied.

This is very important in PPI projects because the private sector is willing to believe the results of a project appraisal done by the public sector has already done.

So this can also reduce time and cost, and avoid unnecessary political intervention etc.

Provided sufficient demand exists for road projects, revenue streams can be identified and the commercial viability determined by the private sector.
The validity of a road project is satisfied when 1) the benefit is greater than the cost, and 2) profitability is greater than those of other alternatives.

9.2.2 Creation of a Complex Framework for a Secure Political Consensus and to Provide Acceptance of Tolling by the Public

As a product of my research, I developed a complex framework, which provides the secure political consensus and acceptance of tolling by the public.

The framework includes the followings:

- The government willingness must be stated clearly.
- The necessity for implementation of a PPI project and the benefits that it will bring must be explained clearly.
- Promoting public hearing in the planning process and dealing with relocation and resettlement in most countries; noise, air pollution, and ecology (e.g. the M3 project in Hungary, the Birmingham Northern Relief Road in the UK, etc); public relations campaigns (e.g. the Citra Metro Manila Tollways in the Philippines, the Incheon International Airport Expressway in South Korea etc.).
- Service value related pricing, as a tolling principal, is important. The toll should either be levied accordingly to the distance covered on a road or according to the time spend on it.
- The choice of financing means and especially the decision to toll should be justified in depth.
- The method for awarding the concession must be transparent and the choice of the concessionaire clearly stated.
- The case of low-income road users should be considered. In some cases this might lead to specific tariff arrangements or to maintaining possible free alternatives to the tolled road.
- Implementation of tolling must be carefully prepared. If the existing free roads are to be rehabilitated, it is advisable to start tolling only after the improvements to the level of service are noticeable.
- On new infrastructures, the reason for resorting to tolling should be explained and the service improvements, which it offers should be emphasized. Users become clients. They have the right to expect a service corresponding to the price paid. In particular, this service should not be lower than the service of a comparable toll-free road.
9.2.3 Use Various Risk Analysis Theories and Techniques

Risk analysis is a key feature of modern decision making, for both public and private sector.
We cannot know what the future holds, but we need to be able to make informed, realistic and justifiable decisions in the face of uncertainty.
Assessing and quantifying risks provide us with the means to understand, value and manage the risks inherent in an uncertain world.

To deal with this issue more efficiently I recommend using various theories and techniques for the different identified risk factors as follows:

- Probabilistic Techniques
- Sensitivity Analysis
- Break-Even Analysis
- Monte Carlo Simulation
- Time-Series forecasting
- Delphi Group Opinion
- Game theory.

I proved the cost reduction impact of risk optimization through a simplified case.

9.2.4 Develop Useful Methods to Forecast Future Traffic Volume

Forecasting the volume of traffic that will use a proposed road project is a key input into the appraisal process.
Given that projects frequently take ten years to plan, design and build, and are extremely long-lived, it is necessary to forecast a long way into the future.

The benefits from a scheme usually rise more than proportionately with the traffic volume, as increased volume leads to worse congestion.
Thus the forecast rate of increase in traffic is very important, as well as being subject to great uncertainty and risk.

I suggest to use special combination of different approaches to forecasting range from
simple time series models based on aggregate growth in population, incomes and petrol prices to more detailed modeling of trips by purpose and destination etc.

- Traffic surveys are carried out in the corridor of the proposed toll road, usually comprising some (but rarely all) of traffic counts classified by vehicle type, origin-destination surveys, stated or revealed preference surveys to establish users’ willingness-to-pay tolls, and journey time surveys.
- Other data are collated on land uses (current and projected), historic traffic, and economic growth.
- A traffic-forecasting model is developed, validated to base year conditions, which produces traffic and revenue forecasts for a few specific future years, for a range of scenarios.
- A revenue stream for the project concession period is developed by interpolation and extrapolation of the model revenue forecasts.

The approach used by the British department of transport combines a car ownership model based on incomes and driving license holding, and a car use model in which the kilometers run vary in accordance with incomes and petrol prices (Nash, C. A., 1995).

For freight traffic, ton kilometers are assumed to be proportional to gross domestic product, whilst bus and coach traffic is assumed constant over time.

High and low forecasts are produced on the basis of alternative assumptions about petrol prices and economic growth (department of transport, 1989).

Given a traffic forecast, it is necessary to estimate the resulting travel times. The interaction between traffic volume and speeds is usually estimated by the use of speed-flow relationships, which vary according to the characteristics of the road (lane width, number of lanes and so on).

9.2.5 Development of Optimal Risk Allocation Methods

Referring to and summarizing the experience gained worldwide in this respect, an optimal risk allocation can be defined as one in which the risks in a project are allocated to the party (i.e. the public or the private sector party) best able to manage them.
9.2.5.1 Identification of the Main Clusters of Risks taken by the Public, the Private Sector, and the Shared

In other words, where a risk is best managed by the public it should take that risk; with private sector taking these risks which it is better placed to manage.

In some cases a risk can be shared, where management of the risk is best shared.

As I studied and reviewed most cases of PPI projects, I arrived to the conclusion that the main clusters of risks taken by the public, the private sector, and shared risks are as follows:

- Public sector: land acquisition, change of law, force majeure (long-term)
- Private sector: construction (time and cost), operation performance
- Shared: foreign exchange loss, force majeure (short-term)

The reason why optimal risk allocation involves allocation risks to the party best able to manage them is that this minimizes the financial impact of the risk on the overall project.

Optimal allocation of risks is not the same as maximizing the transfer of risks to the private sector.

9.2.5.2 Organize a Joint Venture as a Risk Mitigation Device

Taking into consideration the complexity and difficulty of PPI project implementation, I recommend organizing a joint venture.

A joint venture is a form of risk sharing used in project financing. In a joint venture, sometimes called a joint development company, two or more parties join to develop a project or series of projects jointly.

Joint ventures might include a company particularly skilled in construction, another skilled in project development and a third in the political and developmental climate of the host country.

Together, each brings different, useful skills to project development, while allowing for a risk sharing that may be more attractive to them than if one of the entities developed the project singly.

Also, joint ventures provide the framework for accelerating the negotiation process with governments and financial institutions. Further, the increased creditworthiness and experience of individual companies combined into a joint venture allow the joint
venture to be competitive though the individual members, acting alone, would not have
the resources necessary to compete with other, larger and more experienced companies.

9.2.6 Identification of Further Tool Package for Risk Reduction

I strongly recommend using further tool packages for reducing PPI project risks as follows.

9.2.6.1 Limit The Number of Pre-Qualifiers and Develop Suitable Pre-Qualification Criteria

The advantage of a pre-qualification process is that it enables inappropriate prospective bidders to be eliminated at a very early stage.

In addition, on very large projects the costs of bidding are very substantial.

The private sector is in an insecure position where the chances of winning the competition are small.

Thus on large projects it is not unusual to see the number of pre-qualifiers reduced to 3-5.

All projects have different needs.

The private sector needs to know the basis on which pre-qualification will be made.

It is appropriate to allow public sector officials to exercise subjective discretions in applying pre-qualification criteria.

Criteria might include:

- Technical, financial, commercial, management track record
- Proven understanding of project operations
- Potential to meet the government’s requirements for the project
- Willingness to proceed with a bid, which will comply with government’s requirements
- Avoidance of conflicts

9.2.6.2 Prepare Well Organized Contractual Framework

Reconciling the differing objects of parties to a PPI project will involve a complex set of contractual relationships.
The underlying contractual framework of a project is of course fundamental to the success of any project.

The primary risk allocation and mitigation measures are mainly determined through the concession agreements.

So concession agreements should also contain both the rights of the parties and obligations between public sector and private sector.

Many of the general and specific terms of the concession can be found in concession agreements, but terms relating to the governing law, insurances, termination, force majeure and disputes are common to all concession agreements.

Whilst the general and specific terms of the concession will inevitably have a bearing on such common terms, standard clauses could determine the parameters under which the concession is to be carried out.

An accumulation of experience over industrial best practices provides us with a base for suitable contractual framework.

The contractual structure of all entities participating in PPI scheme and their responsibilities must permit flexibility and prompt decision-making.

Fair and equitable allocation of the various risks is essential (TIMÁR, A. 1994).

Countries, which apply to the continental law (statutory law) will be a good way to use common law (case law) complementary for reflecting changeable situation in PPI projects.

When the public sector grants a road a concession agreement, the revenues of the private sector depend to a great extent on the users, the length of the agreement is substantially longer, and thus the contract must include covenants that allow for the changing economic environment.

In the case of a toll road, the contract could limit the construction of alternate routes (also for a certain number of years) or could guarantee a minimum volume of traffic.

9.2.6.3 Special Financial Support to Promote PPI

Aiming to achieve a successful deal of PPI projects, I found that most if not all PPI projects will require some financial support from the government.

Government may provide grants to reflect the wider economic, environmental and social benefits, which cannot be easily captured through fees to users.
Contributions from property developers usually only capture a small fraction of the total development gain, where external benefits are widespread; a contribution from national or local taxation may be appropriate.

The cost of raising finance tends to rise with project size. The government can share the financial risk of larger projects by subordinating debt, bearing part of the capital costs or taking an equity stake in the project.

Public sector funding should be focused at the front end of a project, as this is where the financing risk is great.

### 9.2.6.4 Adopt Co-Financing Methods

Analyzing the situation of PPI projects, multilateral organizations (the World Bank Group, EBRD, ADB, IDB) are also involved in PPI projects alongside commercial banks and export credit organizations.

This is referred to as co-financing.

In practice, the involvement of a multilateral agency in this type of set-up leads to the financial credit being structured at two levels.

- A-Loans granted by the multilateral organization itself
- B-Loans underwritten by commercial banks under the multilateral umbrella

As far as B-Loans are concerned, the notion of “multilateral umbrella” does not mean that multilateral organization gives the commercial banks any kind of guarantee on this credit. It simply means that the banks will feel reassured.

The host states are unlikely to take detrimental measures against the projects, because of the presence of a multilateral organization in the financing structure.

### 9.2.6.5 Make Dispute Resolution Procedure Clear

Taking into consideration the characters of PPI projects, agreements must set out what happens if there is a change in circumstance in future.

Inevitably, a dispute resolution mechanism will be required such as mediation, conciliation, mini trial, panel, litigation, arbitration etc.

The complexity of the contractual documents and the project may make it difficult to find a dispute forum, which has all the expertise required.
Parties may be nervous about relying on the courts, or indeed on ICC (Interstate Commerce Commission) arbitration.

**9.3 Limitation and Further Issues**

PPI projects are certainly not an easy procurement option for the public sector. The PPI procurement is a very complex process because we must consider every participant’s interests for this project.

It is rather complicated and difficult to consider the optimal risk allocation and mitigation methods for all parties because their interests are often contradictory.

I wanted to introduce many real cases on PPI projects as far as I can because empirical evidence should have been included to support the theoretical analyses. The problem with empirical studies in this field is that most information is commercially confidential.

Considering this situation, I mainly suggested the optimal risk allocation & mitigating methods that are common to most projects for the public sector based on the applicant case study and useful risk management theory etc.

The reason is that the public sector is a key player in PPI projects who is responsible for granting a privately financed concession and is the ultimate owner of the facility after transfer.

This study can be expanded in the following way:

- Improve financial model and risk analysis through more practical and complex simulation methods.
- Analyze the dynamic private sector action on various risks of PPI projects.
- Incorporate more quantitative and numerical data into risk analyses.
Bibliography


(5) **BURKE, R.** (2001): Project Management (Planning & Control Techniques), John Wiley & Sons Ltd, England etc.


(10) **Department of Transport** (1989): National Road Traffic Forecasts, Department of Transport, UK.

(12) FISHER, G., BABBAR, S., Private Financing of Toll Roads, RMC Discussion Paper Series 117


(37) **Padeco Co. Ltd** (1999): Study prepared by Padeco Ltd. for the World Bank and Ministry of Construction of Japan (MOCJ) as part of the Asian Toll Road Development Program.

(38) **Palisade Corporation** (2000): Guide to Using @Risk (Risk Analysis and Simulation Add-In for Microsoft Excel), USA.

(39) **PENA, F. –Mora and TAMAKI, T.** (2001): Effect of Delivery Systems on Collaborative Negotiations for Large-Scale Infrastructure Projects (In: Journal of Management in Engineering, American Society of Civil Engineers, USA.


(41) **Permanent International Association of Road Congresses** (1987): 18th World Road Congress, Committee Report No 9, Brussels, pp. 79-83.


(80) **World Highways** (September 2001): Spanish Roads (Maintenance takes center stage), Route One Publishing Ltd., UK.


(82) **World Road Association** (1999): Cost Recovery and Dedication of Road User Fees, USA.


**Internet Site**

- [http://picko.krihs.re.kr](http://picko.krihs.re.kr): The Private Infrastructure Investment Center of Korea Homepage.
Appendix 1 Potential Advantages of Private Sector Participation in Infrastructure (PPI)

<table>
<thead>
<tr>
<th></th>
<th>Construction Efficiency Incentives</th>
<th>Operation Efficiency Incentives</th>
<th>Complementary Funding Capacity</th>
<th>Government Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional Method</strong></td>
<td>Weak</td>
<td>Weak</td>
<td>None</td>
<td>Direct</td>
</tr>
<tr>
<td>(Public Procurement of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Works – Operation by</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Administration)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Contracting Out</strong></td>
<td>N.A.</td>
<td>Weak or Average</td>
<td>None</td>
<td>Direct</td>
</tr>
<tr>
<td>Of Operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Public “Concession”</strong></td>
<td>Weak</td>
<td>Average</td>
<td>Average</td>
<td>Direct</td>
</tr>
<tr>
<td>(State Owned Concession</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company, User’s Toll)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Private Concession</strong></td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>Indirect</td>
</tr>
<tr>
<td>(Shadow Toll or Lease)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Private Concession</strong></td>
<td>Strong</td>
<td>Strong</td>
<td>Average</td>
<td>Indirect</td>
</tr>
<tr>
<td>(User’s Toll)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


* Private sector involvement in the construction, operation, management and financing of road infrastructures offers in general certain potential advantages for the community. It is not possible to draw any general conclusions from this classification: the potential benefits will depend upon the circumstances of the particular case.

Shadow toll does not generate new funding sources. The final cost must be borne by the taxpayer (“delayed” budgetary funding), and not the user. Private concession (user’s toll) is more attractive than shadow toll for complementary funding capacity.

My own development is the next scheme (appendix 2).
Appendix 2 Models of PPI Road Project Implementation Procedure and Risk Management

- Comparison of Economic analysis and Financial Analysis by Special Research Institute etc.

- Result of Feasibility Study

- Design of Risk Allocation
  - Prepare Draft Contract

- Concessionaire Designation Procedure and the Government Support etc.
- Key Elements are to be summarized and announced in English.

- PQ and/or 2-step Evaluation are necessary.
- 2-5 Potential Concessionaire are to be selected.
- Evaluation Task Force Team is to be organized and operated.

- Selects Most Advantageous Proposal on basis of Technical and Financial Merits including Risk Allocation Level etc.
Negotiates / Signs Concession Agreement with Winning Bidder. (Government)

Approval of Detailed Engineering and Design Plan for Implementation (Government).

Implementation of Construction (Concessionaire)

Confirmation of Completion of Construction (Government)

Operation and Maintenance of Road during the Concession Period (Concessionaire)

Transfer of Road Operation Right to the Government (The End of the Concession)

- Determination of the Project Implementation Conditions including Total Project Cost, Concession Period, Tariff, etc.
- Including Government Support and Risks in Project Implementation, Management of Safety and Environment, etc.

Monitors Operation and Maintenance Activities (Government)

Monitors Construction Activity (Government)
Appendix 3 Country Credit Risk Rating and Interest Rate in PPI Road Project

Cost of Capital (Interest Rate)

LIBOR + \( \alpha \)

Higher Rating  Lower Rating

Country Risk (as measured by country rating)

* LIBOR: the London Inter-Bank Offered Rate, the rate at which banks lent to each other in the London inter-bank money market

Credit Ratings and Credit Rating Agencies

<table>
<thead>
<tr>
<th>Standard &amp; Poors</th>
<th>Moody’s</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>Aaa</td>
<td>Best Quality Bonds, Capacity to Pay Interest and Principal is extremely strong</td>
</tr>
<tr>
<td>AA+, AA, AA-</td>
<td>Aa1, Aa2, Aa3</td>
<td>Very Strong Capacity for Repayment</td>
</tr>
<tr>
<td>BBB+, BBB, BBB-</td>
<td>Baa1, Baa2, Baa3</td>
<td>Protection of Interest and Principal is Moderate</td>
</tr>
<tr>
<td>BB+, BB, BB-</td>
<td>Ba1, Ba2, Ba3</td>
<td>Speculative Grade</td>
</tr>
<tr>
<td>B+, B, B-</td>
<td>B1, B2, B3</td>
<td>Highly Vulnerable to Adverse Business Conditions</td>
</tr>
<tr>
<td>CCC+, CCC, CCC-</td>
<td>Caa</td>
<td>Identifiable Vulnerability to Default</td>
</tr>
<tr>
<td>CC</td>
<td>Ca</td>
<td>Highly Speculative. Often in Default</td>
</tr>
</tbody>
</table>

Sample of PPI Road Projects (Standard & Poor’s rating, G. Fisher, S. Babbar)
China (BBB, 1992), Guangzhou-Shenzhen Superhighway (Banks, LIBOR + 1.4%, 8 Years)
Hungary (BB, 1992), M1/M15 Motorway (EBRD A-Loan, LIBOR + 3%, 15.5 Years)
Colombia (BBB-, 1994), Buga-Tuluá Highway (Senior Loan, LIBOR + 5.5%, 5 Years)
Appendix 4 Types of Government Support

- **Contractual Obligations of the Public Sector**
  - Guarantee of Off-Take in Power Projects

- **Policy/ Political Risk**
  - Guarantee of Currency Convertibility and Transferability
  - Guarantee in case of changes of law or regulatory regime

- **Financial Market Disruption/ Fluctuations**
  - Equity Guarantees (San Juan Lagoon Bridge, Puerto Rico)
  - Debt Guarantee (Guangzhou-Shenzhen Superhighway, China)
  - Guarantee of Exchange rate (Incheon International Airport Expressway, South Korea; Spain’s Toll Road Program)
  - Grants and Subordinated Loans (South Access to Concepción, Chile)

- **Market Risk**
  - Guarantee of Tariff Rate (Don Muang Tollway, Tailand; Western Harbour Tunnel, Hong Kong; Buga-Tuluá Highway, Colombia; Mexico Toll Roads; Incheon International Airport Expressway, South Korea; M5 Motorway, Hungary)
  - Minimum Revenue Guarantee (South Access to Concepción, Chile; Incheon International Airport Expressway, South Korea; M5 Motorway, Hungary)
  - Minimum Traffic Guarantee (Colombia’s Buga-Tuluá Highway)

- **Concession Extensions and Revenue Enhancements**
  - Concession Extensions (Toluca Toll Road, Mexico City)
  - Revenue Enhancements: Limitation on the government’s right to construct or expand competing facilities, and the concessionaire receives rights for ancillary real estate development (SR-91, USA)

Source: the World Bank and the Korea Development Bank, 1998
Appendix 5 Contractual Structure of the M5 Motorway Project (Hungary)

Source: (AKA Concession Company, 1995)

* D & C Contract: Design & Construction Contract
  O & M Contract: Operation & Maintenance Contract
Appendix 6-1 Cash-Flow Schedule Analysis (INNO-FINance Program)
Appendix 6-2 Debt Service Cover Ratios Analysis (INNO-FINance Program)