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A Desirability Model for the Development of Privately-Promoted Infrastructure Projects

Volume I

Antonio Dias, Jr. and Photios G. Ioannou

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Antonio Dias, Jr.
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Photios G. Ioannou

Center for Construction Engineering and Management
Department of Civil and Environmental Engineering
University of Michigan
Ann Arbor, MI 48109-2125 USA

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Preface

The ability of governments to operate, maintain and finance infrastructure is increasingly being questioned. Many facilities have been inefficiently operated and inadequately maintained, social needs have been neglected, and governments have been spending more on infrastructure than they can manage. The private promotion of infrastructure projects is a key mechanism for providing new facilities that has advantages for the public and private sectors. This study focuses on the participation of private-sector companies in the development, financing, construction, operation, and ownership of infrastructure projects. It provides a through discussion of the essential issues and concepts involved in the promotion of projects via concession arrangements or privatization.

Questionnaires were sent to 15 renowned experts to gather information about the desirable attributes of promoting companies and projects. As a result, a multiattribute additive hierarchical model, called the Desirability Model, has been developed to evaluate (i) the capability of companies to participate in the promotion of projects and (ii) the feasibility of projects to be pursued by private promotion. A total of 23 attributes have been identified as able to characterize the quality level of companies and projects. Validation was performed and the results indicate that the model closely captures the preferences of the respondents.

A mathematical formulation for determining the value of debt and equity as well as the optimal financial structure for privately-promoted projects is presented in another report (UMCEE Report No. 95-10). The main decision facing the prospective one-project company is how much to borrow, how much to infuse from the promoters' own funds and how much to raise from outside investors. Typically, such projects must repay any debt

obligations through their own net operating income, as they do not provide the lenders with any other collateral (off-balance-sheet financing). Thus, the possibility of a costly bankruptcy becomes much more likely. It is shown that under these circumstances, the maximum amount of debt that a project can service (its debt capacity) is less than 100% debt financing. Furthermore, the amount of debt that maximizes the promoters' return on equity is always less than the project's debt capacity. Exceeding these debt amounts and moving towards debt capacity should be avoided as it can rapidly erode the project's value to the investors. Finally, it is demonstrated that both debt levels as well as the promoters' return increase through the provision of either production or minimum-revenue guarantees.

The contents of this report and of UMCEE Report No. 95-10 were originally published by Dias (1994).

This has proven to be an exciting field of study and continuous research are being performed by the authors. For further information on this report or on our on-going research materials contact us at the following addresses:

Dr. Antonio Dias Jr.
Project Consultant
Rua Paderewsky 81
Sao Paulo, SP 02019-001
Brazil

phone: (55-11) 950-4266
fax: (55-11) 290-7665

Dr. Photios G. Ioannou
Associate Professor
Department of Civil and Environmental Engineering
The University of Michigan
2354 G. G. Brown Building
Ann Arbor, MI 48109-2125

phone: (313) 764-3369
fax: (313) 764-4292
e-mail: photios@umich.edu

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1 Introduction

"A ten-thousand-kilometer walk begins with the first step."

Marco Polo

1.1 The Need for Infrastructure

Infrastructure[1] — physical facilities, equipment, and the provision of services — represents, if not the engines, then the "wheels" of economic activity. Infrastructure lays the foundation for a healthy economy and a high standard of living. It permits production costs to be reduced (e.g., decrease in transportation costs, easier access to information), facilitates the growth of alternative employment and consumption possibilities, and contributes to the raising of quality-of-life standards through the creation of amenities in the physical environment (e.g., cleaner water and air) and the provision of facilities and services that better personal health and community integration.

In recent years, many studies (Auschauer, 1989; Munnel, 1990; Holtz-Eakin 1992; Canning and Fay, 1993a and 1993b; Queiros and Gautam, 1992; Easterly and Rebelo, 1993) have attempted to measure the impact of infrastructure development on economic growth by observing the relationship between increases in the stock of infrastructure (proxied through public capital expenditure or physical measures of infrastructure networks) and some measure of growth in aggregate output or productivity (e.g., GDP growth). The results have supported the perception that public capital expenditure has a significant, positively correlated effect on economic growth.

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[1] Infrastructure, as defined here, includes public utilities (e.g., telecommunications, water and sanitation systems, power, gas), public works (e.g., roads, bridges, railroads, airports, urban transportation, canal works for irrigation), and "social works" (e.g., education and health care facilities).

According to Auschauer (1991), the lack of funds to finance infrastructure projects is one of the major causes of the economy's faltering productivity, profitability, and private sector capital formation. He estimated, for example, that a 1% increase in the stock of infrastructure capital would raise American productivity by 0.24%. The US Department of Transportation has estimated that in 1985, total vehicle delays on the highways exceeded 722 million hours and projects that this number will increase to 3,900 million hours by the year 2005 if improvements to the nation's freeway system are not forthcoming. While these cars and trucks sat in traffic, they wasted nearly 3 billion gallons of gasoline, almost 4% of annual consumption in the US. The total cost of this congestion was estimated at $9 billion. According to the Federal Aviation Administration, air travel delays in 1986 resulted in $1.8 billion in additional airline operating expenses and $3.2 billion in time lost by travelers.

1.2 The Provision of Infrastructure

During the nineteenth century and the first part of the twentieth century it was common to see private enterprises responsible for the delivery of infrastructure services. Examples of such private involvement include the Suez Channel (the channel company was formed in 1856), and the American and British railroads. However, after World War II most infrastructure provisions have been performed by the government. This shift — from private to public infrastructure provision — occurred because governments recognized the economic, social and political importance of infrastructure. They believed infrastructure services would be best produced and delivered by public monopolies because unit costs normally decline as service output increases and presumed they could allocate resources properly so that policies regarding economic development, poverty reduction, and environmental sustainability could be better attained.

During the past 50 years governments worldwide have invested heavily in infrastructure expanding services impressively. According to Kessides (1993), infrastructure expenditure has ranged from 35 to 50% of public investment (around 3-6% of GDP).[2] However, the amount of investment cannot be the only focus of public policies. Improving the quality of infrastructure services is very important. According to a recent World Bank survey, low operating efficiency, inadequate maintenance, political interference, and lack of attention to the needs of users have all played a part in reducing the development impact of infrastructure investments.

The inefficient performance of some infrastructure is easily attested by observing the extent of output lost in the delivery due to substandard operation procedures, inadequate

[2] In the US, for instance, "basic public infrastructure spending declined from 2.3% of gross national product in 1960 to 0.7% in 1990. That's equal to a current annual shortfall of about $90 billion." (Business Week, October 26, 1992, pp. 18)

maintenance, overstaffing, financial inefficiency, neglect of the poor and neglect of the environment. According to World Bank reports, 25% of the power utilities operated in developing countries have had losses in the transmission and distribution of electricity that were twice as much those that occurs in efficiently operated utilities.[3] In Latin America, for each dollar not spent on road maintenance, $3 to $4 are estimated to be required for premature reconstruction. In Tanzania and Zaire, over 60% of the railway labor were also considered to be superfluous. In Brazil, 25% of the highway department staff have been estimated to be unnecessary.

More frequently than not, social goals have also not been fully achieved as the low-income population do not use as much infrastructure services as the middle- and high-income do. This happens not only because of their lower income but also because of their limited access to services. Table 1-1 shows the percentage of the poorest and richest quintiles with access to infrastructure for a few countries. Many governments have used subsidies to improve the access of the poor to infrastructure services, however most of the benefits have been taken by the non-poor. This failure can be attributed not only to bad public policies but also to the lack of emphasis placed on the types of services of most value to the poor.

	Access to public water supply		Access to sewers		Access to electricity	
Country	Poorest quintile	Richest quintile	Poorest quintile	Richest quintile	Poorest quintile	Richest quintile
National areas						
Ivory Coast (1985)	2.4	62.1	3.4	57.0	13.2	74.8
Ghana (1987-88)	10.5	30.6	0.5	14.6	5.6	46.0
Guatemala (1989)	46.9	86.8	n/a	n/a	16.1	86.1
Mexico (1989)	50.2	95.0	14.2	83.2	66.2	99.0
Peru (1985-86)	31.0	82.0	12.3	70.0	22.8	82.5
Urban Areas						
Bolivia (1989)	84.8	89.9	52.6	87.4	n/a	n/a
Paraguay (1990)	53.7	88.8	10.4	62.2	94.5	99.2

n/a = not available

Table 1-1: Percentage of the Poorest and Richest Population Quintiles, In Various Countries, with Access to Selected Infrastructure Services (Source: World Bank Report, 1994)

[3] Appendix A provides worldwide indicators of the coverage and performance of selected infrastructure sectors.

Inefficient performance and poor maintenance results in low-quality and unreliable services. Improving the effectiveness of infrastructure providers is, therefore, essential for economic growth and quality-of-life enhancements. According to the World Development Report 1994, the weaknesses in infrastructure services are a result of the lack or inappropriateness of incentives providers have to perform. In order to create the right incentives for efficient and responsive delivery of services, the report suggests three essential elements:

- *Management based on commercial principles* — Infrastructure must be viewed as a "service industry," that is, it should provide services that meet the demand of the customers. In order to have this happening infrastructure providers should be shielded from noncommercial pressures and constraints (i.e., corporatization of services), should be given autonomy to manage and held accountable for results they have agreed upon, and should employ a pricing strategy designed to ensure cost recovery (i.e., financial independence);

- *Competition* — Competition promotes efficiency. Better services improve productivity, lower prices and enhance the quality of life for individuals. Depending on the infrastructure sector competition can bolstered through unbundling of activities,[4] permission for new entrants, elimination of restrictions, and benchmarking. Table 1-2 shows estimated gains from deregulation of selected infrastructure sectors in the US. Tables 1-3 and 1-4 displays potential worldwide savings due to better pricing policies and increased efficiency in the provision of certain services.

- *Involvement of users and other stakeholders* — Users and other stakeholders should be consulted about potential projects and design alternatives and, if possible, participate in the planning and operation of services.

The report also points out that "there are fewer infrastructure activities requiring government intervention than once believed and, when required, government intervention can be exerted through less distorting instruments of public policy than those traditionally used." It identifies four approaches that governments can use to provide infrastructure services:

- Public ownership and operation, through a public enterprise or government department,
- Public ownership but with private operation,
- Private ownership and operation, and
- Community ownership and user provision.

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[4] Unbundling refers to the detachment of activities that were previously performed by one organization and making them available to different forms of competitive provision. For example, recent regulatory innovation have permitted telephone services to be unbundled (local services, long-distance, cellular, data transmission) making them more open to competition.

Sector	Extent of deregulation	Estimated annual gains from deregulation (billions of 1990 US$)
Airlines	Complete	13.7 - 19.7
Trucking	Substantial	10.6
Railroads	Partial	10.4 - 12.9
Telecommunications	Substantial	0.7 - 1.6
Natural gas	Partial	Substantial gains to consumers

Note: Gains from competition cover net gains to producers (in terms of profits), consumers (price and quality), and industry employment (wages and employment)

Table 1-2: Estimated Gains from Competition Through Deregulation of Infrastructure Sectors in the United States (Source: World Bank Report, 1994)

Sector	Savings	Source of inefficiency
Power	90	Underpricing
Water	13	Underpricing
	5	Illegal connections
Railways	15	Underpriced passenger service
Total	123	

Table 1-3: Potential Worldwide Savings Due to Better Pricing Policies for Selected Infrastructure Sectors (Billions of US$) (Source: Ingram and Fay, 1994)

Sector	Savings from better pricing	Source of inefficiency
Roads	15	Annual investment requirements created by improper maintenance
Power	30	Transmission, distribution, and generation losses
Water	4	Leakage
Railways	6	Excess fuel use, overstaffing, and locomotive unavailability
Total	55	

Table 1-4: Potential Worldwide Savings Due to Increased Service Efficiency for Selected Infrastructure Sectors (Billions of US$) (Source: Ingram and Fay, 1994)

1.3 The Finance of Infrastructure

Developing countries now invest around $200 billion a year on infrastructure. About 80% of this amount is provided by government tax revenues (i.e., approximately 50% of the total yearly government investment), around 10% of this expenditure is borrowed by the government from bilateral and multilateral sources, and the rest of the money comes from publicly guaranteed commercial financing and private sector investments. Table 1-5 displays the total amount committed by official bilateral and multilateral sources to finance development projects and the amounts committed to fund selected infrastructure sectors. Figure 1-1 shows the percentage of the total amount committed that has been directed to infrastructure.

Year	Water supply and sanitation	Transport	Communications	Energy	Other infrastructure sectors	Total infrastructure	Total
1984	1,893	5,983	940	8,565	330	17,666	59,485
1985	2,558	5,303	786	7,675	286	16,608	56,183
1986	3,213	4,690	1,141	7,598	572	17,214	67,092
1987	2,858	8,466	1,080	8,733	1,030	22,167	82,306
1988	4,319	7,697	2,519	8,759	1,454	24,748	87,072
1989	1,979	7,503	1,628	6,750	2,817	20,497	75,115
1990	2,642	6,816	2,373	6,322	2,015	20,168	92,396
1991	2,690	7,380	1,421	8,969	3,298	23,758	101,589

Table 1-5: Official Development Finance Commitments (Millions of 1994 US$) (Source: World Bank Report, 1994)

The present system of infrastructure investment puts a heavy burden on public finances as the predominant sources of finance — tax revenues and government borrowings — rely on the government's ability to generate capital and secure lines of credit. Moreover, the present system of infrastructure financing presents an almost unilateral allocation of risks as the government is liable for most of them.

The main advantage of the present method is the government. This is due to the fact that as the most creditworthy local entity, the government has been able to borrow at the lowest rates and hence, finances infrastructure projects that would not be viable otherwise. Nevertheless, being creditworthy does not imply unlimited access to resources. Actual demand for infrastructure investment in developing countries is around 3-6% of GDP. However, this amount tends to increase as the rapid pace of urbanization in these countries requires investments in water supply, waste treatment and disposal. In Asia, the

share of infrastructure investment in GDP is expected to rise from the actual 4% to more than 7% by the end of the century. Transportation and energy are the most likely to demand the most resources, followed by telecommunications and environmental infrastructure. China, for example, has set a target of installing at least 5 million telephone lines annually up to 1995 and at least 8 million lines per year thereafter, to more than triple its 1992 base of 18 million by the year 2000 (World Bank Report, 1994).

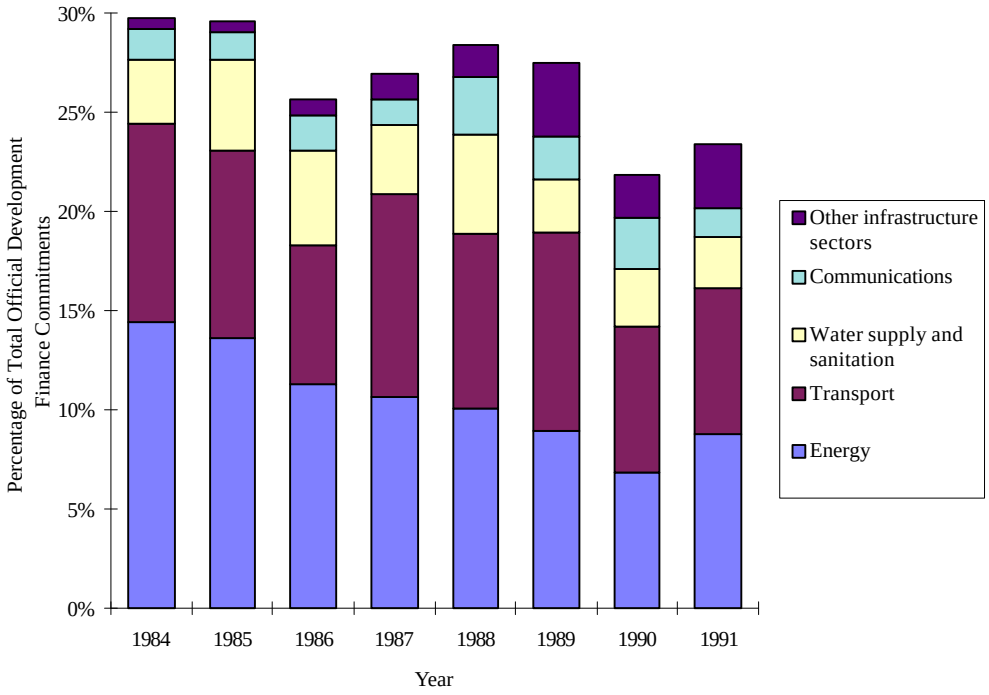

Figure 1-1: Percentage of the Total Amount Committed by Official Bilateral and Multilateral Sources to the Provision of Infrastructure Services (Source: World Bank Report, 1994)

The current situation dictates the need for additional funding sources. Governments simply do not have the funds in place and the credit line required to finance all the infrastructure required. One possible source of funds for infrastructure is the private sector. Its participation in the provision of infrastructure services does not only bring new funds, decreasing the burden on government financing, but also encourages risk sharing and augments the efficiency of infrastructure provisions. The prominent private-sector participants of infrastructure projects are firms seeking overseas business (e.g., construction companies and operators) and firms seeking high-yield investments (e.g., investment banks and pension funds).

In the late 1980's, the participation of the private sector in infrastructure occurred in two ways: through the privatization of state-owned infrastructure providers and through

market deregulation and policy reform that allowed new facilities to be constructed and to compete for the delivery of services. This participation has resulted in annual infrastructure investments in developing countries of about $15 billion (i.e., 8% of the amount spent on infrastructure). Table 1-6 shows the values of infrastructure privatizations in developing countries between 1988 and 1992.

Subsector	1988	1989	1990	1991	1992	Total, 1988-92	Number of Countries
Telecommunications	325	212	4,036	5,743	1,504	11,821	14
Power generation	106	2,100	20	248	1,689	4,164	9
Power distribution	0	0	0	98	1,037	1,135	2
Gas distribution	0	0	0	0	1,906	1,906	2
Railroads	0	0	0	110	217	327	1
Road infrastructure	0	0	250	0	0	250	1
Ports	0	0	0	0	7	7	2
Water	0	0	0	0	175	175	2
TOTAL	431	2,312	4,307	6,200	6,535	19,785	15
Closely related privatizations:							
Airlines	367	42	775	168	1,461	2,813	14
Shipping	0	0	0	135	1	136	2
Road Transport	0	0	0	1	12	13	3
Total developing-countries privatization	2,587	5,188	8,618	22,049	23,187	61,629	25

Note: Countries undertaking infrastructure privatizations:

1988: telecom - Belize, Chile, Jamaica, Turkey; power - Mexico; airlines - Argentina, Mexico.

1989: telecom - Chile, Jamaica; power - Korea; airlines - Chile.

1990: telecom - Argentina, Belize, Chile, Jamaica, Mexico, Poland; power - Malaysia, Turkey; roads - Argentina; airlines: Argentina, Brazil, Mexico, Pakistan.

1991: telecom - Argentina, Barbados, Belize, Hungary, Jamaica, Mexico, Peru, Philippines, Venezuela; power generation - Chile, Hungary; power distribution - Philippines; railroads - Argentina; airlines - Honduras, Hungary, Panama, Turkey, Venezuela; shipping - Malaysia; road transport - Togo.

1992: telecom - Argentina, Estonia, Malaysia, Turkey; power generation - Argentina, Belize, Malaysia, Poland; power distribution - Argentina, Philippines; gas distribution: Argentina, Turkey; railroads - Argentina; ports - Colombia, Pakistan; water - Argentina, Malaysia, airlines - Czechoslovakia, Hungary, Malaysia, Mexico, Panama, Philippines, Thailand; shipping - Sri Lanka; road transport -.China, Peru.

Table 1-6: Value of Infrastructure Privatizations in Developing Countries, 1988-92 (Source: Sader, 1993)

1.4 Research Objectives

Governments worldwide simply do not have the funds in place, or the bonding capacity required, to finance all the public facilities, public services, and infrastructure they must provide. The current situation dictates the need for additional funding sources for infrastructure projects. The following examples illustrate this problem:[5]

> *"Sri Lanka invites tenders for airport runway. Bidders are required to submit proposals for long-term financing of the project, and such proposals will be an important consideration in post-bid evaluations."*

> *"Ivory Coast requests that contractors find external financing for construction of the first 23-km extension of the Abidjan-Yamoussoukro highway..."*

Moreover, apart from funding resources, there is an increasing understanding on the part of some governments that they should not own and/or operate certain types of facilities and infrastructure (Stainback, 1990). Innovative techniques are being used to allow the transition of infrastructure provision and financing from the public to the private sector. In the US, many construction companies want to have a better understanding of alternative financing sources. A study provided by the Technical Affairs Committee (TAC) of the American Society of Civil Engineers (ASCE)[6] showed that two out of the fifteen topics that received most support for further investigation, for the period 1992-1995, are related to finding innovative ways to finance highways and other infrastructure projects.

Two possible methods that governments can use to raise the necessary funds to finance revenue-generating projects when their access to traditional sources of capital is constrained or undesirable are: concession contracts and privatization. In both methods, the government provides project ownership to the private-sector project promoters that, in turn, create a special-purpose company that finances the project, performs the design, executes and manages its construction, is responsible for the operation and maintenance of the facility and owns the facility for either a finite or perpetual time period.[7] Project promoters use the revenues produced during the concession period to pay back lenders, other shareholders, and to get a return on their investment. Examples of projects that can

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5 Extracted from ENR (August 2, 1984, pp. 30)

6 ASCE News, Vol. 14, April 1992.

7 The length of a finite ownership period is typically related to the life of the underlying asset. For example, thirty-year concessions are common for toll roads, and fifteen years is common for power generation projects (although for hydroelectric projects, thirty years is more likely).

be funded using concession arrangements include roads, bridges, tunnels, power plants, water supply and treatment plants, pipelines, and office buildings.

This type of arrangement requires the involvement of several companies (the promoting team). Depending on the nature of the project, the promoting team might include construction companies, engineering firms, equipment and material suppliers, plant operators, utility companies, and customers of the facility. Figure 1-2 illustrates possible contractual relationships (dashed lines) and flows of capital (solid lines) among the different participants of a concession-financed project. The shaded boxes indicate those participants that can either be part of the promoting team or serve as external providers of services.

This research focuses on the participation of the private sector in the development, financing, and implementation of infrastructure projects. It considers projects that are controlled by special-purpose companies created exclusively to be "project owners" and formed with the authorization of the government. It does not consider projects that do not have new companies being established to undertake them. Neither does it discuss various types of projects in the oil and gas, and mining sectors.

The main objectives of this study are:

- To develop a better understanding of the basic and essential concepts involved on the private promotion of infrastructure projects (through the use of concession contracts and market privatization), the risk structure of the parties involved, the strategies used to mitigate these risks, and issues regarding the procurement process of such projects.

- To develop a multi-attribute model that helps companies to decide about their participation in privately-promoted infrastructure projects and allows decision makers to investigate how different scenarios influence the feasibility and attractiveness of such projects.

- To determine the maximum amount of debt a privately-financed infrastructure project can accommodate — its debt capacity — and its optimum financial structure. This information is of paramount importance because it constrains the ability of the promoting team to go ahead with the project. If the promoting team does not have the necessary equity to achieve the optimal debt-to-equity ratio then it should search for additional investors until there are enough resources to achieve the optimal capital structure. (See Dias, 1994 and Dias and Ioannou, 1995b.)

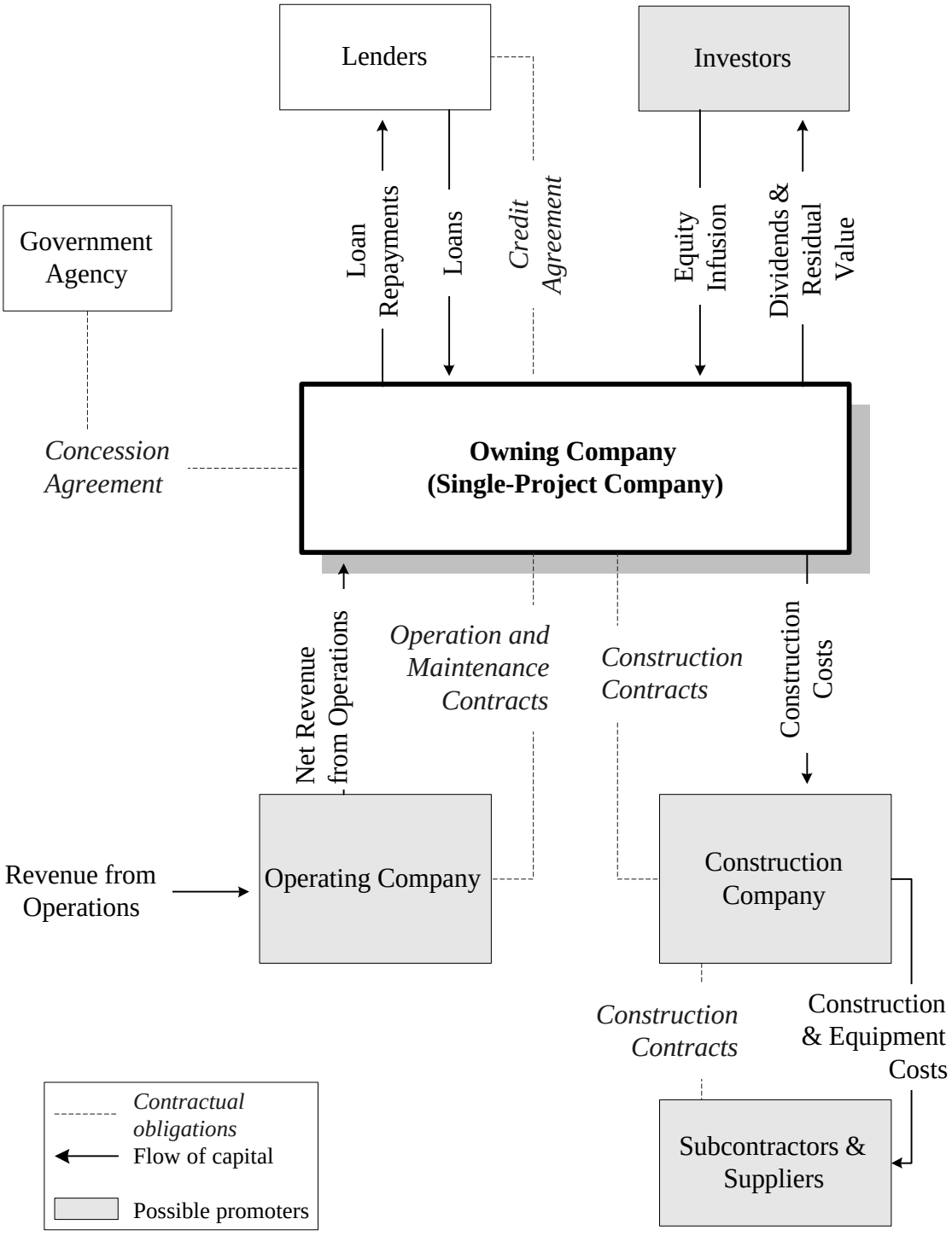

Figure 1-2: Contractual and Financial Structure of a Concession-Financed Project

1.5 Research Methodology

The amount of resources (monetary and non-monetary) that promoting companies must invest in a privately-promoted infrastructure project, even before it is awarded, is enormous. The decision to participate in these projects is unique (projects must be analyzed individually) and complex (involving the concomitant evaluation of several different attributes). Jack Lillywhite, manager of project development at Bechtel Civil Co., expressed the importance of this decision as follows: "We have to decide which ones to look close, which are merely a distraction. Once we have decided to go ahead, we commit as many people fulltime as required to meet the demands of closing."[8]

This study explores the concepts and characteristics of privately-financed infrastructure projects, and uses a multicriteria decision analysis framework (adapted from the simple multiattribute rating technique, SMART, developed by Edwards, 1977)[9] to break down the decision to participate in a privately-promoted infrastructure project into relevant parameters and, subsequently, to reassemble the various parameters into an overall decision making tool that is capable of aiding project evaluation while maintaining sufficient realism. The result is a logical and structured tool that companies can use to help them make decisions regarding (1) their participation in specific infrastructure projects and (2) possible actions that can be taken to decrease project uncertainty and to enhance the likelihood of having a successful venture.

The model developed in this study, called Desirability Model (DM), is a three-level hierarchical multiattribute structure where more general attributes are placed on the top of the hierarchy while more specific attributes are at the bottom. The first (highest) level of the model consists of two general classes:

- **Company Competencies** — where companies analyze their own capability to provide and allocate the necessary resources (e.g., financial, technical, and managerial) to a project so that it can become a successful venture and they can receive a commensurate return from their involvement, and

- **Project Attractiveness** — where companies analyze the attractiveness of the project to a particular company.

The second level of the model consists of seven categories: internal organization characteristics, production capability, financial resources & constraints, promoting team characteristics, technical evaluation, financial assessment, and principal's (client's) qualification & local conditions. The third level of the desirability model hierarchy

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8 "The Bechtel Edge," Worldwide Projects, Autumn 1993, pp. 12-16.

9 Refer to Chapter 4 for a review on SMART.

consists of 23 attributes. Figures 1-3 and 1-4 illustrate how the different attributes are related to the categories (second level) and classes (first level) of the model.

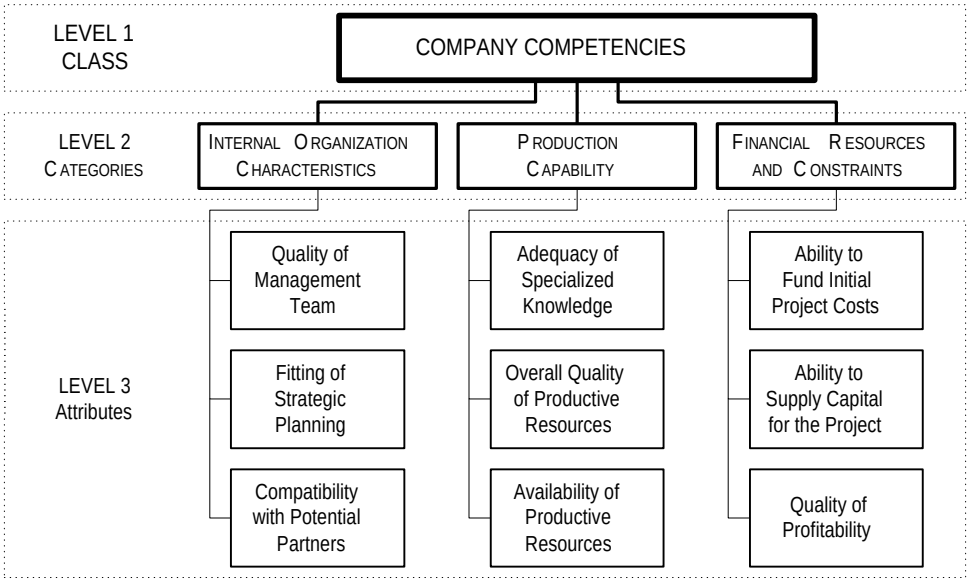

Figure 1-3: Hierarchical Structure of the Desirability Model - “Company Competencies”

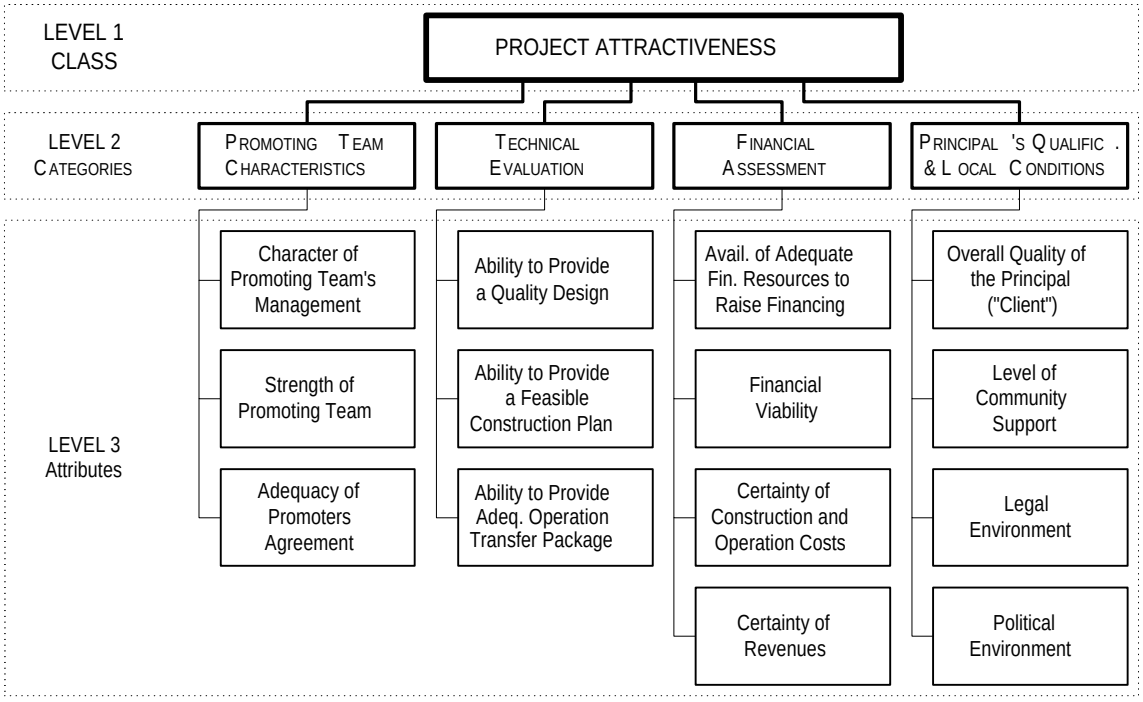

Figure 1-4: Hierarchical Structure of the Desirability Model - “Project Attractiveness”

The development of the model required the help of experts in the evaluation of privately-promoted infrastructure projects that were willing to donate their time and expertise. It was extremely fortuitous that fifteen such experts were identified. The cooperation of these experts was remarkable and very gratifying. The time they spent on the four questionnaires of this study was, undoubtedly, longer than had originally been estimated but they proceeded until the end providing valuable data and insights. The author would like to express his appreciation and acknowledge their assistance in helping to make this study possible. The experts that participated in this study, in alphabetical order, were:

- Mr. Peter Berg (Manager, Eurorail Limited, UK)
- Mr. James Carroll (Vice President - Marketing and Planning Construction Group, Morrison Knudsen Corporation, US)
- Dr. Yuven Cohen (Senior Economist, Parsons Brinckerhoff Quade & Douglas, US)
- Dr. Roger Flanagan (Professor, University of Reading, UK)
- Ms. Ruth Flynn (Managing Consultant, Touche Ross, UK)
- Mr. Michael Harrison (Manager, Hines Interests Limited Partnership, US)
- Mr. K.I.M. Hawwash (Lecturer, University of Birmingham, UK)
- Mr. Rik Joosten (Manager, Phillip Holzsmann, Germany)
- Mr. Jack Lemley (CEO, Transmanche Link, UK)
- Mr. Cliff Matson (Consultant, Australia)
- Mr. Bruce McKendry (Director of Development, HDR Inc., US)
- Mr. Colin Stannard (Consultant, Finance for Enterprise Limited, UK)
- Dr. Robert Tiong (Senior Lecturer, Naygang Tech. University, Singapore)
- Mr. Donald Vuchetich (President, Detroit and Canada Tunnel Corporation, US)
- Dr. Janet Yates (Associate Professor, Brooklyn Polytechnic University, US)

The first contact with these experts was established through an invitation letter. The letter stated the purpose of the research, the procedure that would be used to gather data,[10] and invited them to participate. Twenty-nine letters were sent out, sixteen of them were returned with a positive answer, and fifteen experts completed the four-questionnaire study. The experts were divided into two subgroups: **insiders** and **outsiders**. The insiders were those experts whose affiliation suggested they would look at projects from the promoter's viewpoint (i.e., their companies could be viewed as an active member of the promoting team). The outsiders were those who most likely would advise companies

[10] Originally, the study was to include six questionnaires. An estimated 30-40 minutes would be necessary to complete each of them. During the study, the number of questionnaires was reduced to four. This modification minimized the overall time spent by the experts on responding the questionnaires (upon receiving each questionnaire the experts had to spend time remembering what they answered in previous questionnaires and learning new tasks) and allowed the experts to have a more comprehensive understanding of each of the three model levels (certain pieces of information were gathered at once instead of collecting information in two different instruments as initially designed). The decrease in the number of questionnaires did not affected the contents of the study. In fact, the opposite happened as the third and fourth questionnaires contained items that were not originally anticipated.

as to their participation. The main reasons for grouping the experts into two subgroups were: to verify if the similar perspective held by experts within their groups would yield consistent responses and to verify if the different position of the groups in the promotion process would reflect differences in opinion about the feasibility of potential projects and the degree of importance of the different project attributes. The group of insiders were composed of nine experts while the outsiders were seven.[11]

Each questionnaire was mailed out with a cover letter explaining the task at hand, providing a target date for the return of the answer sheets, and offering assistance (in case the experts had any questions). None of the experts required assistance to complete the questionnaires. Questionnaires Two, Three and Four were color coded to differentiate the different tasks to be performed. White pages contained questionnaire information and instructions. Yellow pages were the answer sheets. Blue pages provided feedback information and displayed responses given by each expert individually and by the group so that each expert could compare his/her answers with "group" answers.[12]

Ten days after the questionnaires were mailed out, letters were sent to make sure that the participants had received the questionnaires and to remind them of the task at hand. After 30-40 days another reminder letter was sent to those experts that had not yet responded. The study took approximately eight months — from May to December 1993, resulting in an average questionnaire cycle (i.e., preparation, mail, response, mail, analysis) of 60 days. The sequence and general contents of each questionnaire is presented in Table 1-7. Appendix B contains the four questionnaires in full.

1.6 Research Outline

Chapter 2 defines infrastructure project financing, presents the basic characteristics of privately-promoted infrastructure projects, discusses the benefits and shortcomings of using a private-sector promoting structure to develop and implement infrastructure projects, and examines the role played by the different project participants — including construction companies. It also considers the factors that lead private companies to participate in privately-promoted infrastructure projects, explores the actual procurement process of such projects, suggests procedures that might be used to enhance its quality,

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[11] As one expert could not participate in the whole study the group of outsiders was reduced to six members. From the thirteen experts that did not participate in the study, eight were insiders and five were outsiders. The experts that participated in the study provide a fair spectrum of viewpoints for this study. The non-participants had no specific reasons (other than their lack of time or their own evaluation as non-experts) to decide not to join the study and, therefore, do not represent a particular segment whose ideas are not represented.

[12] Needless to say that the blue pages were individually tailored to each one of the experts.

and presents the types of infrastructure that have the best potential to succeed through the use of concession and "privatization" arrangements.

Chapter 3 identifies the risks involved in the private promotion of infrastructure projects and suggests actions that can be used to reduce their potential impact and to allocate them to the different project participants. Chapter 4 reviews the theory behind multiattribute decision analysis and explores the concepts used to create the desirability model. Chapter 5 describes the desirability model and presents the results obtained from the questionnaires used in this study.

Chapter 6 presents the conclusion and recommendations of this study and lists future research directions. Appendix A provides worldwide indicators of the coverage and performance of selected infrastructure sectors. Appendix B contains the four questionnaires used to gather data from industry experts.

Questionnaire	Section	Contents
1	A	General information (study overview, concession financing fundamentals, examples)
	B	Introduction to the desirability model (company competencies, project attractiveness)
	C	Information assessment (evaluating the relative importance of model categories, classifying attributes into different model categories)
2	A	General comments
	B	The third level of the desirability model
	C	Information assessment (evaluating the relative importance of model attributes, evaluating the ease of use and the trustworthiness of the method used to acquire information)
	D	Follow-up on the answers provided in the first questionnaire
3	A	The use of value curves in the desirability model
	B	Assembling value curves
	C	The decision to pursue concession-financed projects
	D	Enhancing the procurement process of concession-financed projects
4	A	Validating the desirability model
	B	Determining the attractiveness level of a particular project
	C	The decision to pursue concession-financed projects (part 2)
	D	Enhancing the procurement process of concession-financed projects (part 2)
	E	Considering the types of projects suitable to be developed as concession-financed

Table 1-7: Sequence and Contents of the Four Study Questionnaires

1.7 Explanation of Terms

In other to facilitate the reader's path through the material, some fundamental terms used in this manuscript are defined below.

Construction Company Entity whose main activity is to provide construction services. In infrastructure project financing, it might also participate in the promoting team (active role).

Development Financing Process of financing a facility based on the host government's (principal's) financial strength and credibility and not on the project's potential to repay its loans through its revenues. Project funds are provided by development banks, international agencies, and export credit agencies.

Infrastructure Project Finance (IPF)

A method that relies on an infrastructure project's potential to produce the necessary cash flows, within a private-sector ownership period, to pay for loans and give a return on investment for project promoters (and investors) compatible with the risks they face during the different project phases.

The group of promoters form a new company, the owning company, to build and operate the project. Consequently project debt appears only on the balance-sheet of the "new-formed" company and not on the balance-sheets of the individual promoting firms. The new company is a "one-project" company with its own lenders and investors (independent from the promoting team).

Infrastructure project financing is a subset of project financing because it is specific to infrastructure facilities while project financing can be used to fund a variety of activities, besides infrastructure, such as the development of iron-ore deposits, the development of coal and oil reserves, and the fabrication of ships.

Insiders Experts that participated in the study carried out in this dissertation and whose affiliation suggested they would look at projects from the promoter's viewpoint (i.e., their companies could be viewed as an active member of the promoting team).

Investor Entity that commits capital to a project in order to gain profits (returns) commensurate with the risk profile of the

undertaking. Normally, investors infuse capital through equity instruments.

Lender Entity responsible for providing capital to a project through loans. In infrastructure project financing, lenders should be satisfied with the expected cash flows generated by the facility to obtain their repayment.

Outsiders Experts that participated in the study carried out in this dissertation and whose affiliation suggested that their major role would be to advise companies in their project participation (e.g., consultants).

Owing company Special-purpose company created by project promoters to develop, implement, and own a privately-promoted infrastructure project.

Ownership Period Amount of time the promoter operates a facility before transferring ownership to the principal. Projects can either have a finite ownership period (e.g., Build-Operate-Transfer (BOT) projects) or a perpetual ownership period (e.g., privatization).

Principal (Sponsor) Entity (generally a public agency) that gives a concession entitlement to a private enterprise to develop, finance, build and operate a facility. In case of a limited ownership period, this entity will get the right to own and operate the facility after the concession period expires.

Privately-Promoted Infrastructure Projects (PPIP)
This term refers to infrastructure projects that are developed, designed, constructed, operated, maintained and owned by a special-purpose company created by private-sector companies. These projects are financed through resources secured by lenders and investors based on the projects' future cash flows (i.e., use of infrastructure project finance techniques).

Project Financing Method used to finance a facility in which the lender is satisfied to look initially to the project's cash flows and earnings as the source of funds from which a loan will be repaid and to the assets of the project as collateral for the loan (Nevitt, 1979). Normally, a new company is formed to own the project. Hence, project debt appears only on the balance-sheet of the "new-formed" company and not on the balance-sheets of the individual promoting firms.

Promoter	Entity responsible for coordinating the financing, design, construction, operation and maintenance of facilities during the conceptual, design, construction and operation periods. After ownership is granted, promoters control and manage the facility and can be viewed as project owners. They also have equity participation in the enterprise through the infusion of capital. Depending on the nature of the project, participants in the promoting consortium may include utility companies, engineering firms, equipment and material suppliers, plant operators, construction companies and customers (offtakers) of the facility.
(Degree of) Recourse	The amount of guarantees lenders request from the project's promoters and/or principal to provide the necessary loans to finance the project. If the project is not backed by any guarantees, it is said to be a non-recourse project. If the project is supported by guarantees, but presents risky debt, than it is denominated as a limited-recourse project.
Tax-Based Financing	Process that involves the use of tax money and/or the issuance of government bonds to fund public projects.

2 Fundamentals of Privately Promoted Infrastructure Projects

"If human nature felt no temptation to take a chance, no satisfaction (profit apart) in constructing a factory, a railway, a mine or a farm, there might not be much investment merely as a result of cold calculation."

John Maynard Keynes
The General Theory of Employment, Interest and Money

2.1 Introduction

Infrastructure projects have been typically funded by one of the following two methods: tax/bond based finance and development finance. Tax/bond based finance involves the use of tax money and the issuance of government bonds to fund public projects. In the US, for example, tax money is used by the federal government to finance roads and other infrastructure projects while bonds are used by state and municipal governments to fund local projects. Normally, infrastructure bonds are granted tax-exemption and thus, reduce the borrowing cost of the states and cities that issue them (i.e., because this bonds are non-taxable, investors are satisfied with a return below that offered by comparable federal or corporate bonds).

Development finance refers to a process for funding projects owned or sponsored by the government where the project is located. Project funds are provided by development banks and agencies (such as the World Bank, and the European Investment Bank), export credit agencies, and commercial banks. The repayment of the loan provided for development is backed by the government's credit and commitment to honor its obligations, and does not specifically rely on the revenues produced by the project. Under

these methods, governments bear virtually all risks associated with infrastructure financing.

In the last few years, the shortage of public funds and other traditional sources (e.g., development banks and agencies) to finance new projects, contributed to the creation or resurgence of alternative forms of financing projects. For example, some governments, mainly in less developed countries, are using countertrade to pay for engineering and construction services (Yates, 1990). According to an ENR article,[13] 25% of all projects in some thirty countries have used countertrade to pay for their international purchases and more than fifty other countries use it from time to time. The basic premise of countertrade is the exchange of goods or services for the goods or services of others. For instance, a construction company might get paid in copper, instead of dollars or pesos, by a Chilean owner, for construction services provided on a particular project. Several US firms have been acquiring trading companies to market the goods they have acquired through countertrade with companies from other nations (ENR,[14] 1984; Yates, 1990).

This search for alternative financing promises to intensify as population grows, environmental regulation increases, and infrastructure ages creating high demands of capital spending. In the US, for example, the availability of federal grants for public works projects has been constrained by budget deficits, while the ability of state and municipal governments to finance construction through bond issues has been affected by changes in tax laws and limits on debt capacity imposed by law, political considerations, or capital markets (Beidleman *et. al.*, 1991). The Private Sector Advisory Panel on Infrastructure Financing to the Senate Budget Committee estimated that the shortage of infrastructure funds between 1988 and the year 2000 would be $240 to $488 billion nationwide with many localities already experiencing budget deficits (Lammie, 1988). Other estimates range from $30 billion (to simply recuperate the bridges and roads in the worst conditions) to $500 billion (to rebuild highways and airports and to help create digital data networks.)[15] According to the International Finance Corporation (IFC), developing countries will require more than US$ 3 trillion in new infrastructure over the next 10 years.[16]

Furthermore, apart from the lack of funding resources, there is an increased understanding on the part of some governments that they should not own and/or operate certain types of facilities and infrastructure because of their less effective utilization of resources when compared with the more flexible and cost conscious private sector, and because of political changes toward democratization and decentralization. Private

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13 "Financial Engineering Wins Jobs," ENR, August 2, 1984, pp. 30-35.

14 "Financial Engineering Wins Jobs," ENR, August 2, 1984, pp. 30-35.

15 "Rebuilding America: The Mind-Numbing Cost," Business Week, Special Issue: Reinventing America, 1992, pp. 196-198.

16 "Sharing the Risk," Worldwide Projects, Spring 1994, pp. 14-19.

enterprises can benefit from this situation by providing financial resources and managerial skills to increase their share of the infrastructure market. Infrastructure project finance presents a valid alternative to bring governments and private companies together in order to provide funding and expertise to finance, construct and operate new infrastructure projects.

2.2 Definition of Infrastructure Project Finance

Project financing is a term commonly used to describe the various methods that banks and institutional lenders use to finance new projects on a basis whereby payout is anticipated from the revenue stream generated by the project. It has been extensively used in the oil and mining industries since the 1930's when wildcatters used it to develop oil fields in Texas. Nevitt (1979, pp. 13) has defined it as:

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

Macmillan (1984) has given a similar definition. He states:

> *"[P]roject financing is the financing of a major capital project in which the lender looks principally to the cash flows and earnings of the project as the source of funds for repayment and to the assets of the project as collateral for the loan. The general credit of the project entity is usually not a significant factor, either because the entity is a corporation without other assets or because the financing is without direct recourse to the owner(s) of the entity."*

Stebbins (1979) illustrates the "project financing" concept with an example where a corporate officer approaches a lender saying:

> *"[L]ook, our profits and our retained earnings have not kept pace with our cost of doing business. We need your help in financing this project based on its own merits and without recourse to our other assets because we can no longer afford to pay for it out of our own cash flow or as a direct obligation of our company."*

Infrastructure project finance (IPF), a subset of project finance, is a term used in this research to refer only to infrastructure projects. It is defined here as:

> *[A] method that relies on an infrastructure project's potential to produce the necessary cash flows, within a private-sector ownership period, to pay for loans and give a return on investment for project promoters (and investors) compatible with the risks they face during the different project phases. The group of promoters form a new company to build and operate the project, the owning company. Consequently, project debt appears only on the balance-sheet of the 'new-formed' company and not on the balance-sheets of the individual promoting teams.*

Infrastructure project finance provides a means for projects to be privately promoted and financed, thus increasing the availability of construction funds, particularly for governmental bodies whose access to traditional sources of capital are constrained and allowing the provision of services to be enhanced as promoters operate and maintain the facility for a predetermined period of time. Arrangements and regulations should be used to facilitate the implementation of projects which are socially, politically and financially viable. They should ensure an attractive financial return for promoters and investors while safeguarding public interests and should not be seen as a magic black box which can turn non-viable projects into viable ones.

Some examples of privately-financed infrastructure projects are:

- *The 772 Km North-South Expressway, in Malaysia* — In this project, the concession was awarded to an engineering company, United Engineers (Malaysia), in 1988. They formed a new company called PLUS to design, construct, finance and operate the toll road during the 30-year concession period. The structure of the project is illustrated in Figure 2-1.

- *The 1.4-mile Sydney Harbor Tunnel in Australia* — This twin-bore tunnel was financed privately by an issue of $310 million in special 30-year institutional investor bonds and is being built for the New South Wales government by two development partners, a Tokyo-based contractor and an Australian civil engineering firm, which will receive the toll revenue from the tunnel for 30 years and then turn it over to government ownership (Lammie, 1988).

- *The Hong Kong Second Harbor Crossing* — The one-mile tunnel under Hong Kong Harbor connects the center of the city of Hong Kong with Kowloon in the New Territories and accommodates four lanes of vehicular traffic and two mass transit railway tracks, leased to the Mass Transit Railway Corporation. The project will be financed, built, and operated by a Japanese-led consortium (Lammie, 1988).

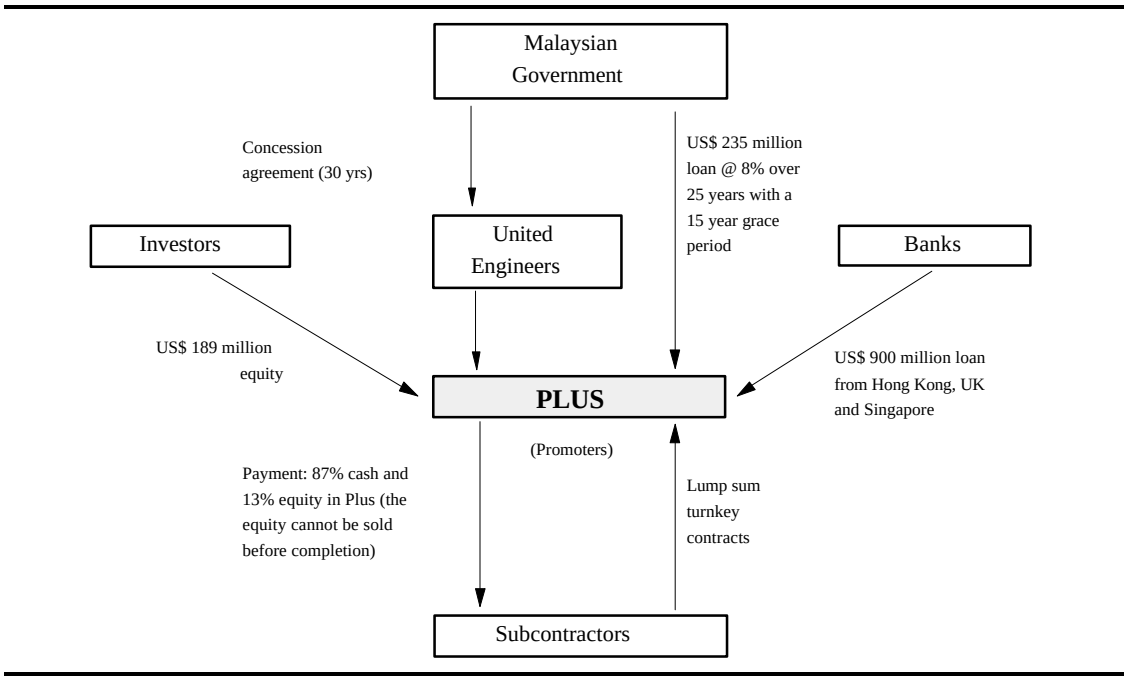

Figure 2-1: Example of a Concession Financing Project Structure (Adapted from Chan and Woodward, 1992)

2.3 Basic Characteristics of Privately-Promoted Infrastructure Projects (PPIP)

2.3.1 Project's ability to generate revenues

The basis of IPF is the project's ability to be sustained through its operational cash flows. Project revenue streams can be tied either to the market or to contracts. Market-led revenues come directly from a customer using the service (e.g., tolls from a bridge) while contract-tied revenues are revenues of a service which is not directly delivered to a specific consumer but through an intermediary, generally a public-sector operator (e.g., power generation and water treatment systems).

It is important that the revenue streams are predictable and, if possible, partially or totally supported by revenue guarantees and long-term production contracts so that project returns and loan repayments become more "secured." For instance, in the Channel Tunnel project, "rail-usage" contracts, for trains traveling from and to locations other than the tunnel terminals, provide 40% of the expected total revenues during the first 12 years

of operation. Thus, the arrangement of long-term "rail-usage" contracts established a guarantee for loan repayments.

2.3.2 Creation of a special-purpose company

Under an IPF arrangement, the project promoters create a new private company, referred to as the "owning company," that is responsible for arranging the finance, construction, and operation of the project facility and which retains ownership through a certain period of time.

An owning company is a "one-project" company with its own lenders and investors. Its creation as a separate entity is of great benefit to project promoters because it allows them to raise debt without providing a portion of their own assets as collateral. That is, the revenues of the project are the only source to repay the debt. In the case where the project does not produce enough revenues to fully repay the debt, the lenders receive only a partial payment of the debt obligations and do not have any rights to demand full payment from the promoters.[17] This type of financing is known as "off-balance-sheet financing" because the debt raised to fund the project is not secured by the promoters, and hence it does not appear on their balance-sheets, but only on the balance-sheet of the owning company. Another advantage of the owning company is that as a local entity in the host country it, most likely, fulfill government ownership requirements.

2.3.3 Nature of ownership

The amount of time in which a private-sector company — the owning company — owns and operates a project is defined as the ownership period. This period can be either finite or perpetual.

In a finite ownership period, the host government provides a concession that permits an owning company to build a facility and to operate it for a specific amount of time, the concession period. Project promoters use the revenues produced during the concession period to pay back lenders, shareholders, and to get a return on their investment. After the concession period has elapsed, the ownership and operation of the facility together with its revenues are transferred to the host government that infused, at the time of construction, no or few monetary resources. BOT (Build-Operate-Transfer) projects fall under this category. Table 2-1 shows a list of BOT projects worldwide.

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[17] The financial risk faced by promoters and investors would be limited to their specific investment level. The balance of the financial risk would be allocated between lenders and the host government.

Country	Type of project	Cost (US$ millions)	Concession period (years)	Completion date
Malaysia	road	8.0	25	1986
Malaysia	road	32.0	9	1988
Malaysia	water supply	127.0	13	1989
Hong Kong	road	256.0	30	n/a
UK	bridge	310.0	20	n/a
Hong Kong	tunnel	436.0	30	n/a
China	power station	517.8	10	1987
Australia	tunnel	550.0	35	1992
Thailand	expressway	880.0	30	n/a
Turkey	power plant	1000.0	n/a	n/a
Turkey	power plant	1300.0	n/a	n/a
Malaysia	expressway	1800.0	30	1995
Thailand	subway	1800.0	30	n/a
UK/France	tunnel	12000.0	55	1994

Table 2-1: Selected BOT Projects (Source: Tiong, 1990a and Tiong *et. al.*, 1992)

In a perpetual ownership period, the project should also produce revenues from its cash flows to cover debt, operation and maintenance costs and to return profit gains to project promoters and investors. However, promoters have an unlimited amount of time to operate the facility as well as full ownership of the underlying assets. This model of project development is a privatization effort where financing, design, construction, operation, maintenance, and ownership of infrastructure facilities is transferred from governments to the private sector.[18] Projects that are suitable for this type of arrangement include: transportation projects (i.e., roads and bridges), energy related projects (i.e., power generation facilities), water treatment plants, waste management plants, correctional facilities, stadiums and convention hotels. Actual examples of such projects are some power plants being constructed and operated in the UK by private utility companies. BOO (Build-Operate-Own) projects fall under this category.

The choice between using a perpetual or a finite ownership period depends on whether the host government desires to regulate private sector involvement on an infrastructure service through regulatory agencies or through contractual agreements. Where a competitive environment allows free entry, the economic environment is stable, private-sector ownership is possible and a continuing subsidy is not necessarily required, private

[18] Seader (1989) mentions the design-construction-financing-operation of facilities by a private sector organization for public use as the most common type of privatization in the United States.

sector involvement would only require regulation to ensure fair business practices and to protect health, safety, and the environment. Hence, a perpetual ownership period (privatization) could be used. Where unlimited private-sector ownership is not possible and the economic environment is less certain, detailed agreements are necessary to define obligations and guarantees in a case-by-case basis, and a finite ownership period is more appropriate.

Principal components of an ownership arrangement include:

- The scope of facilities to be provided and the timing of the provision of the facilities,
- Regulatory/tariff structure,
- Design standards,
- Complete extent of the responsibility for the operation (including acceptable levels of performance and safety),
- Social obligations of the owning company,[19]
- Environmental protection,
- Military considerations,
- Relevant legal system,
- Provisions for arbitration, and
- Ownership period.

In some cases, provisions related to an early transfer of ownership are also included in the arrangement. The two main options are: (McCarthy and Perry, 1989)

- *Early Buy-Back* — This provision allows the principal to buy the promoters out before the end of the ownership period giving the principal an extra degree of control.

- *Early Termination by Negotiation* — This provision is mainly used to release promoters of unprofitable long-term contracts due to large service price variations.

2.4 Project Participants

Privately-promoted infrastructure projects contain several different participants. This section examines the role played by the principal (sponsor), promoters, lenders, investors, and others in the process while the next section looks specifically at the involvement of construction companies.

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[19] Some governments use “golden shares” to hold veto rights on the owning company. They do this to ensure that the policies of the company are in conformity with national policies and objectives.

2.4.1 Principals (Sponsors)

Principals are public entities, normally the host government, that provides a concession to the private sector to finance, build, operate and own an infrastructure facility. According to Augenblick and Custer (1990), the principal (i.e., the host government) is the most important participant in a privately-promoted infrastructure project. It plays an essential role throughout the project life by:

- Authorizing the project in the first instance,
- Creating special legislation to regulate the project,
- Providing political stability,
- Providing information that allows the private promoters to evaluate the project viability,
- Elaborating the necessary agreements,
- Arranging the necessary project guarantees, and
- Making timely decisions.

The host government must be able to provide a politically stable environment and an appropriate regulatory framework in order to attract private companies to promote local projects. Therefore, it needs to demonstrate its ability to maintain continuing support over the life of the project and to deal with the opposition (often formed by political adversaries and by public sector companies that would otherwise construct and operate the project — transit authorities, public utilities, public works administration, etc.). It also needs to have authority to ascertain the use of the existing law and to modify or create appropriate regulations and legislation for the development and implementation of privately-promoted projects (e.g., legislation to authorize the private ownership and operation of power plants, roads, airports, and other facilities that would often involve government monopoly, labor laws that allow the promoting company to hire and fire employees at a reasonable cost, tax and repatriation of funds laws and policies).

Apart of the regulatory and political support, the host government should also be prepared to share some of the project risks.[20] This is because infrastructure projects present the private sector with a high level of risk, as these projects typically involve large capital outlays, lengthy construction periods, slow build up of revenue over time, slow asset depreciation, and little value in alternative use. Risk sharing alternatives include situations where the government assumes force majeure risks that cannot be reasonably covered by insurance, and also cases of government co-financing where the government commits itself to provide funds for the project. There are several mechanisms for government co-financing including:

- Purchasing “shares” or bonds of the owning company,
- Providing subordinated debt and standby loans,

[20] Chapter 3 discusses project risks and risk sharing alternatives in greater detail.

- Seeking the lender's consent to defer or even restructure the debt,
- Providing guarantees on revenues (i.e., purchase agreements where it agrees to pay the project owning company a specific amount regardless of whether the project service is used or not),
- Providing guarantees to the owning company on interest rates and exchange rates,
- Advancing payments of future service purchase (e.g., power supply),
- Transferring existing infrastructure to the owning company free of charge,
- Sharing revenues of existing public infrastructure facilities (e.g., Sydney Harbor Tunnel and the Bangkok Second Stage Expressway),
- Granting land rights (e.g., shopping centers on freeway exits of the Guangzhou-Shenzen highway in China),
- Limiting competition from others (e.g., "no-second-facility" guarantee),
- Allowing the owning company to increase service prices, and
- Extending the ownership period.

Government guarantees and other co-financing alternatives are not always necessary. They make sense only when they can bring the level of project risks to a level that is compatible with the potential rewards the project might bring, thus attracting the interest of promoters and investors. For instance, in the North-South Expressway, the Malaysian government provided the following guarantees: (1) additional finance to the venture if there is a drop in traffic volumes in the first 17 years of operation, (2) a zero-cost take-over of an existing expressway that generates US$ 1.6 million per month in tolls for the promoters, (3) maximum levels for interest and exchange rates, and (4) the establishment of toll rates for cars as follows: until 1992: US$ 0.05/km; up to 1995: US$ 0.075/km; 1995: US$ 0.10/km; after 1995: linked to consumer price index (Chan and Woodward, 1992).

The main idea is that in order to have a successful privately-promoted infrastructure project, the host government must want the project, avoid bureaucratic interference with its development and operation, provide the necessary guarantees and financial support, and be fully committed to it over the long haul; a half-committed government is not sufficient to ensure project success.

2.4.2 Promoters

The main task of project promoters is to use their private management expertise to coordinate the various parts involved in the process during different phases of the projects so that efficient infrastructure services can be provided. They create a new entity — the owning company — to perform financial and technical feasibility studies; negotiate the necessary agreements with the project principal; arrange the required financing with investors (equityholders) and lenders; develop community acceptance programs, study and report on environmental issues, coordinate the engineering and design efforts, build (or select the company to build) the facility, operate and maintain the facility (or contract

third parties to do so), make loan payments to lenders and distribute dividends to equity investors.

Their decision to invest capital, time and effort in infrastructure projects is based primarily on the project's potential to generate revenues and on the local government's commitment to put the project in private hands, to conclude the deal, and to continue to provide a business and political climate that makes it possible for the promoters to own and operate the project profitably (i.e., projects with low commercial and political risks).

Operators are the most natural choice for promoting infrastructure projects. This is because they are capable of owning and operating the facility and should be able to coordinate and control the design, finance, and construction of the project. Other potential project promoters include: construction companies, engineering and design firms, equipment and material suppliers, operators and financial institutions.

2.4.3 Lenders

Private and public lenders provide debt financing to infrastructure projects. Some of the private debt sources are: commercial and investment banks, institutional investors (e.g., insurance companies and pension funds), commercial financing companies, leasing companies, investment management companies and money market funds. Public sources include: the World Bank, the European Investment Bank (EIB), the Export-Import Bank of the US, the Export Credit Guarantee of the UK and government financing agencies.

In a nonrecourse infrastructure project, lenders have no guarantees that debt repayment will occur in full as their source of repayment comes from the revenues generated by the project, or in case of project failure, from the value of the project's assets. The exposure faced by lenders in such projects is completely different than the one they face when financing nonrecourse commercial projects. Lenders consider themselves adequately secured with the latter option as their right to foreclose the facility and equipment provides enough collateral for the loan. However, the same cannot be said for the former where the value of an unfinished road or a non-operational power plant has little market value if any. As a result, few projects are financed in a purely non-recourse basis, the most notable one being the Channel Tunnel between France and England.

The key issue for lenders of privately-financed infrastructure project is finding ways to protect, and recover their loans (i.e., proposing mitigating strategies to deal with financial and political risks). Security devices, such as guarantees and covenants, are used to limit the lenders' exposure. Project guarantees are normally provided by the host government as it assures the performance of certain conditions. For example, guarantees on revenues assure lenders that a minimum amount of revenue will be generated by the project independently of its actual usage rate. One of the few guarantees not provided by the host government is the guarantee of project completion. Lenders try to fulfill this requirement

by forcing the promoting company to negotiate a turnkey contract with the construction companies responsible for building (expanding) the project facility.

Covenants are agreement clauses used to secure certain project provisions and to establish some rules. For example: (1) the utilization of an escrow account to cover debt obligations by paying lenders before project earnings are distributed to equityholders, (2) the establishment of seniority among the different debt issues, and (3) the form of revenue distribution in case of the project failure. Chapter 3 provides examples of several types of guarantees and covenants.

It is obvious that the financing of non-recourse and limited-recourse projects is riskier to lenders than conventionally financed projects. Consequently, in order to fund those projects, lenders demand interest rates that are higher than those in conventional loan markets. In 1993, interest rates for privately-financed infrastructure projects ranged from "LIBOR + 2.5%" to "LIBOR + 3.75%" depending on the project characteristics.[21] Table 2-2 illustrates the interest rates charged by private lenders when funding project financing deals.

Type of Project	Average Rate*	Spread
Domestic Dollar Financing		
Nonrecourse	16.67%	4.67%
Covered by guarantee of completion	15.79%	3.79%
Covered by continuing undertaking	15.53%	3.53%
Eurodollar Financing		
Nonrecourse	None	
Covered by guarantee of completion	12.55%	1.55%
Covered by continuing undertaking	12.25%	1.25%

* All rates computed using the following assumptions:

a. Prime rate assumed to be 12% on the date the loans were negotiated for the life of loan on domestic dollar financing.

b. London Interbank rate (LIBOR) assumed to be 11% on the date the loans were negotiated for all Eurodollar financing.

c. All fixed-rate financing are related to the prime rate on the date the loan was negotiated. The average rate is computed by using the same spread over a 12% prime as the fixed rate was over prime on the date the loan was negotiated.

Table 2-2: Comparison of the Average Interest Rates Charged in Project Financing Deals (Source: Castle, 1975)

[21] Private conversation with few lenders that have provided funds to privately-financed infrastructure projects. Note: LIBOR refers to the London Interbank rate.

2.4.4 Others

Equity investors infuse cash to the project by buying equity shares. Some potential equity investors are: project promoters, institutional investors, corporations, investment and commercial banks, utility subsidiaries, local investors and developers, international agencies such as The World Bank and area development banks, government export financing agencies (i.e., Export-Import Bank), and suppliers and contractors. The participation of local investors and developers is important not just on the financing of the project but also on its management and operation, as they can help project promoters to better understand the local environment, better deal with the host government, better resolve local issues as they arise, and provide needed logistical support during the development stage of the project.

Suppliers might promote infrastructure projects as a means of selling goods for the project and services. For example, General Electric Power Funding Co., a unit of GE Capital, provides financing and development assistance for certain projects using GE equipment (ENR[22], 1992). Similarly, contractors might promote projects as a way of getting new jobs. (See next section for a more detailed discussion about the participation of contractors in such projects.) However, the lack of a secondary market (i.e., a market in which one can buy or sell securities) for project-finance instruments limits the investors' liquidity and the ability of suppliers and contractors to participate in the financing. Often, suppliers and contractors may invest in a project through provision of goods or services. In Malaysia's North-South Expressway, for example, subcontractors receive 87% of their payment in cash and 13% in form of project equity. This equity cannot be sold to third parties before the completion of the project (Chan and Woodward, 1992).

Obviously, some project participants only provide their services and do not have any interest in the financing schema per se. Possible examples of such participants are: insurance companies, CM companies, subcontractors, designers and architects.

2.5 The Involvement of Construction Companies

Traditionally, engineering-construction companies provide services in areas such as feasibility and technical analysis, procurement and construction. The need to provide financial assistance has not been usual because most project owners have had their own source of funds, have had sufficient lines-of-credit in banks or have had access to capital markets to raise the necessary funds for the project's construction. However, a more

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22 "Money is Out There For Projects That Make Lots of Sense," ENR, May 04, 1992, pp. 24-28.

competitive construction market — a result of a decline in project demand[23] coupled with the growth in the number of companies that developed the capability of designing, managing and constructing complex projects — and an increase in owners giving preference to engineering and construction companies that include financing plans in their proposal (ENR[24], 1983) has been pushing contractors to broaden the scope of their services into areas of project development other than the basic areas of engineering, procurement and construction. These services include: project conception, project financial analysis, and the arrangement of financing (including equity participation and commercial structuring). Many large construction companies have started capital subsidiaries to put financing deals together and to take equity positions in projects designed or built by their partners or even projects proposed by others (ENR[25], 1992). Bechtel Financial Services, for example, has raised US$ 8 billion in financing in the last decade. One billion dollars was for projects in which Bechtel has taken equity positions in the past five years (mostly domestic power plants) (Worldwide Projects[26], 1993).

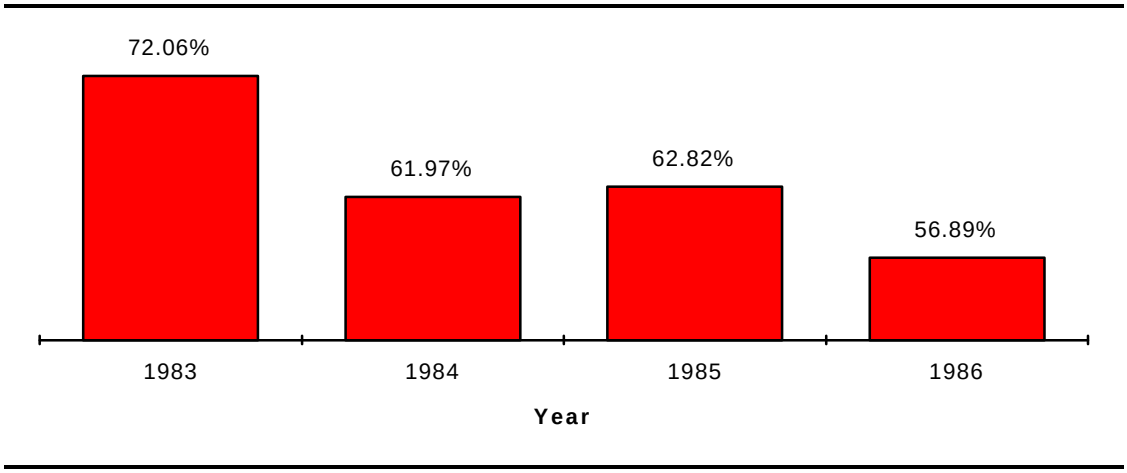

Figure 2-2: International Contract Awards as a Percentage of the Contract Value Conferred in 1981 (Source: US Department of Commerce, 1989)

Several construction companies have taken the major role in the promotion of several projects. When privately-promoted infrastructure projects began to emerge during the

23 According to a report entitled *A Competitive Assessment of the US International Construction Industry* (US Department of Commerce, 1989), the value of international construction contracts awarded in 1986 was $73.9 billion. This represents only 57% of the contract value conferred in 1981 ($129.9 billion). Figure 2-2 displays the international contracts awards, from 1983 to 1986) as a percentage of the value of contracts conferred in 1981.

24 "The New Alliance - Bankers & Construction," ENR, January 27, 1983, pp. 22-23.

25 "Money is Out There For Projects That Make Lots of Sense," ENR, May 04, 1992, pp. 24-28.

26 "The Bechtel Edge," Worldwide Projects, Autumn 1993, pp. 12-16.

mid and late 1980's, contractors felt the opportunity to obtain new contracts while controlling construction prices would allow them to become "their own masters." They believed the requirement of an equity investment with long-term returns could be resolved by including part, or even all, of it in the construction price (Joosten, 1993). Examples of projects that had construction companies in a leading role are shown in Table 2-3.

Project	**Project Cost (US$ * 10^6)**	**Concession (# years)**	**Country**	**Main Project Promoters**
Sydney Tunnel	550	35	Australia	Kumagai Gumi and Transfield
Dartford Bridge	310	20 (max)	England	Trafalgar House
Eastern Harbour Crossing	436	30	Hong Kong	Kumagai Gumi
Tate's Cairn Tunnel	256	30	Hong Kong	Nishimatsu
Second Stage Expressway	880	30	Thailand	Kumagai Gumi
Eurotunnel	12,000	55	UK and France	10 UK and French contractors and banks

Table 2-3: Examples of Projects That Had Construction Companies in the Leading Role of the Promoting Team (Source: Tiong *et. al.*, 1992)

However, the participation of construction companies as providers of construction services and as members of the promoting team did not, in several cases, provide the expected returns and many contractors decided not to pursue the promotion of projects further. There are three major reasons for this nonsuccess. The first reason is related to the high upfront costs, long negotiation periods, and uncertain outcomes. The costs of preparing proposal for these projects are high because of the necessity to do preliminary design, to perform feasibility studies, and to arrange the necessary financing. The evaluation of different proposals and the search for the right allocation of risks between the government and the potential promoters have proven to be a difficult process and have resulted in long periods of negotiation. A better structured, less expensive, and shorter procurement process together with strong government support would undoubtedly help potential promoters (including construction companies) in their quest for new project opportunities.

The second reason is related to the apparent conflicting roles faced by the construction companies. This is because as contractors responsible for the construction of the facility construction companies might favor a more expensive project but as promoters they would not.

The third reason is the lack of expertise and/or desire contractors have to operate the facility and their preference to have a way-out after the project is built. The Channel Tunnel is a prime example where the contractors wanted to build the tunnel, the lending

institutions wanted to lend to the project but neither of them wanted to own and operate the project (Stannard, 1990).

The initial euphoria of construction companies has disappeared and only a few major contractors have remained seriously active in this field. Among them, Morrison Knudsen (US) and Phillip Holzmann (Germany). Morrison Knudsen (M-K) is participating in projects such as: the 8.2-mile-long bridge connecting New Brunswick and Prince Edward Island in Eastern Canada where M-K and others in a consortium will finance, design, build and operate the facility for 35 years; the Buenos Aires rail transit project where M-K is part of a consortium that operates and maintains three commuter rail lines and the city's subway system; and the fast-speed train in Texas.

Phillip Hollzmann has a department — the Infrastructure Project Development Department (IPDD) — to specifically analyze the viability and financial feasibility of privately-financed infrastructure projects from the investors' perspective. Current projects under study and/or negotiation (as of 1993) at IPDD include:

- A tolled highway (D5) in the Czech Republic,
- A highway network in the Republic of Slovenia,
- The Fehmarn Belt Crossing between Germany and Denmark,
- The Second Tagus Bridge in Portugal,
- The western bypass of Lyon,
- The Semmering Tunnel in Austria,
- The Ferihegy Airport project in Budapest, and
- Environmental projects in Germany (e.g., waste treatment facilities, soil cleaning facilities and sewage treatment plants.)

2.6 The Financial Structure

Privately-promoted infrastructure projects are funded through a combination of debt and equity capital. Debt is provided by lending and investment institutions. The use of debt is essential to fund infrastructure projects because promoters rarely have all the necessary financial resources. Equity represents the injection of risk capital into the concession company. It can be provided through public share issues or private placements. Few projects have been financed through public share issues. Two examples that have are the Channel Tunnel in the UK and the North-South Expressway in Malaysia.[27] Potential sources to acquire equity through private placements are companies that have an interest

[27] These two examples illustrate the idea defended by some experts that, nowadays, a project really has to be of national significance to be able to attract public shareholders.

in the project (i.e., the promoting companies), companies that view the project as an investment opportunity (e.g., pension funds) and, occasionally, the host government.

There are two major advantages for having equity investments in an infrastructure project (as opposed to 100% debt financing). The first is flexibility to accommodate the financial needs of the project. This is because debt instruments present rigid payment dates and amounts and do not normally offer large grace periods while equity dividends are paid based on the availability of funds. The second is to ensure commitment from the promoting team. Typically, lenders are not completely familiar with the design, construction and operation details of the project and feel more comfortable with the technical feasibility and potential performance of the project when promoters infuse equity into the project. This is because promoters having an equity stake would not only take the project to get new business and would be more likely to spend time and effort to solve problems rather than just walk away from them.

In order to compensate for "higher risks," equityholders demand a return on their investment higher than that required by debtholders (lenders). Equityholders receive dividends from profits if the company is successful but do not get anything if it loses money.[28] As equityholders normally rank last in the order of repayment, they are very likely to lose their investment if the owning company enters a "bankruptcy stage" and is liquidated. According to Flynn,[29] in order to encourage the private sector to participate in the finance of infrastructure projects, after-tax return on equity[30] should be around 20-25% for power-plant projects and 15-20% for transportation projects. According to Khan (1991), potential equityholders are looking at 13-15% after-tax yields on the "safest projects." Table 2-4 shows a few return-on-equity figures for privately-financed infrastructure projects.

The percentage of equity used to finance concession-financed projects usually ranges from 10 to 30% of project costs (Augenblick and Custer, 1990 and World Bank Report, 1994). Nevertheless some projects have had equity infusions out of this range. For example, the finance package of the Dartford Bridge (UK) was composed of nearly 100% debt. (There was a nominal equity infusion of £1000.) Dias (1994) discusses the debt capacity and the optimal capital structure for privately-financed infrastructure projects under market equilibrium conditions. (This is also shown in Dias and Ioannou (1995).)

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28 The presence of profits is not sufficient for dividends to be paid out as the servicing of debt in the majority of cases has priority over dividend payments. That is, dividends can only be distributed after the debt claims have been met.

29 Private conversation with Ms. Ruth Flynn, Managing Consultant, Touche Ross (UK).

30 The return on equity is the discount rate that equates the present value of equity investments to the present value of annual residual cash flows after debt amortization, interest and income taxes.

Project	Country	Return on Equity
Chesapeake Bridge	United States	5%
Sydney Harbour Tunnel	Australia	6%
Paris-Cologne fast train (TGV)	France and Germany	6-11%
Channel Tunnel	UK and France	10-20%
North South Expressway	Malaysia	12-17%
Gazi Power Plant	Turkey	16%
Labuan Water Supply Project	Malaysia	18-20%
Hab River Power Project	Pakistan	18-23%
Bangkok Second State Expressway	Thailand	21%

Table 2-4: Return on Equity for Selected Privately-Financed Infrastructure Projects (Sources: Chan and Woodward, 1993 and Worldwide Projects, Spring 1994)

A survey published by Public Works Financing (October 1993) provides information on 148 infrastructure projects that had been privately financed since the early 1980's on a stand-alone, limited recourse basis. Transportation projects, mainly toll roads, were clearly the most funded type of projects accounting for 60% of the total amount of projects financed, power and water related projects accounted for 29% (i.e., 13% and 16% respectively). The total cost of these projects is more than US$ 60 billion. Developing (low and middle income) countries have been responsible for 57% of the projects surveyed while accounting for 46% of the total cost. Mexico stood out with the largest number of limited-recourse projects. The pipeline of projects under serious consideration is substantial, some 358 projects with an approximate estimated total cost of US$ 235 billion. According to this survey, the countries of East Asia and the Pacific Rim are expected to be the biggest users of concession-financed projects in the next 10 years. The region has 150 projects in the pipeline, with an estimated total cost of $114 billion. Table 2-5 shows the number of funded projects as well as projects in the pipeline, and their total and average value for high-, middle-, and low-income countries. Table 2-6 displays the percentage of projects funded under different infrastructure sectors.

It is interesting to note that although low- and medium-income countries have smaller coverage of infrastructure services than high-income countries (see Table 2-7), it has not been easy to attract financing for their infrastructure projects. According to the International Monetary Fund's 1992 annual report, only US$ 20 billion of the US$ 14 trillion (i.e., 0.14%) available for investment to professional management such as pension, insurance, and mutual funds in the US, Canada, Germany, France, and United Kingdom was invested in developing countries' infrastructure. From this amount, US$ 15 billion went to Latin American infrastructure projects, US$ 4 billion went to Australia and East Asia, and US$ 1 billion went to the rest of the developing world. Two thirds of the US$ 20 billion was in project debt financing, the remaining one-third was in equity. Virtually all developing-country infrastructure projects that have tapped into the public capital

markets for debt financing are operating projects — not works under construction or in the planning stages. The main difficulties encountered to attract financing for developing-country infrastructure projects are:

- A history of government mismanagement,
- The difficulty of placing developing-country infrastructure bonds,
- The prevalence of country and financial risks, and
- The lack of capital markets providing long-term debt.

Country group	Number of projects		Total value of proj (US$ billion)		Average value of proj (US$ billion)	
	Funded	Pipeline	Funded	Pipeline	Funded	Pipeline
World	148	358	63.1	235.4	.44	.71
High income	64	107	34.3	112.0	.54	1.05
Middle income	77	179	25.7	77.1	.33	.43
Low income	7	72	3.1	46.3	.44	.64

Table 2-5: Infrastructure Project Financing for Projects Funded and in the Pipeline (Source: Public Works Financing, October 1993)

Country group		Percentage distribution of projects				
	Number of projects funded	Power	Transport	Water & environ.	Telecom	Other
World	148	13	60	16	2	10
High income	64	8	48	25	2	17
Middle income	77	16	69	10	3	3
Low income	7	29	57	0	0	14

Table 2-6: Project Financing of Funded Infrastructure Projects, by Sector (Percentage) (Source: Public Works Financing, October 1993)

Indicators	Low-income economies	Middle-income economies			High-income economies
		Reforming	High-growth	(socialist) transition	
Coverage of infrastructure					
Main lines per thousand persons	3	73	122	95	475
Households with access to safe water (%)	47	76	86	95	99
Households with electricity (%)	21	62	61	85	98
Basic indicators					
GNP per capita, 1991 (US$)	293	1,941	3,145	2,042	20,535
GNP per capita average annual growth rate, 1980-91 (%)	-0.2	-0.6	5.0	1.0	2.0
Population average annual growth rate, 1980-91 (%)					
Urban	6	3	4	1	1
Total	3	2	2	0.3	0.5

Table 2-7: Country Infrastructure Coverage According to Level of Country Income (Source: World Bank Report 1994)

A recent important development for the success of privately-promoted infrastructure projects is the involvement of multilateral development agencies, such as the World Bank, the European Bank for Reconstruction and Development and the Asian Development Bank, in the process. Their involvement is very helpful because of the financial community's understanding that these agencies can reduce project risks. For instance, they can facilitate the private financing of projects by providing country-risk insurance for lenders and investors to cover their investment,[31] advising countries on ways to improve their investment climate, lengthening the maturity of the project loans, and providing stand-by financing or subordinated debt.[32]

Infrastructure companies and projects add to the supply of long-term securities on the capital market. Another important development is the creation of demand for such long-

[31] The World Bank — under the Extended Cofinancing Facility (ECO) — has issued guarantees to cover sovereign risks associated with infrastructure projects, improving developing country access to international capital markets. This facility has been used for the Hub River Project in Pakistan and a thermal power project in China. The Multilateral Investment Guarantee Agency (MIGA) — another World Bank affiliate — has also provided guarantees for several infrastructure projects. (World Bank Report, 1994)

[32] Officials at the Inter-American Investment Corporation (IIC), an offshot of the Inter-American Development Bank (IDB), have recommended that 5-10% of the bank's lending to be directed to private infrastructure, without government guarantees. ("Comeback at the IDB," Worldwide Projects, Summer 1993, pp. 6-11)

term securities.[33] Pension funds and insurance companies appear to be good candidates to acquire these securities as they have steady and predictable cash inflows, incur long-term liabilities, and are looking for alternative risk diversification possibilities. Specialized infrastructure funds could play a main role in this regard as they would get resources through investors. For example, an investor with little interest in participating in a specific power-plant project in Brazil might participate in a fund that invests in a portfolio of worldwide power-plant projects. In India, for example, the new and innovative Infrastructure Leasing and Financial Services aim to sell their loans to private financial institutions once project credit histories have been established. They also plan to package securities from different projects and to offer shares of these packages to investors (World Bank Report, 1994).

2.7 The Private Promotion of Infrastructure Projects

2.7.1 Factors That Lead Private-Sector Companies to Pursue the Promotion of Infrastructure Projects

Governments worldwide have asked private companies to design, finance, build, own, and operate infrastructure facilities. Several private companies have accepted the challenge and started procuring and promoting infrastructure projects, but why? Some construction companies, for instance, believed that if they could obtain new contracts while controlling construction costs, they would create a "win-win" situation as they would be seating on both sides of the negotiation table. However, they soon found out that the promotion business was not so easy because the procurement process was very expensive and long, and also because, after the construction was finished they would become project operators, and would not have an easy way out.

Parts of the third and fourth questionnaires were used to identify and evaluate the factors that would contribute to the potential promoter's decision to pursue the promotion of infrastructure projects. Questionnaire Three provided a list of possible reasons and asked the respondents to use a nine-point scale[34] to describe the level of importance (effect) such factors had on the promoter's decision. It also provided space for respondents to include additional factors. Questionnaire Four had a compiled list of the suggestions offered in the previous questionnaire and asked respondents to evaluate them using the same nine-point scale.

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33 Today, there are virtually no sources of financing for securities with duration larger than 10 years.

34 On this scale "1" means EXTREMELY LOW level of importance (effect) and "9" means EXTREMELY HIGH level of importance (effect).

In total, twenty-four suggestions were considered. They were divided in two basic groups: financial and managerial. The six financial-related suggestions take into account the monetary elements that encourage the private-sector companies in their decision to promote in infrastructure projects. The eighteen managerial-related suggestions consider how strategic, market, operational, and political issues contribute to the private-sector participation.

In the "insiders" group, the most important factor to participate in the promotion of infrastructure projects is financially related, the **possibility of long-term income**. Six of the next eight most important factors are managerial related, they are basically pertaining to market conditions (competition) and strategic issues. The factor "seeking contractor, project management, or operator role" is placed high in the list despite the fact, previously mentioned, that many construction companies have decided not to pursue the promotion of infrastructure projects anymore. The rationale for that is that either most of the construction companies represented in this study are indeed accepting the idea of operating the infrastructure facility after the end of the construction, or they are getting associated with established operators. The idea of leaving the promotion team at the beginning of the operating phase and cashing out their gains, does not seem to carry as much weight because the "possibility of having a long-term source of income" received a higher ranking. The relatively low scores received by "need for work" and "only mechanism under current regulatory conditions" coupled with the high scores obtained by long-term strategies suggest that "insiders" do not consider the private development of infrastructure projects a short-lived business endeavor but a lasting one.

In the "outsiders" group, the most important factor is also financially related, the **return on equity investment**. "Seeking contractor, project management, or operator role" appears in second place. Five of the next six most important factors are also managerial in nature. Market conditions and possible company competitive advantages (e.g., unique know-how and strong image) constitute their basic characteristics.

It is interesting to note that even though "insiders" and "outsiders" had a financial factor as the one most important for their decision to pursue infrastructure projects, their factors differ from one another. The "insiders" placed great importance on the possibility of having a long stream of income while the "outsiders" were more concerned about the quality of the investment. Another point worth mentioning is the very low scores (from both "insiders" and "outsiders") obtained by "access to new markets" and "diversification of line of business." This suggests that companies pursuing infrastructure projects, while expanding their business, should stick to their specialty. The risks involved in these projects are already too high, companies should not experiment with projects or technologies that they do not hold expertise on. Table 2-8 shows, for "insiders" and "outsiders," the average and the standard deviation values for all 24 suggestions considered. The financial and managerial factors are sorted, in descending order of importance, by the responses given by the insiders.

2.7.2 The Creation of the Project Owning Company

The creation of an owning company is very important to promoters as it allows them to benefit from off-balance-sheet financing and forms an independent private entity that can use its managerial, technical, and entrepreneurial skills to develop, design, build, own and operate an infrastructure project. This company is responsible for project development, detailed design, finance arrangements, government negotiations, construction, procurement, operation, and ownership, and should be formed at an early stage as its creation helps the promoters to: (Augenblick and Custer, 1990)

- Elaborate an arrangement to share the development costs with the members of the promoting team, and

- Negotiate with the various parts that will be involved with the project (e.g., the host government, construction contractors, suppliers, operators, lenders, insurers, and other equity investors.)

The amount of time, effort, and money that is spent by potential promoters to create the owning company and to engage in the development of a proposal for a privately-promoted infrastructure project is enormous. Several promoting teams have committed substantial resources to complete detailed feasibility studies, designs, and to hold negotiations with lenders, investors, contractors and suppliers without being able to materialize a deal. It is unrealistic to think that potential promoters will keep spending a large amount of resources if they do not feel confident about the integrity of the process and their chance of success. Therefore, it is vital that the procurement process is sound, orderly and streamlined to ensure the participation of potential promoters and to increase the likelihood of success in future contracts. The next section highlights some important issues about the procurement process and suggests procedures that might enhance its quality.

		Insiders (G1)		Outsiders (G2)		Rankings	
		Avg	St Dev	Avg	St Dev	G1	G2
	Financial-Related Issues						
a	Possibility of long-term income	7.11	1.76	6.17	1.47	**1**	12
b	Project cash flows (“extra income”)	6.44	2.19	7.00	1.55	**5**	**4**
c	Return on equity investment	6.00	2.55	7.83	0.75	7	**1**
d	Excess “cash”	5.33	2.35	4.50	2.43	16	24
e	Sale of capital equipment	4.22	2.64	6.17	1.60	23	12
f	Tax-related issues	4.00	1.94	4.67	1.21	24	21
	Managerial-Related Issues						
g	Perception that traditional markets may dry up	6.89	2.03	7.00	0.89	**2**	**4**
h	Fits long-term strategy	6.67	2.06	6.67	1.03	**3**	8
i	Seeking contractor, project management, or operator role	6.67	2.29	7.33	1.37	**3**	**2**
j	Degree of competition in actual line of business	6.33	1.22	5.00	1.10	6	20
k	Enhancement of the company’s strength in its industry	5.89	1.54	6.33	1.03	8	11
l	Perceived competitive advantage because of unique know-how	5.89	2.42	7.17	1.72	8	**3**
m	Possibility of generating new business with the same principal	5.67	1.80	6.00	2.00	10	14
n	Past experience with similar projects	5.56	1.94	6.00	2.68	11	14
o	Understanding that companies must be involved in these type of proj as they are becoming increasingly popular	5.56	1.67	4.67	1.97	11	21
p	Principal’s (e.g., client government) request	5.56	2.35	6.50	0.84	11	9
q	Excess capacity	5.44	3.00	5.83	1.47	14	16
r	Need for work	5.44	2.55	7.00	1.10	14	**4**
s	Value of image to other clients	5.22	1.86	6.83	0.98	17	7
t	Only mechanism under current regulatory conditions	5.11	2.47	6.50	1.52	18	9
u	Access to new markets	5.00	2.40	5.33	2.07	19	19
v	Diversification of line of business	4.67	1.87	4.67	1.97	20	21
w	Invitation from potential partners	4.56	1.24	5.83	1.83	21	16
x	Enhancing relationship with lenders	4.33	1.73	5.83	1.17	22	16

Table 2-8: Factors that Lead Companies to Pursue the Promotion of Infrastruc. Projects

2.8 The Procurement Process of Privately-Promoted Infrastructure Projects

2.8.1 Background

The procurement process begins with the conceptual idea of the project and ends with the award of the project ownership by the principal to the winning promoting team. During this process, the government defines the project specifications and invites proposals from private-sector companies, feasibility studies are performed, detailed design is carried out, finance is arranged, proposals are prepared, submitted and evaluated, negotiations between the government and potential promoters are performed, contract arrangements are laid out, risks and responsibilities are allocated, and finally, the project ownership, either for a limited or perpetual period, is awarded to the winning promoting team.

This process has been complex, costly and time consuming leaving many promoters apprehensive about the benefits of pursuing promoting contracts. To date, potential promoters have spent millions of dollars and months of time in the preparation of studies, proposals and in the arrangement of finance. For instance, the promoters of the Sydney Harbor Tunnel project have spent $2.2 million on the feasibility study and submittal of their proposal (Tiong et.al., 1992). In the Dartford Crossing project, the promoters spent "hundreds of thousands" of pounds to put their proposal together (Tiong et. al., 1992). If there is more than one "bidder" then everyone but the winning promoting company has spent all this money for nothing. Moreover few projects have successfully finished the procurement process and actually started to being built. Up to the middle of 1993, in the UK, only six projects with limited-ownership ("BOT" type) have progressed to the final agreement stages: the Channel Tunnel, the Dartford River Crossing, the Manchester Metrolink, the Second Severn Crossing, the Skye Bridge, and the Birmingham Northern Relief Road (Hodgson, 1993). These six projects have been subject to inordinately long lead times and have been expensive to bid. In the case of the D5 highway in the Czech Republic, one of the two finalist consortia bidding for project spent nearly DM 10 million just to learn that the host government later decided not to pursue the project on a concession basis.[35] As a result, potential promoters are reluctant to spend time and money in the development of privately-promoted infrastructure projects as they perceive the risks to be too high for the eventual project rewards. It is, therefore, necessary for governments to take actions to minimize the risk faced by potential promoters during the procurement process.

Parts of the third and fourth questionnaires were used to acquire information on what could be done by principals to enhance the quality of the procurement process. (See

[35] Personal communication with Mr. Rik Joosten, Phillip Holzsmann (1993).

Section 1.5 for an overview of the contents of the questionnaires used in this study.) The third questionnaire focused on **"how"** the process could be improved so that the amount of time and money associated with it could be reduced; the fourth questionnaire explored the concept of **"when"** different phases of the process should be implemented. The section below presents and discusses the responses given by the 15 study participants.

2.8.2 Study Results

The study explored two concepts that can be used to decrease the costs of procuring privately-financed projects: pre-qualification and cost reimbursement. Under a pre-qualification procedure the principal invites organizations to prepare preliminary documents that allow it to screen potential promoters. Normally, the invitation outlines the scope of the project providing information regarding its location, importance, future use, and funding requirements. The pre-qualification documentation may include: (Merna and Smith, 1993)

- The experience of all the members of the consortia with similar type of project and contractual relationships,
- A report on the financial health of the different members,
- A description of their technical and operational capabilities,
- Their safety records,
- Their existing working load,
- The management structure of the future project company, and
- Proposed sources of finance.

The information provided by the pre-qualification documentation is analyzed by the principal to determine the suitability of each potential promoter and to select the ones whose characteristics and expertise best match the project necessities. Virtually all respondents, 100% of the "insiders" and 83% of the "outsiders," are in favor of the use of a pre-qualification procedure. According to them, the number of potential promoters that should be invited to the tendering phase is between 3 an 4 (the average was 3.6 for "insiders and 3.8 for "outsiders"). Table 2-9 presents the number of respondents, "insiders" and "outsiders," that are in favor of and against the use of a pre-qualification procedure to limit the number of organizations that are invited to bid the project. Figure 2-3 shows the number of participants that should be selected, through the pre-qualification procedure, to participate in the tendering phase.

A two-stage procedure is a good way of enhancing procurement as it limits the amount of money spent on the first stage — the pre-qualification phase — and allows only a selected number of potential promoters to participate on the second-stage — the tendering phase. However, in order to have a more effective and successful procurement process, pre-qualification procedures and tendering processes should occur at appropriate project phases. The following seven project stages were given to study respondents:

A during conceptual idea
B after conceptual idea but before feasibility studies
C during feasibility studies
D after feasibility studies but before detailed design
E during detailed design
F after detailed design
G other

	Insiders	Outsiders
In favor	9	5
Against	0	1

Table 2-9: Limiting the Number of Companies that Participate in the Procurement of Infrastructure Projects

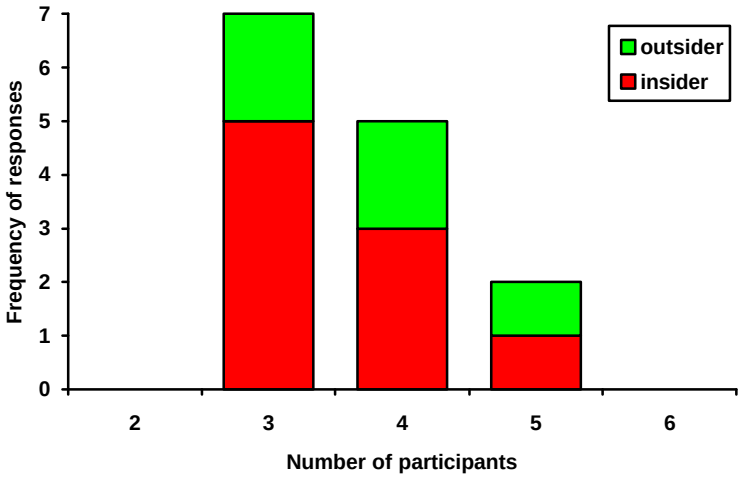

Figure 2-3: Number of Participants that Should be Selected to Participate in the Project's Tendering Phase

Figures 2-4 and 2-5 show, respectively, the most appropriate phases for pre-qualification and tendering to happen. They confirm the idea that pre-qualification should be carried out right after the government presents the project idea to the private sector. The level of responses from the private sector indicates whether it is worthwhile to continue the process and undertake feasibility studies. They also endorse the idea that the tendering process should occur before detailed design. If detailed design is performed before the project is awarded to one of the tendering private-sector companies, it would inhibit competition. This is because if each tendering company does its own design then

procurement costs become very high, and if the public sector undertakes the design then the owning company is excluded from a vital part of its normal function.

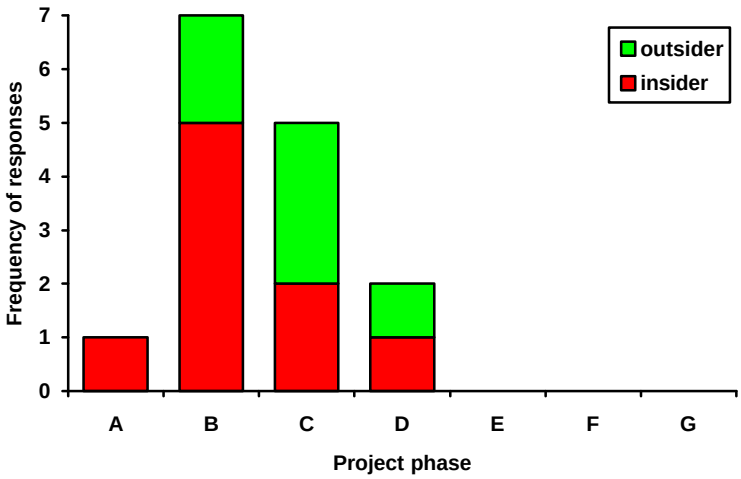

Figure 2-4: At Which Project Phase Should a Pre-Qualification Procedure Occur?

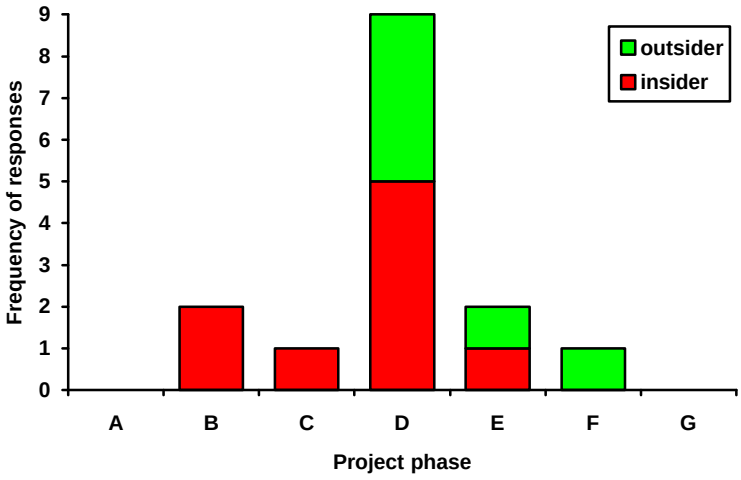

Figure 2-5: At Which Project Phase Should the Tender Process Occur?

The resources involved in preparing a proposal to finance, design, build and operate an infrastructure project are greater than those required for conventionally procured projects. Merna and Smith (1993) estimate that bidding costs for these projects can represent 5-10% of the project total costs. One possible way to reduce the costs of preparing a

proposal for the pre-qualified teams, and hence encourage competition, is to have the principal reimburse the costs of the unsuccessful bidders. However, only 44% of the "insiders" (4 out of 9) and 50% (3 out of 6) of the "outsiders" are in favor of some form of reimbursement.

Most of the respondents that did not support any form of reimbursement alluded to the difficulty of defining and assessing the bid costs as the major reason for their skepticism. Defenders of the reimbursement procedure stated that some form of reimbursement should occur, but it should only cover part of the costs as potential promoters must accept the fact that the infusion of some risk capital is necessary. Suggestions for partial compensation can be summarized as follows:

- The principal should pay for certain studies (e.g., geological investigations, measurement of traffic volume on existing facilities) that are required for all bidders.

- The principal should use the successful bidder's costs as a benchmark for "reasonable" expenditure and award part of this amount (e.g., 50%) to each of the unsuccessful bidders.

The length of the procurement process is known to be very long, and in some cases promoters and principals have had to endure it for several years (e.g., the coal-fired power plants in Turkey). Respondents were asked if it would be possible to streamline the entire process, from letters of invitation to the award of the concession, into a relatively short period of time. Almost ninety percent (8 out of 9) of the "insiders" and two thirds (4 out 6) of the "outsiders" believe that it is possible to decrease the amount of time necessary for the completion of this process. The responses clearly reflect the concerns of "insiders" and "outsiders" about the length of the project and automatically lead to the next issue: "What is a reasonable amount of time for the entire procurement process to take place?" The answers, displayed in Figure 2-6, suggest a procurement period of around six months.[36]

The evaluation of the different project proposals is a very important issue for both the potential promoters and the host government. Potential promoters invest a considerable amount of time and effort to prepare a proposal and expect a coherent, honest, and orderly evaluation process. The host government must conduct the process in a very objective and professional matter and award the ownership to the best proposal. Traditionally, governments have used project costs to analyze project proposals, that is the winning proposal is the least expensive one. However, proposals for the promotion of infrastructure projects cannot and should not be evaluated in those terms alone. These proposals are non-identical (i.e., potential promoters might suggest different alternatives

[36] One of the respondents that answered YES to the possibility of streamlining the procurement process was not specific about its duration, he/she responded "it varies according to the project."

for the project)[37] and considerations such as the technical quality of the facility (e.g., the compatibility between existing facilities, or the length of its design life), the satisfaction of end users (e.g., quality and price of service), and the amount of guarantees required by promoters should all be taken into consideration. Merna and Smith (1993) suggest that principals use four criteria to evaluate the project proposals: construction, operation, finance, and revenue. The proposals would then be evaluated on each of the criteria and points would be assigned to them according to their relative importance. The winning proposal would be the one with the highest overall score (i.e., the sum of points obtained from each evaluation criterion).

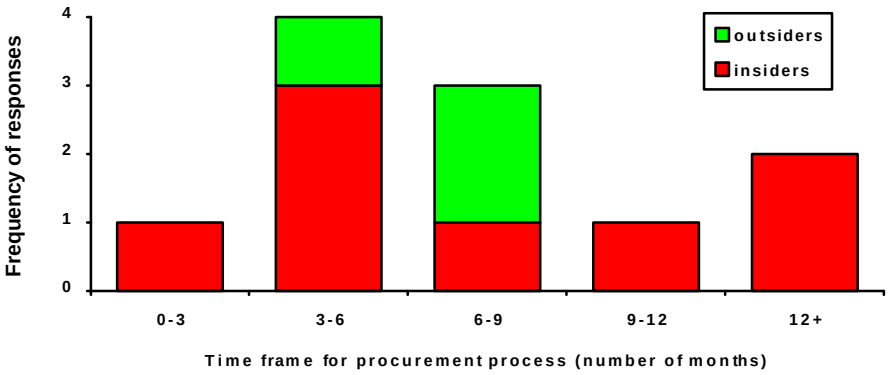

Figure 2-6: Reasonable Duration for the Procurement of Privately Promoted Infrastructure Projects

Respondents were first asked if they agreed with the idea that the host government should state in the tender documents which criteria were going to be used to evaluate and award the project ownership. All of them responded "yes." The following question was: Should the relative importance of each criteria be provided in the tender documents, and consequently be known by promoters? For instance, if the criteria used by the principal to evaluate different bids are "A," "B," and "C," and their relative importance are respectively 10, 30, and 20, should the principal reveal these weights (e.g., 10, 30, and 20) to the different promoting teams? Seventy-eight percent (7 out of 9) of the "insiders" and 50% (3 out of 6) of the "outsiders" want the host government to provide this type of information. Those in favor believe that potential promoting teams can use the information to better direct their efforts in the development of their proposals as promoters would focus on the issues perceived as most important by the host government.

[37] The final proposals for the bidding of a fixed link project between the UK and France presented four different alternatives: a seven span road and rail suspension bridge, a combined bridge and immersed tube drive-through scheme, a very large bored road and rail tunnel, and a twin-bored rail tunnel. (Stannard, 1990)

The possible inferior quality of the resulting proposals are cited as the major concern for those against the release of the relative importance of the criteria. They believe potential promoting teams would only focus on the most important criteria and would not provide a good overall proposal. This author suggests that principals do reveal the importance of each criterion as it would direct potential promoters to the issues that are of major importance. However, it is also suggested that principals use local thresholds in the evaluation of project proposals. In doing that, principals can eliminate proposals that have excellent scores for certain criteria but have a criterion that fails to achieve a minimum "quality" level.

The discussion so far has been centered on competitive bids. However, it might also be possible to relax competition in order to encourage the private sector to generate new ideas, new projects, and new concepts that have not been previously thought of by the public sector. When asked about the possibility of governments to allow unsolicited proposals for infrastructure projects, 78% (7 out of 9) of the "insiders" and 83% (5 out of 6) of the "outsiders" gave a favorable opinion. According to them, unsolicited proposals can produce benefits by allowing the private sector to put forward innovative projects.

Nonetheless, governments are often apprehensive about encouraging unsolicited proposals as the process might be politically dangerous or even illegal (e.g., European countries must comply with the competition regulations set by the European Community). Winfield (1993) suggests that governments should look to comparisons with similar projects to verify the benefits of the proposal. Stannard[38] suggests that the private-sector company presenting the ideas should only be given the right to form the owning company and should be required to carry competitive tenderings for detailed design, construction and procurement contracts.[39]

2.8.3 Example of a Successful Procurement Process[40]

In September 1991, the Motorway Directorate of Hungary issued an "invitation for pre-qualification" asking private companies to finance, build, and operate the M1 and M15 toll highways (2x2 traffic lanes) and connected secondary developments (e.g., gas stations, shops, restaurants, hotels, and rest areas) on the highway. The M1/M15 highway has a total length of about 60 km and is the last section of the 260 km Vienna-Budapest highway. The estimated project costs are around US$ 210 million (1991 figure).

Forty-one interested companies bought the documents containing the preliminary information about the project and the procurement conditions. The information was based

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38 Personal communication.

39 Section 2.9 presents a similar idea in detail.

40 This subsection relies heavily on Timar (1993).

on a feasibility study elaborated by local consultants and on a preliminary design that was financed and ordered by the Government, undertaken by Hungarian design and consulting agencies, and already approved by appropriate authorities and the local population. The document put great emphasis on the government's requirement that potential promoters should arrange for the finance, design, construction, maintenance, and operation of these toll highways in Hungary without using public funds, or any kind of government financial guarantee.

By the middle of November 1991, the deadline for submittals of initial proposals, the "Bureau for Motorways in Concession" at the Motorways Directorate received 10 requests for qualification. By the end of January of 1992, five international consortia (i.e., three led by French companies, one by Italians, and one by Spanish) were selected to participate in the tendering process by a committee formed by Hungarian experts in civil engineering and finance. At the end of February 1992, the Hungarian government approved the terms and conditions of the tender documentation. The major points included the government's decision to finance land acquisition, to provide the project promoter autonomy to set toll rates, and to require competitive tendering procedures for detailed design and parts of the construction work.

By the middle of March 1992, the tender documentation was distributed among the selected potential promoting teams with a preliminary draft of the concession contract (around 40 pages). The potential promoters had about 150 days to elaborate and present their final proposal. By August 17, 1992, four bids were received. The expert committee took three months to evaluate the bids against a set of criteria announced in the tendering documentation. By mid November 1992, the first and second best teams were selected and the final negotiations began in December. The concession contract between the Ministry of Transportation and the winning promoting team was supposed to be signed in early 1993, allowing construction to start in late spring 1993 and operation of the M1/M15 toll highway to begin before the end of 1995.

2.9 An Alternative Way of Promoting and Procuring Privately-Financed Infrastructure Projects[41]

The decision to participate in the promotion of a large-scale complex project or to award the project to a specific promoting team cannot be based on data available on the conceptual design stage because, at this point, the risks are very large for both the private and public sectors to bear. The uncertainties of a large-scale complex project will either deprive the private sector from a proper return on its investment or will require the public sector to offer guarantees that might prove to be to costly. Potential promoters will not be able to fund detailed design or arrange full financing as lenders will not commit funds to large-scale limited-recourse infrastructure projects without knowing if the project is going to be carried further or without having reliable expected construction and procurement costs. Governments will not provide all the guarantees necessary to mitigate the high initial risks as they might commit more resources than necessary, and thus, not make good use of taxpayer's money.

A natural solution to this problem is to have the public sector responsible for the development of the project and its detailed design and then, to have the private sector competing for the construction contracts, and consequent project ownership. This alternative, referred by Stannard as "pre-construction privatization," should be avoided as it removes any possibility of the private sector to use its managerial, technical and entrepreneurial skills during the vital formative period in which the project will be defined, detailed design will be performed, and major construction and procurement contracts will be negotiated. The participation of the private sector during project definition is a must and cannot be left out. After all, the main contribution of the private sector in the promotion of infrastructure projects is its ability to provide better skills than the public sector, and thus, to enhance the quality and efficiency of infrastructure services.

A proposed alternative solution consists of creating a two-stage independent project owning company. In the first stage, the owning company is a public-private partnership (e.g., corporate joint venture between private- and public-sector companies) while in the second stage, the owning company becomes a pure private enterprise with full project ownership. The objective of having a public-private partnership during the first stage is to combine the public sector knowledge with the private sector entrepreneurial and managerial skills in order to jointly establish realistic cost, time and revenue estimates and to develop a formula that determines the contribution of the public sector to the project.

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41 This sub-section is a result of information exchanges between the author and Mr. Colin Stannard (Director of Finance for Enterprise Ltd. and past Managing Director for Eurotunnel plc).

The process of creating a project owning company begins with the host government. At the earliest possible time, the government should select, either by competition or negotiation, an independent private-sector team to form with the public sector a public-private partnership which will share project ownership during the first stage of the process. The government should, at the same time, select external consultants and financial advisers to assist the owning company in issues related to the design, construction, and project finance. This selection should be based on competence and would provide the following benefits:

- Brings in an independent private-sector team with all necessary managerial and entrepreneurial skills before the project is fully defined and the detailed design completed;

- Establishes a multi-disciplinary team of experts to closely work with the owning company in the development of the project; and

- Provides enough time for the future project-owning company to arrange full financing.

In such circumstances, project promoters compete for the right to own and operate the project and not to provide engineering services or to sell equipment. Potential promoters are: the future long-term directors of the owning company,[42] the private sector providers of management services, the future operating company, and the financial institutions who will arrange the initial finance required to take the project through its development period and, subsequently, the full finance necessary to complete the project.

During the first stage, the independent owning company should control all aspects of project development. It should arrange the necessary funds to develop the project up to the position where full financing is possible to secure. The funds would be mostly in the form of debt (80-90%) and would be provided by financial institutions. The necessary equity would be furnished by the promoters of the project and the government. On top of that, governments should provide a "political" guarantee on the financing, that is, if the government decides not to pursue the project further on a private basis, or cancels the project, or does not approve the necessary regulations within a reasonable period, then it is responsible for the incurred costs and must reimburse lenders and promoters their full investment amount.

The original owning company should also use competitive tenders to award detailed design, construction and procurement contracts. It is important that the detailed design, construction and procurement contracts are not "pre-placed" as a way of enticing private sector investment into the owning company as this situation would put the company on "both sides of the table" distorting the contract negotiation process. However, it is conceivable that organizations that first formed the owning company participate in the bid

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42 Their original companies can also be considered project promoters.

for detailed design and construction contracts. In this case, these organizations should not get involved in the selection or contract negotiation process.

After the detailed design is finished, the major construction and procurement contracts are negotiated, the necessary government approvals and negotiations finalized (including the employment of the agreed formula to the final cost, time, and revenue estimates to determinate the public sector contribution to the project), the full project finance is secured (probably consisting of a limited recourse bank loan and public equity offerings), the public sector should transfer the ownership of the project owning company and the existing contractual obligations entirely to the private sector. At this point, the second stage of the independent owning company begins.

At the second stage, the private sector has total control over the project. The owning company should have a board of directors and an executive staff in place with the necessary skills to manage the construction phase, to ensure company growth, and to smoothly implement operations.

In summary, the two-stage owning company approach is recommended for large-scale complex projects because (1) the private sector can provide their managerial, technical, and entrepreneurial skills from early on (thus, enhancing the likelihood of project success), (2) the public sector contribution does not need to provide unnecessary guarantees (thus, securing value for money to taxpayers), (3) financing is easier to obtain because as the project enters the construction and operation phases the level of uncertainty decreases (compared to earlier project phases) and, (4) it can be used to develop and promote a project regardless of the ownership period — finite or perpetual.

2.10 Suitability of Infrastructure Projects to Private-Sector Promotion

Much of the discussion carried on Chapters 1 and 2 suggests that host governments can help to enhance the quality of infrastructure services and enable the provision of additional finance by allowing the private sector to promote projects. It is clear however that countries face different realities and have particular characteristics, and thus, have a distinct capacity to implement the necessary changes and to provide the necessary ingredients to attract the private sector to promote and finance infrastructure projects. It is also certain that although country characteristics are extremely important, sectoral characteristics provide essential evidence about the types of projects that are most likely to succeed under the arm of the private-sector. The suitability of infrastructure projects for private promotion depends on sectoral characteristics such as:

- Public service obligations (political and social factors),
- Strategic industry,

- Environmental externalities,
- Potential for competition (existence of monopoly elements),
- Potential for efficiency gains (during construction and operation),
- Potential for cost recovery from user charges,
- Certainty of revenues, and
- Level of initial investment.

Part of the fourth questionnaire was used to evaluate the suitability of using the private sector to promote several different kinds of facilities. It asked respondents to use a nine-point scale[43] in the evaluation of infrastructure projects under two distinct ownership structures — concession (finite ownership period) and "privatization" (perpetual ownership period).[44]

The different infrastructure projects, for report and analysis purposes, have been divided into four groups:

- *Public Works* — airports, bridges, mass rapid transportation systems, railroads, roads, tunnels;

- *Public Utilities* — power generation, power transmission and distribution, sewage treatment facilities, telecommunications, water distribution, water treatment facilities, and waste treatment facilities;

- *Social Works* — correctional facilities, educational facilities, and health facilities;

- *Other Facilities* — parking structures, industrial plants, pipelines, public buildings, sports arenas and stadiums, and tourism related facilities.

Generally, a perpetual ownership period ("privatization") is used for infrastructure services that offer highly marketable services with direct measures of consumption, potential cost reductions due to efficiency gains and competitive environment, reasonably accurate revenue forecasts, the possibility of private-sector ownership, and high potential for cost recovery from user charges without government guarantees. This study suggests the following types of projects as particularly suited to "privatization" arrangements:

- Telecommunications and power generation (from the "public utilities" group) and

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43 On this scale "1" means EXTREMELY LOW level of suitability and "9" means EXTREMELY HIGH level of suitability.

44 The complexity of risk allocation increases rapidly with project size, as a result many complicated agreements between project participants are required. The saying "start small," therefore, has its attractions. However, many contractual agreements are required irrespective of project size, and the associated high transaction costs often mean that promoters are not interested in projects below a certain size. The study asked the respondents to assume projects of a large enough magnitude so that they could be considered appropriate for privatization or concession arrangements.

- Parking structures, industrial plants, hotels and resorts, and public buildings (from the "other facilities" group).

Table 2-10 shows, for "insiders" and "outsiders," the average and the standard deviation values for the suitability of different infrastructure projects to private-sector promotion through "privatization" arrangements.

The use of concession arrangements in the private development of infrastructure projects is most recommended for projects that are unsuitable for full privatization (i.e., they are part of strategic industries), present unreliable revenue forecasts, provide uncapturable external benefits, need government guarantees to cover their costs, and do not promote "direct service competition." (i.e., the user cannot choose the provider of service). This study suggests the following types of projects as particularly suited to concession arrangements:

- Bridges, tunnels, airports and roads (from the "public works" group) and

- Water treatment facilities, waste treatment facilities, power plants, and sewage treatment facilities (from the "public utilities" group).

Table 2-11 shows, for "insiders" and "outsiders," the average and the standard deviation values for the suitability of different infrastructure projects to private-sector promotion through concession arrangements.

It is interesting to note that "power generation" has received high suitability scores for possible private promotion from both arrangements — concession and "privatization." This fact suggests that this service can be effectively pursued by the private sector regardless of long-term ownership structure and has the highest likelihood of being successfully promoted by private companies. Therefore, it should be the one initially targeted by governments interested in utilizing private-sector expertise and funds to promote infrastructure projects.

Also notable is the fact that "social works" projects appear at the bottom of the ranking table for both arrangements, suggesting that social services should not be "privatized." However, governments might consider the participation of the private-sector to design, finance, construct, maintain and even own the buildings where social work is performed. The public-sector would operate and devise a leasing arrangement that provides an adequate financial return to "promoters" and investors. An example of such arrangement, the IRS Detroit Computer Center, is described briefly on Appendix B - Questionnaire One.

		Insiders (G1)		Outsiders (G2)		RANKINGS	
		Average	Std Dev	Average	Std Dev	G1	G2
	Public Works						
a	Bridges	6.25	2.71	6.50	2.81	7	16
b	Airports	6.13	2.47	6.67	2.58	8	15
c	Railroads	5.63	2.33	5.50	1.97	13	19
d	Tunnels	5.50	2.67	6.83	2.56	14	12
e	Mass rapid transportation systems	5.38	2.56	5.17	1.72	17	22
f	Roads	5.25	2.43	5.33	2.07	18	21
	Public Utilities						
g	Telecomms	7.25	1.75	7.67	1.21	**2**	**2**
h	Power generation	6.63	1.41	8.17	0.75	**6**	**1**
i	Water treatment facilities	6.00	2.56	7.33	1.21	9	**5**
j	Power transmission and distribution	5.75	2.60	7.00	1.41	10	10
k	Sewage treatment facilit.	5.50	2.27	7.33	1.21	14	**5**
l	Waste treatment facilities	5.50	2.27	7.17	1.17	14	7
m	Water distribution	5.13	2.70	7.00	1.26	19	10
	Social Works						
n	Correctional facilities	4.88	2.80	6.50	1.64	20	16
o	Health facilities (e.g., hospitals)	4.88	3.00	5.50	2.17	20	19
p	Educational facilities (e.g., schools)	3.75	2.82	5.67	2.58	22	18
	Other Facilities						
q	Parking Structures	7.63	1.77	7.17	1.72	**1**	7
r	Industrial plants (e.g., refineries)	7.13	1.89	7.50	1.05	**3**	**3**
s	Tourism related facilities (e.g., hotels)	7.13	2.17	7.50	1.05	**3**	**3**
t	Buildings (e.g., offices for public agencies)	6.88	2.30	7.17	1.83	**5**	7
u	Pipelines	5.75	2.66	6.83	1.33	10	12
v	Sports arenas and stadiums	5.75	2.76	6.83	1.47	10	12

Table 2-10: Suitability of Different Infrastructure Projects to Privatization Arrangements

		Insiders (G1)		Outsiders (G2)		RANKINGS	
		Average	Std Dev	Average	Std Dev	G1	G2
	Public Works						
a	Bridges	7.75	1.49	8.33	0.82	**1**	**1**
b	Tunnels	7.38	1.51	7.83	1.47	**2**	**2**
c	Airports	7.00	1.85	7.00	2.10	**4**	**4**
d	Roads	6.63	2.07	6.83	0.98	11	**5**
e	Mass rapid transportation systems	5.50	2.62	5.17	2.64	18	21
f	Railroads	5.38	2.67	5.33	2.07	19	17
	Public Utilities						
g	Water treatment facilities	6.88	1.64	6.67	1.03	**5**	**6**
h	Waste treatment facilities	6.88	1.25	6.33	0.52	**5**	9
i	Power generation	6.88	1.46	7.67	1.21	**5**	**3**
j	Water distribution	6.75	1.98	6.00	2.00	8	10
k	Sewage treatment facilit.	6.75	1.39	6.67	1.03	8	**6**
l	Power transmission and distribution	6.50	2.27	6.00	1.10	12	10
m	Telecomms	6.25	2.43	5.83	1.94	15	12
	Social Works						
n	Health facilities (e.g., hospitals)	4.88	3.00	5.50	1.05	20	16
o	Correctional facilities	4.38	2.26	5.33	1.51	21	17
p	Educational facilities (e.g., schools)	3.88	2.75	5.83	1.47	22	12
	Other Facilities						
q	Parking Structures	7.13	1.55	4.17	2.32	**3**	22
r	Industrial plants (e.g., refineries)	6.75	2.19	5.33	1.03	8	17
s	Pipelines	6.50	2.56	6.50	1.64	12	8
t	Buildings (e.g., offices for public agencies)	6.38	2.72	5.67	2.16	14	14
u	Tourism related facilities (e.g., hotels)	6.13	1.96	5.33	2.34	16	17
v	Sports arenas and stadiums	5.75	2.76	5.67	2.58	17	14

Table 2-11: Suitability of Different Infrastructure Projects to Concession Arrangements

2.11 The Benefits and Shortcomings of Using a Private Promoting Structure to Develop and Implement Infrastructure Projects

In recent years, governments have encouraged the private sector to become more involved in the development and implementation of infrastructure projects. This section discusses both, the benefits and shortcomings, of using a private promoting structure in the development and implementation of such projects.

2.11.1 Benefits

Improvement in Efficiency

One of the greatest attractions of the infrastructure-project-financing concept, from the principal's point-of-view, is the efficiency gains that can be realized by having a private-sector team responsible for the planning, design, construction, operation, maintenance, and ownership of public infrastructure projects. These efficiency gains arise from the business expertise offered by the private sector (e.g., innovation, marketing and management skills), its greater incentive not only to design for quick and economic construction but also for effective and economic operation and maintenance, the use of technology not available to the public sector, and the mitigation of some government-related problems. Government related problems include the use of inappropriate design and technology; a scarcity of adequately trained managers, technicians and artisans; insufficient funding for operation and maintenance; excessive bureaucracy; low priority and status of maintenance; low pay of maintenance staff and labor; overstaffing and corruption.[45]

Expanded Financial Resources

Infrastructure project financing offers the possibility of realizing a project when the principal does not have the necessary monetary resources or the borrowing capacity to fund the project. It removes from the host government the burden of public financing projects and also allows it to pass much of the cost of design, feasibility, and financial studies on to the promoters. Therefore, equity investment by project promoters and investors and loan packages presented by commercial and investment institutions (that might not available for the principal itself) produces "additional" finance for economically

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[45] Research in economics has uncovered a heuristic called the "bureaucratic rule of two" that states: "[I]f you want to find the public cost of doing something, you must find the private cost and then multiply by two, and that will get you pretty close." (Lammie, 1988)

justifiable projects that would not exist otherwise.[46] According to Augenblick and Custer (1990), governments which are actively promoting concession or "privatization" arrangements (e.g., Turkey, Pakistan, Malaysia and the Philippines) have cited this "additionality" concept as a principal reason for their interest. Timar[47] (1993) states "... it has to be emphasized that without the active participation of foreign capital in financing transport investments needed in Eastern Central Europe, there are no real chances for economic recovery in a reasonable time."

Privatization

The private promotion of projects offers the possibility of infrastructure services to be developed and implemented by the private sector instead of the public sector. This is of great appeal for host governments that want to move their economy towards the private sector because of changes in their political ideologies or because they want to secure private-sector expertise, skills, capital, and operating resources. Privatization also enhances competition and creates a free market that results in better service and lower costs to the public.

Project Risk Sharing

The promotion of infrastructure projects by the private sector allows the host government to share (transfer) some of the project risks that are, under conventional public provision of projects, its sole responsibility. The risks transferred to the private sector should be manageable and should have the potential for efficiency gains otherwise it would inhibit the private participation in the promotion of projects (e.g., construction and operating risks). Chapter 3 discusses risks present in infrastructure projects and risk sharing alternatives in detail.

Technology Transfer and Training

The involvement of the promoting team in the construction and operation of the facility may facilitate a more continuous transfer of technology and expertise from the contractors and operators to the owning company, and hence to the principal, than the case where the project were owned and operated by the public sector.[48] Moreover, privately-promoted projects usually have a structured training program which can provide significant technology and skills transfer to local staff. The trained staff provides a center of

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46 The willingness of promoters, lenders and investors to make a long-term commitment to a concession-financed project can be understood as an indication that the project is considered by experts as financially viable.

47 Dr. Andras Timar is the Director of the Hungarian Bureau for Motorways in Concession.

48 This is especially true if the project promoters come from a developed country and the principal is a developing country.

expertise which is left behind when the concession contract is complete (Winfield, 1993). Obviously, such training could be performed without a concession arrangement, however its adoption provides a framework in which the presence of promoters facilitates such training.

Efficiency for Public Projects

It might be useful for the host government to have projects designed, built and operated by the private sector to be used as a benchmark to measure the efficiency of the public sector with similar type of projects.

2.11.2 Shortcomings

Complication and Cost

Without question, the private promotion of infrastructure projects is a very complicated process. It takes time, money, patience, knowledge and endurance to successfully produce a concession or "privatization" arrangement. The structuring and negotiation of contractual agreements need particular expertise from the host government that might not be available. Moreover, some experts suggest that, from the principal's point-of-view, the opportunity costs of such time consuming process are very large and the host government, in case of sufficient resources, might be better off by publicly financing the project.

The overall cost of the project to the host government has been a point of controversy. Counter-supporters of concession and "privatization" arrangements say that because of the complexity and length of the process, governments end up spending more money in a privately-promoted project than they would if the project were to be publicly financed and procured. However, proponents point out that the opposite is true when design, construction and operation efficiencies are taken into consideration.

Long and Expensive Procurement Period

From the promoters' point-of-view, getting involved in the promotion of projects is very risky and expensive. They spend a lot of effort and money trying to develop a project that they have no idea will be carried forward. Previous sections of this chapter (i.e., Sections 2.8 and 2.9) have discussed this issue and offered suggestions to minimize the adversities presented during the procurement period.

Extensive Government Support

If promoters and lenders require too much government support for the project, the benefits of efficiency gains and additionality might be lost as project promoters face no real project risks and, hence, do not have any motivation to effectively construct and operate the project. At the same time, if infrastructure project financing is viewed only as a substitute for government funding rather than the creation of an enduring public-private partnership then the arrangement is unlikely to be successful.

In order to have a successful project, it is necessary that the government creates the necessary legal, financial, environmental, and administrative regulatory framework for the specific type of project being negotiated. Regulation must ensure stability, service quality, safety, environmental protection, obligations, and the rights to network access.

2.12 Summary

Serious questions have been raised about the government's ability to operate, maintain, and finance infrastructure as facilities have been inefficiently operated and inadequately maintained, social needs have been neglected, and governments have been bearing more of the burden of infrastructure expenditure than they can reasonably be expected to manage. The potential for improving performance on infrastructure provision and investment exists and is substantial. The private promotion of infrastructure projects is a key mechanism for initiating a process of change with advantages for the public and private sectors. From the principal's perspective, it provides additional finance to projects, has the potential to improve the quality and efficiency of infrastructure services and facilities, encourages better risk sharing, and provides access to technology, management expertise and financial skills that would not be available otherwise. For the private sector, it provides new business with the possibility of high returns.

However, private entrepreneurship in infrastructure also has its difficulties, among them: the complex, costly and time consuming procurement process, and the difficulty to attract finance due to the presence of higher than traditional levels of project risks. In order to overcome these difficulties, the host government must play a major role. It must

be fully committed to the project, offer the necessary financial guarantees and provide stable and adequate political and legal environments.

In order to enhance the procurement of privately-promoted infrastructure projects, this study suggests to principals the following two-stage procedure:

- Invite potential promoters to qualify for the tendering of the project just after the project has been conceptualized;
- Select the best three or four promoters to participate in a competitive tendering procedure;
- Provide information regarding the criteria that will be used to evaluate and award the project ownership together with their relative importance; and
- Streamline the process by curbing the procurement duration to 3-9 months, by paying for certain studies that are required for all bidders, and by possibly partially reimbursing the unsuccessful bidders.

An alternative procurement process has been suggested in the case of large-scale complex projects because the level of uncertainties would either deprive the private sector to have a proper return on its investment inhibiting finance to be arranged or require the public sector to offer guarantees that might prove to be to costly. It consists of creating a two-stage independent project owning company. In the first stage, the owning company is a public-private partnership while in the second stage, the owning company becomes a pure private enterprise with full project ownership.

The basic characteristics of privately-promoted infrastructure are:

- The project's ability to generate the necessary revenues to repay lenders and provide an adequate return on investment to promoters and investors, thus benefiting from infrastructure project finance;
- The creation of a special-purpose company — the owning company — that is responsible for the development, finance, implementation ,and ownership of the project;
- The length of the ownership period — finite (concession) or perpetual (privatization).

The suitability of the different types of infrastructure projects depend on parameters such as: the certainty of revenues, the potential for efficiency gains, and the level of initial investments. This study suggests that telecommunications, power generation plants, parking structures, industrial plants, hotels and resorts, and public buildings are particularly suited to "privatization" arrangements while bridges, tunnels, airports, roads, water treatment facilities, waste treatment facilities, power plants, and sewage treatment facilities are suited to concession arrangements.

The benefits of promoting infrastructure projects privately go beyond the construction of new facilities and the level of return to promoters and investors because the provision of better services improve productivity, lower prices, and enhance the quality of life for individuals.

3 Risks in Privately-Promoted Infrastructure Projects

"Nobody can really guarantee the future. The best we can do is size up the chances, calculate the risks involved, estimate our ability to deal with them, and then make our plans with confidence."

Henry Ford II

Infrastructure projects carry higher-than-traditional levels of risk as they typically involve high capital outlays, long lead times and long-lived assets with little value in alternative use. The identification, analysis and allocation of various types of risks is an important aspect for the valuation of privately-promoted infrastructure projects. This chapter discusses the implications of risks to project promoters. In doing so, frameworks used to analyze and allocate project risks are reviewed, the risks related to these infrastructure projects are identified, and risk management actions that can be used to minimize and mitigate project risks are presented.

3.1 The nature of risk

3.1.1 Definition of Risk

Most human activities are characterized by the presence of risk and the process of developing, financing, building and operating an infrastructure facility is, by no means, different. In the literature, the word "risk" has several different meanings. For example, a

common view of risk in the management literature is in terms of variability or uncertainty, that is a project is perceived to be risky because its future outcomes are not known with uncertainty. The insurance industry does not see risk as an item to be insured before differentiating between 'pure' and 'speculative' risks. 'Pure' risks exist when there is possibility of financial loss but no possibility of financial gain (e.g., physical damages to assets, criminal acts). 'Speculative' risks involve the possibility of both gain and losses (e.g., financial and production risks). The reward for taking 'speculative' risks are the profits that eventually occur from projects (Hertz and Thomas, 1983).

In the construction literature, several authors have acknowledged the fact that risk is present in all construction projects and have proposed different risk definitions. Erickson (1979) defines risk as "exposure to possible economic loss or gain arising from involvement in the construction process." Wideman (1986) defines it as "the degree of exposure to negative events, and their probable consequences." Cooper and Chapman (1987) define it as "exposure to the possibility of economic or financial loss or gain, physical damage or injury, or delay, as a consequence of the uncertainty associated with pursuing a particular course of action." Al-Bahar (1988) defines it as "the exposure to the chance of occurrences of events adversely or favorably affecting project objectives as a consequence of uncertainty."

In coping with risks two approaches can be taken: the traditional and the risk management. The traditional approach relies on rules of thumb developed by companies' past experience. In the construction industry, contractors use their intuition to deal with project risks. According to Ashley (1977), contractors classify risks into three categories: risks to be insured , risks to be priced in a estimate (contingencies such as costs due to strikes, incorrect estimates of labor, lost time due to weather conditions), and risks not to be priced in a estimate (owner's responsibilities such as currency devaluation, design inadequacy, termination of contract). Then, they include in their estimate the premiums of each insurable risk and the contingencies yielded by each "contractor-priced" risk. They assume that risks are independent and that ignored uncertainties level out at the end of the project.

The risk management approach tries systematically to identify, to analyze and to evaluate risks in order to consider an appropriate response strategy among different alternatives such as defensive actions as mitigation by risk avoidance, deflection by insurance, transfer by contractual arrangements, and retention by loss control programs and contingency planning. The principal aim of risk management is to ensure that the risks are managed most efficiently. Figure 3-1 illustrates the main differences between the risk treatment approaches.

3.1.2 Risk Frameworks for Project Financing

Project financing requires identification and analysis of risk areas during different phases of the project and with different parameters. Classification and definition of risks in

project financing have been proposed by several authors. Beidleman *et al.* (1990) affirm that the allocation of risks to the participants best able to manage them is the key ingredient for successful project financing undertakings. They classify risks according to project phases[49]:

- Developmental phase (technology, credit and bid risks);
- Construction phase (completion, cost overrun, performance and political risks);
- Operating phase (performance, cost overrun, liability, equity resale and off-take risks);
- Ongoing risks (interest rate and currency risks).

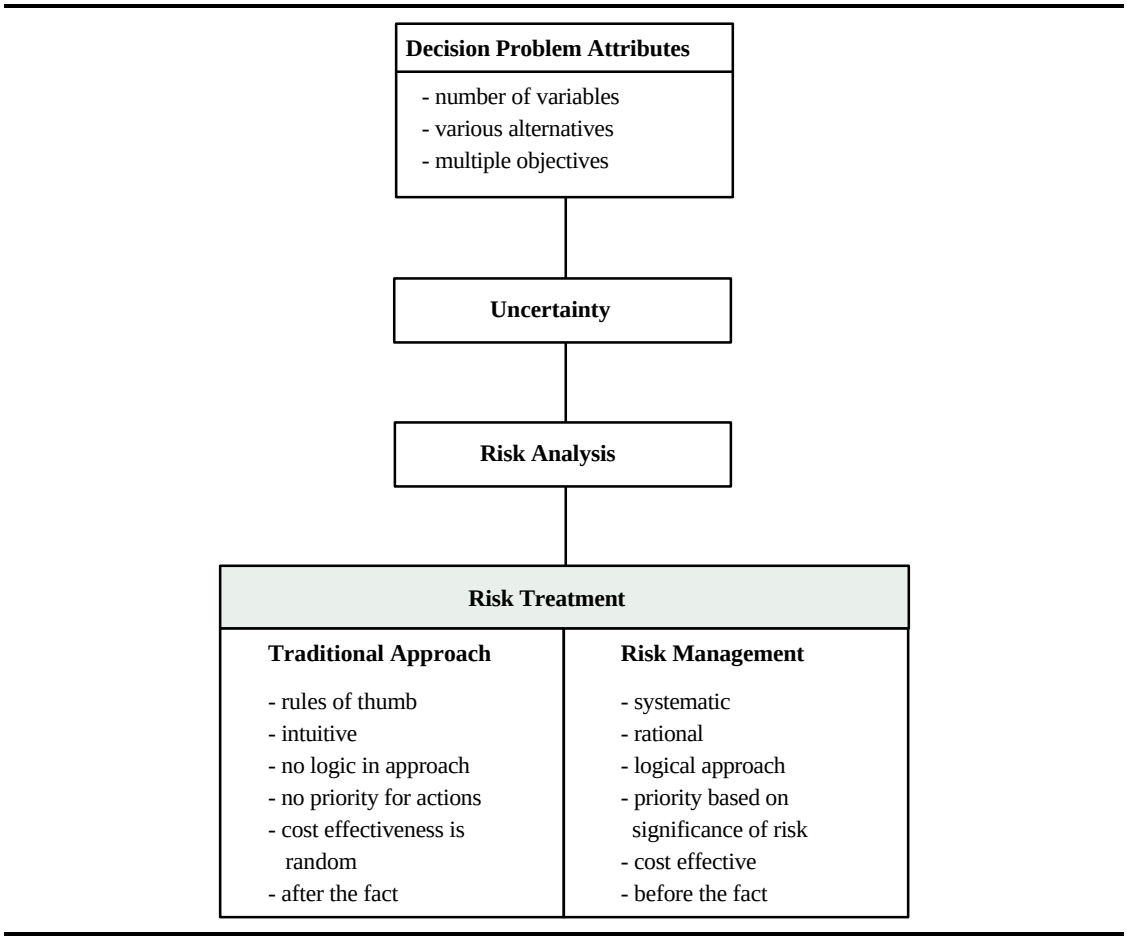

Figure 3-1: Differences of the Two Approaches of Risk Treatment (Adapted from Al-Bahar, 1988)

49 Chan and Woodward (1992) use the same classification.

They propose the project participants to whom the aforementioned risks should be allocated and suggest that because of the size of projects it makes sense to have several sponsors managing the project together through strategic alliances (*e.g.*, partnerships, joint-ventures and/or leases of capital equipment).

Hoffman (1989) states that financial responsibility for the various risks must be allocated to parties that will assume recourse liability and that possess credit adequate to accept the risk allocated. This allocation varies from transaction to transaction and depends largely on the bargaining positions of the participants and the ability of the project to cover risk contingencies with the underlying cash flow and reserve accounts. He classifies risks in two general categories:

- Design engineering and construction risks (e.g., increase in construction costs, delay in completion, experience of contractor, problems with resources);

- Start-up and operating risks (e.g., technology, market for product or service, costs of raw material and utilities, operator experience, legal problems, economic risks and force majeure).

Sterling (1977) claims that the main difference between "project financing" and "finance for projects" is the nature of repayment risks. In "project financing," cash flows from the project constitute the principal repayment source, whereas the borrowers' internal sources are the principal repayment guarantees in "finance for projects." He states that, risk analysis in project financing normally emphasizes two major areas: project completion according to plan and, after start up, operating cash flow levels. The completion risk has three basic dimensions: the ability to meet the target completion date; the realization of a final cost at or below estimate; and the achievement of design performance. The operating risk is expressed as the difference between gross revenues and operating costs before the financing charges. A potential third area for risk analysis is country risk. It affects projects located in countries with political uncertainties and soft currencies.

Melman (1982) indicates that the banking industry has developed in-house computer models, based on sensitivity analysis and simulation techniques, to analyze prospective project-financing projects . An example of such model is PROFAS - Project Finance Analysis System. The model has been used by the Canadian Imperial Bank of Commerce to perform risk analysis using simulation and to do regression and correlation analysis for cash flow calculations. Brzozowski *et al.* (1977) also suggest simulation to evaluate project financing deals.

Tiong (1990a) looks at the risks involved in BOT projects. He says "the analysis and allocation of risk is central to the structuring of a BOT project financing." The next section expands the list provided by Tiong and also describes the different types of risk faced by a private-sector promoter of a large infrastructure project.

3.2 Identification of Risks

The identification of possible sources of risks is an essential factor in the risk management process because it allows project participants to recognize the existence of uncertainty in the project and hence, to analyze its potential impact and to consider an appropriate strategy to mitigate its effect in the project. Sources of risks have been classified in the following ten categories: country (political and regulatory), force majeure, physical, financial, revenue, promoting, procurement, developmental, construction, and operating. A description of each risk category is given below.

Country Risks (Political & Regulatory Risks)

Country risk is defined as the exposure to a loss by the promoters and lenders of a privately-promoted infrastructure project due to events or factors in the host country that are, at least to some extent, under the control of the government but not under the control of the promoters and lenders (Nagy, 1979).

Country risks, political and regulatory, are of major significance in privately-promoted infrastructure projects because they can change local economic, social, and political conditions that are essential for promoters to be able to construct, operate, and successfully recover their investment. Some of the factors that can lead to the emergence of political and regulatory risks are:[50]

- Outbreaks of hostilities (e.g., riots, terrorism, and wars);
- Government instability;
- Expropriation;
- Nationalization;
- Government failure to provide permits necessary for construction, maintenance, and operation of the project;
- Lack of commitment to concession contracts or privatization arrangements (e.g., withdrawal of government support or guarantees);
- Government interference in the operation of the facility (e.g. capping toll or tariff levels);
- Non-existence of a legal and regulatory system that enforces contracts and arrangements, and provides a framework to resolve disputes;
- Changes in fiscal policy (tax laws and royalties);
- Changes on legislation affecting technical standards and the use of technology for the construction, maintenance and operation of the project facility;

[50] A more complete discussion about political risks and the principal factors or events that influence them can be found in Nagy (1979) and Krayenbuehl (1985).

- Changes in environmental regulations due to pressure of "green" groups or changes in the environmental consent (e.g., the creation of a more strict wetland legislation might prevent promoters of a toll road to build real estate properties along the highway in an area previously approved);
- Changes to the legislation that determines the repatriation of funds policy;
- Changes to the legislation regarding the private ownership of assets (e.g., forced sale of assets); and
- Changes on general legislation that affects the project (e.g., national or regional laws, corporate law, commercial law).

Several institutions (e.g., the Business Environment Risk Information (BERI) Institute, Euromoney, and Institutional Investor) provide country-risk ratings. Different institutions follow different risk assessment concepts, however these ratings are a valuable instrument for cross-checking one's own assessment. Krayenbuehl (1985) presents an explanation of how the different ratings are constructed and provides the country ratings for 1984.

Force Majeure Risks

The force majeure, or Acts of God, risks are related to physical damage or personal injury as a result of natural catastrophes such as earthquake, tornado, hurricane, landslide, flood and fire. They are unpredictable and are beyond anyone direct control. They can be characterized as having a small probability of occurrence with large consequences. Promoting companies are single-project companies that are more vulnerable to events of force majeure than companies whose assets are diversified and hence, should find ways to mitigate this risk.

Physical Risks

Risks associated with this category are associated with damage of property or asset that promoters own or have under their possession during the ownership period. Such risks include: labor injuries or death, damage to equipment or material, and damage to the facility (structure or property).

Financial Risks

Typically, privately-promoted infrastructure projects are funded on an off-balance-sheet-financing basis. There is no participant filling the traditional responsibilities of the owner in terms of residual risks and guarantee of debt repayment. Therefore, in order to successfully implement these projects, funds must be properly arranged and delivered. The financial risks faced by promoters and lenders include:

- Failure to raise finance;
- Inappropriate financial structuring;
- Default on interest payments;

- Default on loan or bond repayments;
- Default by lender (i.e., failure to deliver the loan amount to promoters);
- Unsuited ("non-viable") project;
- Difficulty in the resale of equity (i.e., promoters and other equity investors may not be able to sell their share in a project because the secondary market for project equity positions can be very limited); and
- Undeveloped general business environment.

Revenue Risks

Revenue risks represent the exposure faced by promoters and lenders due to uncertainties in the future economic conditions of the host country and the real demand for the project. These risks affect the feasibility of the project because they curb the ability of lenders to be repaid and the ability of promoters and investors to have an adequate return on their investment. Some of the factors that contribute to this exposure include:

A. Economic

- Changes in economic policies;
- Exchange rate movements (especially when debt financing relies on hard foreign currency and revenues are raised on soft local currency);
- Convertibility to foreign currency;
- Variations in interest rates; and
- Inflation.

B. Demand[51]

- Reliability of demand and growth forecasts;
- Error in forecasting demand for service or goods;
- Changes in demand for facility or product over concession period due to economic downturns, competing facilities, etc.;
- Accuracy of demand associated with existing facilities;
- Tariff fight with competing facilities;
- Social acceptability of user-pay policy (e.g., consumer resistance to tolls);
- Failure to receive revenues from principal (in case of projects where the principal collects fees directly from the end-user); and
- Low historical pricing of services (e.g., utilities, tolls).

[51] The demand risk is considerable in most sectors. For example, it is very difficult to forecast traffic levels for a road or tunnel, especially when alternative routes are available.

Promoting Risks

The owning company is responsible for managing a project during its different phases. It interacts with governments, lenders, contractors and other parties and should have the necessary experience, expertise and strength to do so. Promoting risks include the owning company's:

- Lack of independent management;
- Lack of experience;
- Lack of expertise;
- Lack of negotiation skills;
- Financial weakness;
- Inability to allocate risks to the participants best able to manage them; and
- Inability to define the specific functions of each member of the promoting team.

Procurement Risks

Several potential project promoters have spent a lot of time and money to prepare a package to procure privately-promoted infrastructure projects only to be disappointed with the outcome.[52] During the 1980's several projects, proposed by different governments, did not advance to (or, past) the procurement stage leaving many would-be promoters apprehensive about the true benefits of pursuing infrastructure projects (Winfield, 1993). Promoters of these type of projects face the following procurement risks:

- Unrealistic expectations of the principal due to lack of experience and expertise;
- Expensive and long tendering process;
- Delay in granting concession;
- Lack of authority of principal's negotiators to commit to the terms of the negotiation with the promoting team;
- Changes in project specifications;
- Lack of integrity on the "tendering process";
- Innovative ideas not being rewarded by the principal; and
- Intellectual rights not protected.

Developmental Risks

During the early stages of a privately-promoted infrastructure project several decisions that can potentially influence the overall success of the project are made. These decisions range from choosing the different technologies that will be applied for the construction

[52] The costs of tendering a privately-promoted infrastructure project amount to 5-10% of total project costs and can discourage potential promoters to prepare project proposals. (Merna and Smith, 1993)

and operation of the facility to the adequacy of the design to comply with the facility's requirements of performance and quality and hence, influence the project quality and/or costs. Developmental risks arise due to:

- Incomplete or erroneous geological and geotechnical exploration;
- Inadequate specifications and standards;
- Incompatibility with existing facilities and services;
- Incomplete design scope;
- Delays in design approvals;
- Short design life;
- Changes in design during construction;
- Use of technology that may prove economically or structurally non-viable; and
- Excessive development costs.

Construction Risks

Construction risks can be viewed from two different angles. From the promoters' viewpoint, construction risks involve completion, cost-overrun and schedule-delay risks. While from the contractors' perspective construction risks include performance, cost-overrun, and safety risks.

Completion risk refers to the possibility that the project will not reach the operating stage. The cost overrun risk refers to the possibility that construction costs will exceed projections. Promoters try to allocate this risk to construction companies and equipment vendors through the uses of fixed-price, lump-sum contracts. The schedule delay risk relates to the possibility that construction will not be completed within the projected schedule. It has a direct impact on project revenues affecting the feasibility of the venture. Promoters might use performance incentives to stimulate contractors to finish construction before the contractual deadline.

The risks faced by contractors are inherent to the construction work itself. The following are potential risks that are considered typical in every construction project:

- *Performance-related risks* — labor unavailability, labor disputes and strikes, material shortages and quality, differing soil and site conditions, failure to meet specified quality, defective work, component failure, equipment failure, adverse environmental impact, weather conditions;

- *Cost-overrun-related risks* — low labor productivity, error in construction cost estimates, inflation during construction period; and

- *Safety-related risks* — accidents and labor injuries.

Operating Risks

Operating risks are characterized by the inability of the project to perform as expected jeopardizing the promoters' ability to honor financial obligations and to recover their own investment. Some of the factors that contribute to uncertainties regarding the operation of the project include:

A. Performance

- Inability to perform as expected (reduced output);
- Inability to meet increases in demand;
- Latent construction defects;
- Equipment failure or accidental damage;
- Changes in the local ecosystem due to the environmental impact caused by the project during the operation phase (e.g., the local government might require the promoters of a nuclear power plant to provide health assistance for the local population as well as to reimburse local farmers for their agricultural problems due to a radioactive leakage);
- Vandalism;
- Employee dishonesty;
- Operations and maintenance contractors may not meet quality standards;
- Inappropriate operating conditions;
- Inappropriate operating methods;
- Insufficient time allowance for major maintenance;
- Unavailability of power supply;
- Unavailability of essential natural or raw materials to operate the facility;
- Unavailability and quality of personnel to operate the facility;
- Incompatibility with associated facilities; and
- Lack of license to operate the facility.

B. Cost Overrun and Liability

- Error in operation and maintenance cost estimates;
- Error in training cost estimates; and
- Accidents and labor injuries.

3.3 Risk Management Actions

The main purpose of risk management is to find acceptable solutions to manage the risks identified in privately-promoted infrastructure projects by reducing the potential impact of the various types of risks and by allocating these risks to those participants best able to manage them. Within the framework of risk management, Al-Bahar (1988) classifies risk

management into five groups: avoidance, prevention, retention, transfer and insurance. Therefore, the risk management process consists of creating measures aimed at avoiding or reducing the probability and/or potential severity of losses and generating provisions to finance the losses that might occur during the project lifetime.

The risk allocation process should be performed with the following question in mind: "Who is better able to manage this risk?" Two factors — **responsibility** and **potential reward** — should be used to determine where the various risks will ultimately lie. As a general rule, the host government should be prepared to retain and/or minimize the risks that are largely outside the control of the private sector (e.g., political, procurement and force majeure). On the other hand, the private sector should retain the risks that can be managed and have potential for efficiency gains (e.g. construction and operation). However, the interdependence between the risks complicates this general rule. In particular, financial risk is largely outside the control of the private sector, but the taking on of this risk by the private sector will have a favorable incentive effect on project cost elements which are largely subject to "controllable risk," such as construction and operation. The impact upon the project as a whole must therefore be carefully considered.

Risk management strategies are rarely used alone to handle a particular risk, it is much more common to use several of these strategies in combination for each type of risk. The list below identifies a number of management actions and strategies that could be used to ensure that the risks faced by the private-sector participants of a privately-promoted infrastructure project are reduced and allocated to the parties best able to bear them. The assignment of risk strategies follows the same risk categorization presented in the previous section.

Country (Political & Regulatory)

- Regulatory system that provides for clear and open enforcement of contracts and regulations;
- Restructuring/establishment of regulatory structures and institutions to separate policy development, regulation, and operations;
- Political risk insurance, either from export credit agencies (such as the US's Overseas Private Investment Corporation and the UK's Export Credits Guarantee Department) or from sources such as the Multilateral Investment Guarantee Agency;
- Formation of a consortium of international investors and lenders so that expropriation of the project facility will result in default of a number of international loans and jeopardize the country's credit rating to an unacceptable degree;
- Joint ventures with public partner;
- Offshore escrow account;
- Provisions for changes in regulations;
- Acquisition of land by principal; and

- Provision of a mechanism that assures foreign investors that they will be authorized to convert local currency earnings into foreign currency (i.e., convertibility guarantee).

Force Majeure

- Commercial insurance coverage;
- Principal indemnities; and
- Principal to take over outstanding debt and other financial obligations in case *force-majeure* events occur and affect the operability of the project.

Physical

- Contract with third parties (e.g., advice on environmental issues);
- Host government guarantees; and
- Insurance coverage.

Financial

- Involvement and support from international financial institutions (e.g., World Bank, European Bank for Reconstruction and Development);
- Flexible loan repayment (financial flexibility in operation);
- Capture some of the land value enhancement by the owning company in order to off-set the capital cost of the project;
- Use of outside experts;
- Infusion of equity by the principal;
- Principal's commitment to make subordinated loans available on a standby basis over a certain period of time to guarantee senior debt service when and if the project company's cash flow is insufficient for such purpose;
- Standby equity commitments;
- Appropriate financial structuring;
- Longer time horizons for loan repayment;
- Escrow arrangements to cover forward debt service and to guard against possible interruptions or ups and downs in cash flow;[53]
- Contractual arrangements with creditworthy partners;

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[53] An offshore escrow account (trust fund) gives lenders a guarantee that they will get their debt repayment before promoters can use the money elsewhere. This is because project revenues are deposited in this account, established in an "offshore" (foreign) country, and lenders are paid before funds reach the promoters of the project. An escrow account can also be used to assure foreign loans are being used, by the promoters, in the development and construction of the infrastructure project and not somewhere else because only the value of the expenses incurred by the project can be withdrawn from the account.

- Purchase of equity instruments by institutions such as the International Finance Corporation (IFC), and
- Creation of "infrastructure funds" to attract polls of capital and diversify risk.

Revenue

A. Economic

- Involvement and support from international financial institutions (e.g., World Bank, European Bank for Reconstruction and Development);
- Arrangement to capture some foreign exchange denominated or linked revenue (e.g., selling services to neighboring countries);
- Provisions in the ownership agreement allowing the project company to adjust the price of goods and services to be sold by the project according to a flexible formula (e.g., indexation according to local inflation);
- Interest rate guarantees;
- Foreign exchange guarantees (Because loans are generally made in hard currencies while project revenues occur in local currency, fluctuations in exchange rates can jeopardize debt service repayments. Governments can provide guarantees to decrease the exchange risk faced by promoters and lenders by assuring them the indemnification of project revenue losses due to currency rate fluctuations. In the Malaysian North-South Expressway, the government provided the operating company with the guarantee that it would make up the shortfall if the exchange rate dropped by more than 15% against the rates used to convert "foreign currency" in ringgits (Malaysian currency) at the time of capital infusion in the project. In another project, the Argentinean government indexed the toll rates on a privatized Buenos Aires highway to the US dollar, if the local currency loses value versus the dollar, the toll rates on the road would increase, and vice-versa);
- Use of hedging instruments (e.g., futures, swaps); and
- Have loan and revenues in the same currency (incentive to local currency financing).

B. Demand

- Restructuring of utilities and associated pricing;
- Principal's commitment to provide standby (subordinated) loans to the project company whenever revenues fall below a certain minimum;
- Protection from competition (e.g., transfer of existing facility to promoting entity, "no second facility" guarantee);
- Commercial freedom to establish tariffs or user charges at a level which can cover operating costs during the concession period and provide an adequate surplus of capital to the promoting team;
- Guarantee of revenue projections;
- Provision of compensation clauses (by the principal) to allow promoters to have greater flexibility in charging consumers in adverse economic circumstances;

- Offtake agreement guaranteeing a minimum demand volume or minimum operating income (e.g., in the power-plant project at Shajiao, China, funded on a BOT basis, the government agreed to purchase a minimum quantity of electricity, and to pay the promoters a fixed price per kilowatt-hour over the 10 year concession period. In the case of the Malaysian North-South Expressway, the government agreed to provide a loan facility if the traffic volume fell below an assured minimum level in the first 17 years of the concession period (McCarthy and Tiong, 1991));
- Feedstock (supply) agreement guaranteeing the supply of required raw materials (e.g. gas or oil, at competitive prices to enable the facility to run smoothly and compete successfully in the markets (McCarthy and Tiong, 1991));
- Throughput agreement (In this type of arrangement "customers" have contracts with the facility promoter to use the facility to transport (or process) a certain quantity of their product for a pre-determined fee. This has been used extensively in pipeline and refinery financing arrangements);
- Take-or-pay agreement (This is a long-term contract where the "customer" provides payment for a service (product) to be supplied (delivered) at stipulated levels over the period of the contract. The obligation is unconditional and payments must be made even it the "customer" does not use the service or take the product. This type of arrangement has been common in the United States in natural gas contract agreements. (Hall, 1976));
- Advanced payments (In this type of arrangement, also known as production payment, promoters sell the facilities' output before its is actually produced. This is similar to selling apartments before building them);
- Variable ownership period;
- Charging competing services (e.g., a major risk to privately promoted toll roads is competition from existing untolled roads. It may be appropriate to consider tolling competing roads);
- Structure the project with the service being sold to a public sector intermediary which subsidizes the service in selling it on to the final consumer;
- Grants from the host government to reflect the wider economic, environmental and social benefits which cannot be easily captured through fees to users; and
- Contributions from national or local taxation (tax incentives).

Promoting

- Experienced promoters;
- Creation of a strong independent owning company;
- Financially sound promoters;
- Presence of negotiating and political skills; and
- Use of outside experts.

Procurement

- Restricting the competition (limiting the number of tenderers);
- More specific tender documents;
- Clear principal requirements;
- Expediting the tender process;
- Procurement cost sharing (allowing potential promoters to collaborate on research and analysis of ground conditions, expected demand, and so on);
- Procurement cost reimbursement (e.g., the successful tenderer or the host government can refund some of the costs of the unsuccessful parties);
- Contract award criteria must be carefully considered and made known to potential promoters in advance
- Contract with third parties (e.g., advice on financial structuring, legal aspects, accountancy, etc.); and
- Protection of the intellectual property rights of potential promoters by providing adequate compensation to the innovating company.

Developmental

- Use of outside consultants (experts);
- Performance specification;
- Compatibility with existing structures; and
- Use of known/proven technology.

Construction

A. Performance

- Experienced turnkey contractor;
- Infusion of equity by construction contractors and equipment suppliers;
- Use of known/proven technology;
- Quality assurance systems;
- Penalties/bonus for delaying/on time construction;
- Completion/performance guarantees;
- Performance incentives;
- Stipulated liquidated damages; and
- Casualty insurance covering plant and equipment.

B. Cost Overrun

- Fixed price construction contract (firm date, lump-sum, turnkey construction contract);
- Presence of a reasonable contingency allowance for cost and time variations; and
- Standby loan facility.

C. Liability

- Commercial insurance coverage (insurance against physical loss or damage to the project facility, general liability insurance, builders all risk insurance, and workmen's compensation insurance).

Operating

A. Performance

- Experienced and qualified operator;
- Infusion of equity by operators (in order to increase their willingness to succeed);
- Use of known/proven technology;
- Principal's approval for the facility to be operated;
- Performance incentives;
- Quality assurance systems;
- Compatibility with existing structures;
- Casualty insurance covering plant and equipment;
- Strategic alliances with reputable firms; and
- Commercial insurance covering business interruption.

B. Cost Overrun and Liability

- Presence of a reasonable contingency allowance for cost variations;
- Standby loan facility; and
- Commercial insurance coverage.

3.4 Summary

Risk is an inherent part of any privately-promoted infrastructure project. A keen understanding of project risks is essential to the success of privately-promoted infrastructure projects. The identification and analysis of the risks presented in a particular project and their subsequent reduction and allocation to those participants best able to manage them is central to the success of any undertaking.

In this chapter, risks have been classified into ten categories. Each category was individually discussed and an extensive, but non-exhaustive, list of risk management strategies was presented. The objective of such list is to recommend risk management actions and strategies that give better control and reduce the financial impact of project risks to the private-sector participants. Strategies that improve the risk-reward ratio of

the project without decreasing the incentive gains that the private sector might bring are of particularly interest. Some of these strategies are:

- Creation of a national framework for the promotion of infrastructure projects;
- Streamlined procurement process;
- Limited numbers of tenderers;
- Clear contract criteria;
- Variable ownership period;
- No upper limit ("cap") on the investors' and promoters' return on investment;
- Commercial freedom to establish tariffs or user charges;
- Government guarantees on risks largely outside the control of the private sector; and
- Take over of competing facilities.

Quantitative risk analysis is not within the scope of this report. The reader is directed to the works of Pouliquen (1970), Reutlinger (1970), Lifson and Shaiffer (1982), Hertz and Thomas (1983), Cooper and Chapman (1987), Al-Bahar (1988), and Thompson and Perry (1992) for an exposure of the different approaches used to quantify project risks.

4 Background on the Concepts Used to Develop the Desirability Model

"There is a prevalent myth that the expert judge of men succeeds by some mystery of divination. Of course, this is nonsense. He succeeds because he makes smaller errors in the facts or in the way he weights them. Sufficient insight and investigation should enable us to secure all the advantages of the impressionistic judgment without any of its defects."

E. L. Thorndike, 1918

The ability to analyze situations and to make good decisions is a very important aspect of any managerial work. The decision making process involves several tasks: planning, generating a set of alternatives, setting priorities, choosing a best policy after finding a set of alternatives, allocating resources, determining requirements, predicting outcomes, designing systems, measuring performance, insuring the stability of a system, optimizing, and resolving conflict (Saaty, 1980). Usually, the decision maker formulates his analysis considering a single criteria or objective (e.g., minimize construction costs, increase labor productivity, etc.) however, some situations require the decision maker to consider several dimensions simultaneously in order to provide an acceptable solution.

The decision as to whether or not private-sector companies should promote infrastructure projects is one of these situations that demand the identification and consideration of several simultaneous dimensions (e.g., maximization of project revenues, minimization and allocation of project risks, availability of finance, maintenance of an acceptable range of debt-equity ratios, etc.). Hence, a multiattribute decision methodology should be used to evaluate the various factors affecting the company's

analysis. This chapter describes the method used to create and develop a multicriteria tool that companies can use to analyze their capability of promoting infrastructure projects and the potential these projects have to become successful endeavors under private promotion. It reviews the concepts that provide the theoretical skeleton for the development of the Desirability Model, namely, the type of function adopted to aggregate the individual contributions of the model attributes, the weighting procedures used to determine the relative importance of these attributes, and the form of curves used to convert the level of performance (quality) of the attributes into numerical worth scores. The next chapter reports and discusses the data provided by the experts that participated in the survey.

4.1 Motivation to Formulate a Multiattribute Decision Model

It is known that individuals have their judgmental capacities broken down or perform sub-optimally when making complex (i.e., involving a large number of dimensions) decisions (Miller, 1956). Gardiner (1974) provided examples of studies where decision makers have evaluated multiattribute alternatives by resorting to intuitive and subjective evaluation processes and have had difficulty in integrating the diverse sources of information into an overall judgment of worth or a decision about a course of action. As the number of parameters to be considered increase, judgmental (holistic) evaluations tend to fail to preserve the underlying values of the decision making and to produce unreliable evaluations (not consistent over a period of time and not easily reproducible).

A decomposed evaluation approach can advantageously substitute a holistic evaluation by providing a more reliable and consistent procedure to deal with complex (multiattribute) decisions. One of the first (linear) decomposed models documented was proposed by Benjamin Franklin in a letter (in Bigelow, 1887) to his friend, Joseph Priestly in 1772:

> *"In the affair of so much importance to you, wherein you ask my advice, I cannot, for want of sufficient premises, advise you what to determine, but if you please I will tell you how. When these difficult cases occur, they are difficult, chiefly because while we have them under consideration, all the reasons pro and con are not present to the mind at the same time; but sometimes one set present themselves, and at other times another, the first being out of sight. Hence the various purposes or inclinations that alternatively prevail, and the uncertainty that perplexes us. To get over this, my way is to divide half a sheet of paper by a line into two columns; writing over the one Pro, and over the other Con. Then, doing three or four days' consideration, I put down under the different heads short hints of the different motives,*

> *that at different times occur to me for or against the measure. When I have thus got them all together in one view, I endeavor to estimate the respective weights; and where I find two, one in each side, that seem equal, I strike them both out. If I find a reason pro equal to some two reasons con, I strike out the three. If I judge some two reasons con, equal to some three reasons pro, I strike out the five; and thus proceeding I find at length where the balance lies; and if, after a day or two of further consideration, nothing new that is of importance occurs on either side, I come to a determination accordingly. And, tough the weight of reasons cannot be taken with the precision of algebraic quantities, yet, when each is thus considered, separately and comparatively, and the whole matter lies before me, I think I can judge better and am less liable to make a rash step; and in fact I have found great advantage for this kind of equation, in what may be called moral or prudential algebra."*[54]

However, despite the possibility of having a consistent procedure to aid decision makers, people feel averse and have an emotional resistance to the use of evaluation rules because they introduce some "mechanical rigidity" into the decision process (Hogarth, 1987). Dawes (1977) tried to lower such aversion by showing that the advantage of such rules is the creation of a "general policy" to evaluate different projects under the same grounds instead of recreating policies for each project. Several studies (Edwards, 1971; O'Connor, 1972; Gardiner, 1974; Guttentag and Snapper, 1977) addressed the benefits of using the decomposed evaluation approach. O'Connor (1972), for example, used a multiattribute model to create water quality indices and De Neufville and Keeney (1972) employed a multiattribute utility model, with six attributes, for the evaluation of an airport facility in Mexico City.

In particular, Gardiner (1974) developed a multiattribute model to evaluate permit requests for the development of single-family, duplex, triplex, or multi-family dwellings in the coastal zone of Southern California. Ten experts, divided in two groups with different viewpoints (i.e., group 1 is formed by the development-oriented respondents and group 2 by the conservationists) evaluated 15 hypothetical development plans using their intuitive judgment and using a model called MARS — Multiattribute Additive Rating Scales.

Gardiner reported that the two groups provided substantially different holistic evaluations over the fifteen-plan set (see the top chart in Figure 4-1). When using MARS, however, the evaluations of the two groups follow a similar pattern and show a greater agreement even though they place different importance on the alternatives (see the bottom chart on Figure 4-1). Edwards (1977) tried to provide a plausible explanation for the results of this study by arguing that "when making holistic evaluations, people with

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54 First referenced by Dawes, R.M. and Corrigan, B. Linear Models in Decision Making. Psychological Bulletin; February 1974; Vol. 81(2): pp. 95.

strongly held points of view tend to concentrate on those aspects of the entities being evaluated that most strongly engage their biases. The multiattribute procedure does not permit this; it separates judgment of the importance of a dimension from judgment of where a particular entity falls on that dimension."

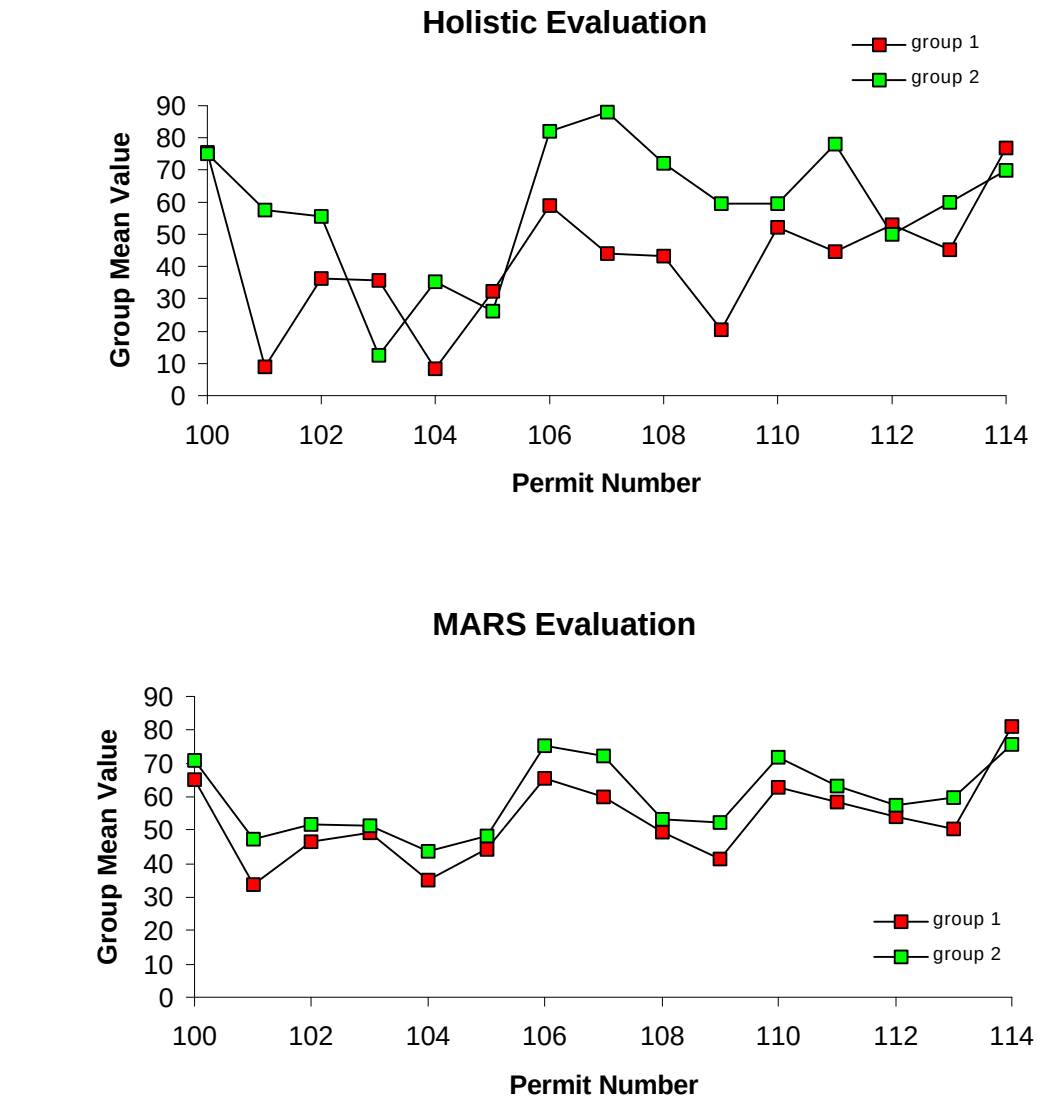

Figure 4-1: Evaluation of Hypothetical Development Plans Using a Holistic Approach and a Decomposed Multiattribute Model (Gardiner, 1974, pp. 134)

The amount of resources invested by private companies in the promotion of infrastructure projects is tremendous. In deciding to engage in the promotion of infrastructure projects, companies face two basic questions: "Is the company capable of

promoting an infrastructure project?" and "Is the project attractive enough to compensate for the risks the company will encounter?" Figure 4-2 shows a schematic decision tree representing the decisions companies face when addressing their participation in this type of projects. The squares represent "decision nodes," the circle represents "chance nodes," *p* is the probability that a company is chosen to promote a project. Similarly, 1-*p* (the complement of *p*) is the probability that a company is not chosen to promote a project.

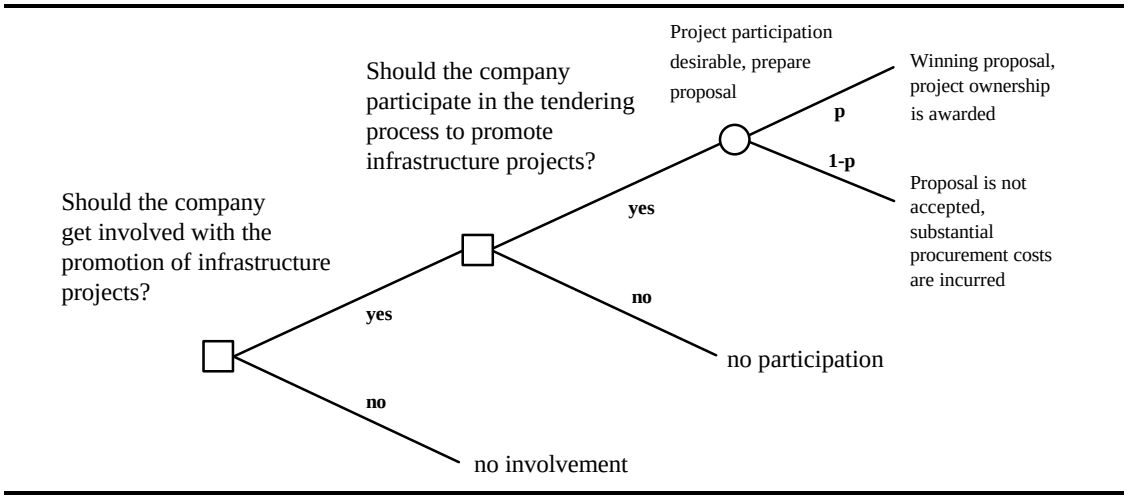

Figure 4-2: Schematic decision tree for companies deciding to get involved and to participate in the promotion of infrastructure projects.

Unquestionably, the aforementioned decisions are complex as they are influenced by several parameters and because most parameters have a subjective, non-quantifiable, nature. This study addresses the evaluation of privately-promoted infrastructure projects from the promoters' point of view and, in doing so, elaborates a model — called **Desirability Model** (DM) — that has two main objectives:

- To provide a logical, reliable and consistent procedure that facilitates a company's decision to engage in the promotion of an infrastructure project through the analysis of different parameters, the combination of their qualitative characteristics, and the calculation of two indices that assess the company's capability to become a promoter and the project's feasibility to be privately promoted; and

- To allow sensitivity analysis to be performed such that prospective promoters can evaluate how different scenarios (e.g., risk mitigation strategies) influence both indices, and consequently, the decision the company has in getting involved and participating in the promotion of projects.

4.2 The Structure of the Desirability Model

The model developed in this study uses a functional hierarchy to represent the important dimensions of both decisions faced by companies that contemplate the private promotion of infrastructure projects. In the adopted three-level hierarchical structure, more general dimensions are placed on the top while more specific ones are at the bottom. The first (highest) level of the model consists of two dimensions (called classes): company competencies and project attractiveness. The second (intermediate) level consists of seven dimensions (called categories) and the third (lowest) level consists of 23 dimensions (called attributes).

It is important to note that the hierarchy used in this model differs from the ones used in the majority of multicriteria problems. Typically, the hierarchies used in these problems have many dimensions, there is more than one alternative to choose from, and the objective of the decision maker is to find the alternative that best fits the overall focus or goal of the situation being analyzed. In contrast, the objective of the Desirability Model is not to help choose the best project among several alternatives, but rather to decide if it is feasible for the project being analyzed to be privately promoted and if the company is capable of doing so. Therefore, the level "alternatives," typically at the top of the hierarchy, does not exist in the Desirability Model. Instead, the model measures the worth of projects and companies by aggregating the worth of individual attributes.

In discussing the procedure used to aggregate the worth of individual attributes to form indices that reflect the overall worth of projects and companies, the following terminology will be used.

Let

$$\bar{x} = (x_1, x_2, \ldots, x_n) \tag{4.1}$$

be a vector describing the attributes that effectively encapsulate the characteristics of a potential privately-promoted infrastructure project (promoting company), and

$$v(\bar{x}) = v(h_1, h_2, \ldots, h_n) \tag{4.2}$$

be the value that represents the overall worth of the project (company), $v(\cdot)$ represents some intuitive evaluation function, and h_i is a function that represents the contribution of x_i to the worth of $\bar{x}$. Then, in order to find the necessary information to construct the model, it is necessary to:

- Identify the set of relevant attributes, $\bar{x}$, that are going to be used to measure the level of project attractiveness (company capability);
- Identify for whom the function $v(\bar{x})$ is to be found;

- Specify the appropriate form of $v(\cdot)$, the aggregation function, for determining the project attractiveness (company competencies) index; and
- Determine the appropriate forms of h_i.[55]

4.3 Identification of Model Attributes

The most important task in the development of a multiattribute decision model is the identification of the relevant model attributes. Keeney and Raiffa (1976) suggest five criteria for considering the adequacy of parameters (dimensions) chosen to represent a problem:

- *Completeness* — all important aspects of the problem should be covered by the parameters.
- *Operational* — the parameters should be meaningful to the decision maker and other people involved in the problem.
- *Decomposible* — parameters need to be decomposible into simpler parts to allow "intelligible" handling.
- *Non-redundancy* — different parameters should not measure the same thing by different means.
- *Minimal* — the number of parameters should be kept to the minimum possible. Edwards (1977) advises that when starting an analysis one should be careful not to include too many dimensions; as a rule of thumb, "eight dimensions is plenty and fifteen is too many."

In addition, Wedley (1990) points out that parameters that belong to the same hierarchical level should present the same order of magnitude so that meaningful comparisons can be made.

As said before, the Desirability Model is composed of three levels. The first level consists of two classes, the second level of seven categories and the third level of twenty-three attributes. Figure 4-3 displays the first and second levels of the model. We developed these two levels based on one of the objectives of this study (i.e., the calculation of two indices that assess the company's capability to become a promoter and the project's feasibility to be privately promoted) and based on information acquired from the literature. These levels were presented to the experts participating in the study in the first questionnaire. We defined the three categories which companies should use to evaluate to demonstrate their potential to be involved in a privately-promoted project as follows:

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[55] In utility theory, h_i would represent an one-dimensional utility function and $v(\cdot)$ a n-dimensional utility function.

- **Internal Organization Characteristics** — Companies should assess the adequacy (i.e., experience and quality) of their management team to handle the complexity and scope of the project and the interaction among the different companies participating in the enterprise. They should also check how well the project fits their strategic objectives regarding their access to new markets, the enhancement of their corporate image, and the expansion and diversification of their line of business.

- **Production Capability** — In this category companies should consider their ability to provide the necessary resources (e.g., human and equipment) and to use their specialized technical knowledge to enhance the likelihood of project success. Their expertise in other areas relevant to the project is also of importance and should be analyzed. For instance, besides the technical capability of constructing a facility, a contractor might also provide skills to operate and maintain the project.

- **Financial Resources and Constraints** — Companies should examine their ability to fund the initial stages of the project (e.g., feasibility studies, preliminary design, proposal preparation, etc.) and to invest their own financial resources, normally through equity infusions, in order to provide funds for the project during its "non-revenue" phase. Companies should also consider the quality of the project return on their investment in terms of its expected amount, its certainty (risk profile), and its timing.

We also defined the four categories that companies should use to analyze the level of attractiveness of different projects. They are:

- **Promoting Team Characteristics** — Companies should examine the strength of other promoters (e.g., their engineering talent, facility-operating experience, in-country knowledge, local contacts, negotiating skills and financial capabilities) and their ability to create and develop a management team capable of identifying strategies and pursuing objectives that enhance the project's likelihood of success rather than making decisions based on what is best for individual promoters.

- **Technical Evaluation** — In this category companies should consider the promoting team's ability to provide an appropriate technical solution for the needs of the project. Factors to be considered include: the functionality of the design, the use of well-known construction technologies, the length of the construction period, and the capacity to offer simple and efficient operational procedures. The availability of skilled labor and other resources for the construction and operation of the facility are also of importance and should be examined.

- **Financial Assessment** — The requirement that projects need to provide the necessary cash flows to pay for loans and to give an adequate return on investment for the project's investors is essential but not sufficient to have a financially sound project. Companies should assess the certainties (i.e., risk profiles) of the construction costs, operational costs, and operational revenues. They should also

evaluate the availability of adequate financial instruments to raise the necessary financing, the project's capacity to repay the debt financing and the project's cash flow exposure to foreign exchange fluctuations.

- **Principal's Qualification & Local Conditions** — The idea is that companies should be capable of evaluating how local conditions impact projects. They should analyze the political stability of the local country (e.g., possibility of riots, terrorism, general strikes, and wars); the local government commitment to the project; the local government regulations and restrictions on the project (e.g., environmental laws, taxation and controls on equity, repatriation of funds and exchange mechanisms); the economic policies and trends (e.g., fiscal and monetary controls, economic growth, etc.); and the community attitude towards the project.

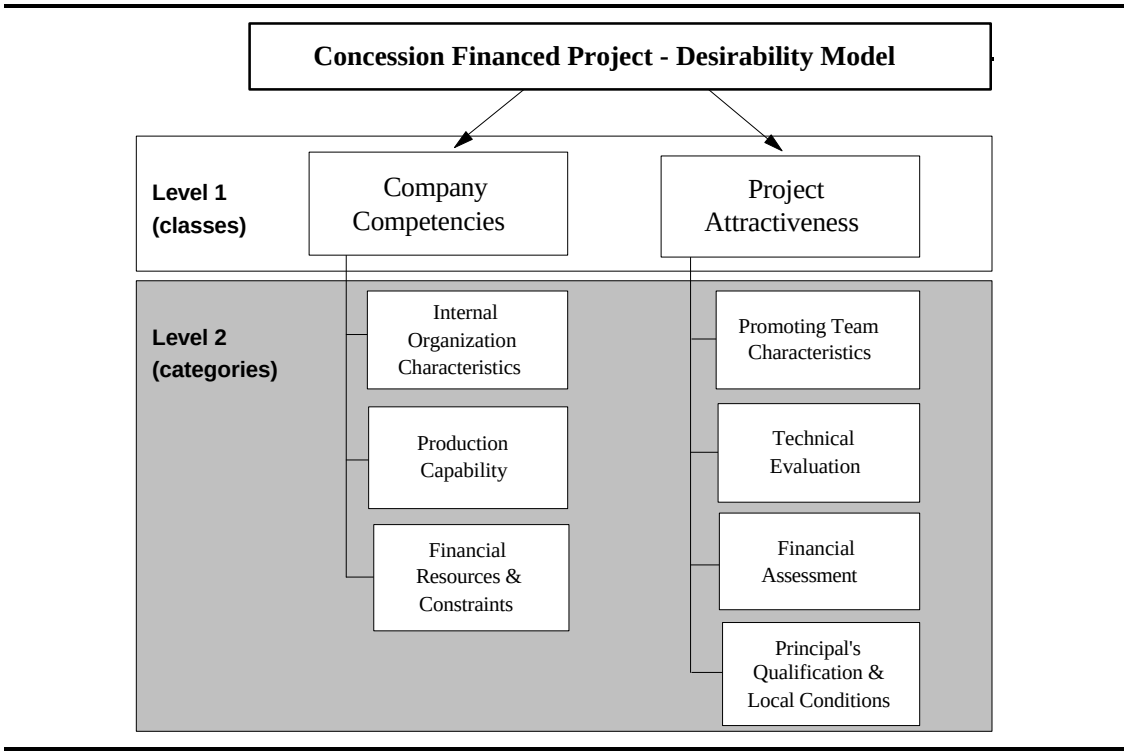

Figure 4-3: Hierarchical Structure of the Desirability Model

Then, we provided experts with several model attributes and asked them to classify these attributes into the different model categories. The objective of this task was to capture the expertise of the respondents in an active but structured manner as we presupposed that the experts would be influenced by pre-establish groupings of attributes. In this case, the experts would probably assume a more passive role in the elaboration of the third level of the Desirability Model as they would only examine some attributes and would not classify them. A "non-relevant" category allowed respondents to exclude from

the list of attributes those that, in their opinion, had no apparent value in the decision to engage in private promotion of infrastructure projects.

We also asked the experts to add the attributes they judged necessary to enhance the quality of the model. The information gathered from the first questionnaire was compiled and resulted in nine company-related attributes and fourteen project-related attributes. A discussion of each attribute, grouped by category, is presented in the next chapter.

4.4 The Aggregation Function

The aggregation function, $v(\cdot)$, combines the contribution of the relevant model parameters to determine the overall worth of an object (alternative), $v(\bar{x})$. This aggregation can take several functional forms, the most common are:[56] (von Winterfeldt and Edwards, 1986)

- Additive
$$v(\bar{x}) = k_1 v_1(x_1) + k_2 v_2(x_2) + k_3 v_3(x_3) \qquad (4.3)$$

- Multiplicative (compact)
$$Kv(\bar{x}) + 1 = \left[Kk_1 v_1(x_1) + 1\right] * \left[Kk_2 v_2(x_2) + 1\right] * \left[Kk_3 v_3(x_3) + 1\right] \qquad (4.4)$$

- Multiplicative (extended)
$$\begin{aligned} v(\bar{x}) = {} & k_1 v_1(x_1) + k_2 v_2(x_2) + k_3 v_3(x_3) + \\ & + Kk_1 k_2 v_1(x_1) v_2(x_2) + \\ & + Kk_1 k_3 v_1(x_1) v_3(x_3) + \\ & + Kk_2 k_3 v_2(x_2) v_3(x_3) + \\ & + Kk_1 k_2 k_3 v_1(x_1) v_2(x_2) v_3(x_3) \end{aligned} \qquad (4.5)$$

- Multilinear
$$\begin{aligned} v(\bar{x}) = {} & k_1 v_1(x_1) + k_2 v_2(x_2) + k_3 v_3(x_3) + \\ & + k_{1,2} v_1(x_1) v_2(x_2) + \\ & + k_{1,3} v_1(x_1) v_3(x_3) + \\ & + k_{2,3} v_2(x_2) v_3(x_3) + \\ & + k_{1,2,3} v_1(x_1) v_2(x_2) v_3(x_3) \end{aligned} \qquad (4.6)$$

where k_i is the weight of attribute i (and will be referred as w_i from here on),[57] $v_i(x_i)$ is the value function of attribute i (i.e., the function that is used to transform the performance of

[56] For elucidation purposes, without losing generality, a model with three attributes is assumed in the formulations that follow.

attribute i into its worth), and K is a normalizing parameter that insures consistency between $v(\bar{x})$ and the $v_i(x_i)$, that is, if all $v_i(x_i)$ are at their best levels (i.e., 1.0) then $v(\bar{x})$ should also be equal to 1.0. Substituting $v_i(x_i) = 1$ for all i into (4.4) provides the following polynomial expression:

$$K + 1 = \prod_{i=1}^{n} (Kk_i + 1) \tag{4.7}$$

where K can be determined by trial and error. The additive and multiplicative (compact) functions are the most common aggregation procedures (von Winterfeldt and Edwards, 1986). The multiplicative (compact) function (given by equation 4.4) is the definition of a multiattribute utility curve when assuming preferential independence and utility independence. The additive function is a special case of the multiplicative (compact) version.[58]

For the aggregation form to be additive a condition known as "additive difference independence" must hold (Dyer and Sarin, 1979). In order to define additive difference independence, consider the following two alternatives, $\bar{x}$ and $\bar{y}$, that differ only on the contribution of attribute i:

$$\bar{x} = (a_1, a_2, a_3, \ldots, x_i, \ldots, a_n) \tag{4.8}$$

$$\bar{y} = (a_1, a_2, a_3, \ldots, y_i, \ldots, a_n) \tag{4.9}$$

The difference between both overall worth functions is determined only by x_i and y_i:

$$\begin{aligned} v(\bar{x}) - v(\bar{y}) &= \sum_{j \neq i} w_j v(a_j) + w_i v(x_i) - \sum_{j \neq i} w_j v(a_j) - w_i v(y_i) \\ &= w_i \left[v(x_i) - v(y_i) \right] \end{aligned} \tag{4.10}$$

Further consider, $\bar{x}'$ and $\bar{y}'$, having the same x_i and y_i as $\bar{x}$ and $\bar{y}$ but different contribution levels for the other attributes:

$$\bar{x}' = (b_1, b_2, b_3, \ldots, x_i, \ldots, b_n) \tag{4.11}$$

$$\bar{y}' = (b_1, b_2, b_3, \ldots, y_i, \ldots, b_n) \tag{4.12}$$

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57 Keeney and Raiffa (1976) emphasize that, in case of utility curves, k_i's are not importance weights for attributes but rather individual scaling factors used to make single-attribute assessments consistent with overall assessments.

58 The multiplicative (compact) function is equal to the additive function when $\sum_{i=1}^{n} w_i = 1$.

The difference between the above overall worth functions is again determined only by x_i and y_i:

$$v(\bar{x}') - v(\bar{y}') = w_i\left[v(x_i) - v(y_i)\right] \tag{4.13}$$

This implies "additive differential independence" as follows:

$$v(\bar{x}) - v(\bar{y}) = v(\bar{x}') - v(\bar{y}') \tag{4.14}$$

Therefore, if alternatives $\bar{x}$ and $\bar{y}$ differ from $\bar{x}'$ and $\bar{y}'$ only in the constant attributes (i.e., a_1, a_2,..., a_n, b_1, b_2, ..., b_n) then additive difference independence means that the strength of preference of alternatives (and also their performance order) is maintained when attribute i remains fixed while all attributes are assigned to a different level, that is if $x_i \geq y_i$ then $\bar{x} \,\tilde{\phi}\, \bar{y}$ and $\bar{x}' \,\tilde{\phi}\, \bar{y}'$. Note that additive difference independence does not mean that the decision maker does not consider the other attributes important. It only implies that the preference order of alternatives does not change because of changes in the level of the constant attributes. A simple way of thinking about this condition is that the shape of the value function for attribute i, $v_i(x_i)$, would be unaffected when constructed at different levels of the other attributes, and the relative weight, w_i, attached to the value function would remain constant.

Dawes and Corrigan (1974), Einhorn and Hogarth (1975), and Dawes (1979) affirm that even when attribute independence conditions are not entirely satisfied, the additive function can approximate nonadditive forms very well if individual attribute monotonicity holds true. This condition states that an increase in the worth of attribute j does not ever decrease the overall value of an alternative, that is, if $a_j > b_j$ then $\bar{x} \,\tilde{\phi}\, \bar{x}'$ and $\bar{y} \,\tilde{\phi}\, \bar{y}'$. Yntema and Torgerson (1961) have shown that, as long as monotonicity holds, approximately 94% of the variance on the worth of alternatives is accounted for by an additive function. Rorer (1971) and Dawes (1968) use computer simulation to show the high degree of fit between multivariate models with monotonic parameters and linear approximations. Fisher (1972) shows the high degree of correlation (0.964 for three attributes, 0.985 for six, and 0.990 for nine) between a model that uses the aggregation rule below and an additive approximation.

$$v(\bar{x}) = v(h_1, h_2, \ldots, h_n) = \sum_i h_i + \sum_i \sum_{j, i \neq j} h_i h_j \tag{4.15}$$

Several authors have taken advantage of the two conditions above mentioned (i.e., additive differential independence and monotonicity) to develop multiattribute rating models (Edwards, 1971; O'Connor, 1972; Gardiner, 1974). In this study both conditions are expected to hold because the model attributes are assumed to be independent (i.e., the evaluation of an attribute does not depend on the levels of other attributes) and because increases in the quality of attributes would never decrease the overall value of an alternative (i.e., more of a good thing is better or more of a bad thing is worse).

Therefore, the aggregation function is assumed to have an additive form. Questionnaires One, Two, and Three were used to acquire the information necessary to structure the aggregation function $v(\bar{x})$, that is, to determine the importance weights, w_i, and to establish the value functions, $v_i(x_i)$, for each of the model attributes. The next two sections provide a theoretical background on the weighting procedures and on the value functions used in this study. The next chapter presents the results obtained from the experts and discusses its implications.

4.5 The Weighting Procedure

In this study, two subjective methods are used to assign importance weights to the different parameters of the Desirability Model: the direct rating method and the eigenvalue method. The direct rating method (DRM) is used by Edwards in the development of a multiattribute decision method called Simple Multi-Attribute Rating Technique (SMART).[59] The eigenvalue method (EM) is used by Saaty in the development of another multiattribute decision method, the Analytic Hierarchy Process (AHP).[60] The objectives of using both methods are twofold: (1) to verify if the different methods yield different weights and (2) in case of weight differences, to verify if there are differences in model prediction. The next two sub-sections elucidate how these methods work.

4.5.1 The Direct Rating Method (DRM)

The direct rating method (DRM) was developed by Edwards (1971, 1977) to determine the relative importance weights of different attributes of a multiattribute model. This method requires the decision maker to perform the following tasks:

- Rank order the attributes in decreasing in order of importance (ties are possible),
- Weigh the attributes in importance-preserving ratios (to do this, assign the value 10 to the least important (lowest ranked) attribute, consider the next least-important attribute, assign it a number that reflects how much more important it is than the least important, continue the procedure up the list of attributes and check each set of implied ratios, among the attributes already considered, as each new judgment is made), and

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59 A review of some of the multiattribute models developed using SMART appears in von Winterfeldt and Edwards (1986).

60 A comprehensive review of AHP applications appears in Zahedi (1986), Vachnadze and Markozashvili (1987), and Vargas (1990).

- Normalize the final weights (divide the value given to each attribute by the sum of the values given to all attributes).[61]

For example, in order to determine the relative importance of the three attributes (G, H, I) of a model, it is first necessary to rank them in decreasing order of importance (e.g., I, G, H). Second, assign a value of 10 to H (i.e., the least important parameter). Next, move over to the next more important parameter (G in this example), compare it to H and assign a value that reflects how much more important G is over H (e.g., if G is three times more important than H then the value of attribute G is 30). Continue up the list of attributes, checking each set of implied ratios every time a new judgment is made. If attribute I is assigned a weight of 30, it should be three times more important than H and have the same importance as G. Finally, normalize the values given to all parameters to determine their relative importance weights: $w = (30/(30+10+30) = 0.429, 0.143, 0.429)$.

4.5.2 The Eigenvalue Method (EM)

The eigenvalue method (EM) is used by Saaty in the development of the Analytic Hierarchy Process (AHP). The basic purpose of the eigenvalue method is to derive importance weights from pairwise comparisons among the different attributes of a multiattribute model. The pairwise comparisons are performed with the aid of a qualitative scale that tries to incorporate the decision maker's subjectivity and experience and to reflect the degree to which the decision can discriminate among the intensity of relationships between attributes. Saaty (1980) compared several scales and concludes that a qualitative scale with intensities ranging from 1 to 9 is the most appropriated one. The stated reasons for this choice are the following:

- The qualitative distinctions are meaningful in practice and have an element of precision when the items being compared are of the same order of magnitude or close together with regard to the property used to make the comparison.

- The human ability to make qualitative distinctions is well represented by five attributes: equal, weak, strong, very strong, and absolute. As, we can make compromises between adjacent attributes when greater precision is needed, the totality requires nine values.

- The assumption that the brain can simultaneously process 7±2 items (Miller, 1956).

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[61] Similar procedures have been suggested by other authors. O'Connor (1972) used a procedure where the most important parameter is assigned a value of 100 and all other parameters are rated relative to that parameter (hence, receiving values lower than 100). Schoemaker and Waid (1982) have asked subjects to directly distribute 100 points among the different model parameters.

The qualitative definitions used in the original AHP scale are: equal importance, moderate or weak importance, strong or essential importance, very strong or demonstrated importance, and absolute or extreme importance. A slightly modified version of the above scale is adopted in this study in an attempt to have a more uniform distance among the verbal expressions than the one provided by the original scale. Table 4-2 lists the verbal expressions employed in this research and their correspondent intensities of importance.

Intensity of importance	**Definition**	**Explanation**
1	Equal importance	Two parameters contribute equally to the objective.
3	Slight importance of one over another	Experience and judgment slightly favor one parameter over another.
5	Moderate importance	Experience and judgment moderately favor one parameter over another.
7	Substantial importance	One parameter is favored very strongly over the other.
9	Absolute importance	The evidence favoring one parameter over another is of the highest possible order of affirmation.
2,4,6,8	Intermediate values between adjacent scale values	When compromise is needed.
Reciprocals of above nonzero	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	Assumption.

Table 4-1: Scale used to perform pairwise comparisons (Adapted from Saaty, 1980)

Once pairwise comparisons have been made among the different model attributes, a comparison matrix can be assembled and the relative importance weights can be determined through the use of the eigenvector method. A model with n attributes needs n(n-1)/2 comparisons to be made in order to provide information to assemble the comparison matrix. This is because the comparison matrix is reciprocal, that is, the elements of the main diagonal, $a_{i,i}$ (for all i = 1, 2, ..., n), are equal to unity and the elements below the main diagonal are reciprocal to the elements above the main diagonal ($a_{j,i} = 1/ a_{i,j}$). An example will help illustrate the procedure.

Let us determine the relative importance weights of a three-attribute model according to a specific criterion. The attributes are: G, H, and I. First it is necessary to make a pairwise comparison of the attributes, that is, compare G with H, G with I, and H with I.[62] Suppose that the comparisons yield the following results:

- G is slightly more important than H;
- G and I are equally important; and
- I is slightly more important than H.

Then, the comparison matrix M given by the above pairwise (ratio) comparison is

$$M = \begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \\ a_{3,1} & a_{3,2} & a_{3,3} \end{bmatrix} = \begin{bmatrix} 1 & a_{1,2} & a_{1,3} \\ 1/a_{1,2} & 1 & a_{2,3} \\ 1/a_{1,3} & 1/a_{2,3} & 1 \end{bmatrix} = \begin{bmatrix} 1 & 3 & 1 \\ 1/3 & 1 & 1/3 \\ 1 & 3 & 1 \end{bmatrix}$$

In the case of *exact transitivity*[63] the relations between the relative importance weights w_i and the elements $a_{i,j}$ are given by

$$\frac{w_i}{w_j} = a_{i,j} \quad \text{for } i, j = 1,2,3,\ldots,\text{n} \qquad \text{and} \tag{4.16}$$

$$M = \begin{bmatrix} w_1/w_1 & w_1/w_2 & \ldots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \ldots & w_2/w_n \\ \text{M} & \text{M} & \text{O} & \text{M} \\ w_n/w_1 & w_n/w_2 & \ldots & w_n/w_n \end{bmatrix}$$

Rewriting (4.16) gives

$$\frac{w_j}{w_i} a_{i,j} = 1 \quad \text{for } i, j = 1,2,3,\ldots,\text{n} \tag{4.17}$$

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62 The appropriate question to ask when performing pairwise comparison is: "With respect to criterion X (e.g., category 'financial assessment'), which of the two attributes (e.g., 'availability of adequate financial sources to raise the financing' or 'certainty of revenues') is more important? By how much?"

63 The transitivity axiom states that, for any three outcomes, O1, O2, and O3, if O1 is preferred to O2, and O2 is preferred to O3, then O1 is preferred to O3. Exact transitivity refers not only to preferences but also to the intensity of preference (e.g., if O1 is twice as preferred as O2, and O2 is three times as preferred as O3, then O1 should be six times as preferred as O3.)

Thus,

$$\sum_{j=1}^{n} a_{i,j} w_j \frac{1}{w_i} = n \quad \text{for } i = 1,2,3,\ldots,\text{n} \tag{4.18}$$

or

$$\sum_{j=1}^{n} a_{i,j} w_j = n w_i \quad \text{for } i = 1,2,3,\ldots,\text{n} \tag{4.19}$$

The above formula can be expressed in the following matrix equation format:

$$Mw = nw \tag{4.20}$$

In matrix theory, (4.20) represents the fact that w is an eigenvector of M with eigenvalue n. In our example, the above equation can be written as

$$\begin{bmatrix} 1 & 3 & 1 \\ 1/3 & 1 & 1/3 \\ 1 & 3 & 1 \end{bmatrix} * \begin{bmatrix} w_1 \\ w_2 \\ w_3 \end{bmatrix} = 3 * \begin{bmatrix} w_1 \\ w_2 \\ w_3 \end{bmatrix}$$

Solving the system of equations with the normalizing condition $\Sigma w_i = 1$ gives: w = (0.429, 0.143, 0.429) which are the relative weights for attributes G, H, and I respectively. Note that this result is exactly the same as the result obtained in the example that illustrates the direct rating method (Section 4.5.1). This is because the pairwise comparisons among the different attributes (i.e., the values of the elements $a_{i,j}$) in this example are equal to the ratios between the importance values of the attributes of the DRM example (e.g., $a_{G,H} = v_G / v_H = 30/10 = 3$).

Let us now turn to an example where the decision maker provides the following analysis when comparing attributes G, H, and I:

- G is slightly more important than H;
- G and I are equally important; and
- I is moderately more important than H.

The comparison matrix M' given by the above pairwise (ratio) comparison is

$$M' = \begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \\ a_{3,1} & a_{3,2} & a_{3,3} \end{bmatrix} = \begin{bmatrix} 1 & 3 & 1 \\ 1/3 & 1 & 1/5 \\ 1 & 5 & 1 \end{bmatrix}$$

In this case *exact transitivity* does not hold, and hence the relation $a_{i,j} = w_i / w_j$ is not valid. However, Saaty (1980) noted that if matrix M' is reciprocal, then small variations of the $a_{i,j}$ keep the maximum eigenvalue λ_{max} close to n and a unique solution for the relative weights of the different parameters still exists (i.e., w_i and w_j can change to accommodate the change in $a_{i,j}$ from the ideal case).[64] Thus, (4.19) can be rewritten as

$$\sum_{j=1}^{n} a_{i,j} w_j = \lambda_{max} w_i \quad \text{for } i = 1,2,3,\ldots,n \tag{4.21}$$

and the problem becomes to find the eigenvector w' that satisfies

$$M'w' = \lambda_{max} w' \tag{4.22}$$

The operational procedure used to compute the vector of relative importances, or eigenvector w', for a certain comparison matrix M' consists of elevating the matrix to a certain power p where the differences amongst its normalized columns are smaller then a certain ε (i.e., 0.001). The eigenvector w' is any one of the normalized columns of the matrix $(M')^p$. In the above example we have:

$$(M')^2 = \begin{bmatrix} 3.000 & 11.000 & 2.600 \\ 0.867 & 3.000 & 0.733 \\ 3.667 & 13.000 & 3.000 \end{bmatrix} \quad \text{normalized}(M')^2 = \begin{bmatrix} 0.398 & 0.407 & 0.411 \\ 0.115 & 0.115 & 0.116 \\ 0.487 & 0.482 & 0.474 \end{bmatrix}$$

$$(M')^3 \quad \begin{bmatrix} 9. & 33\,000 & .800 \\ 2. & 9\,267 & .200 \\ 11. & 39\,000 & .267 \end{bmatrix} \quad \text{normal} \quad (M')^3 \quad \begin{bmatrix} 0. & 0\,406 & .405 \\ 0. & 0\,114 & .114 \\ 0. & 0\,480 & .481 \end{bmatrix}$$

$$(M')^4 = \begin{bmatrix} 28.07 & 99.80 & 23.67 \\ 7.89 & 28.07 & 6.65 \\ 33.27 & 118.33 & 28.07 \end{bmatrix} \quad \text{normalized}(M')^4 = \begin{bmatrix} 0.405 & 0.405 & 0.405 \\ 0.114 & 0.114 & 0.114 \\ 0.481 & 0.481 & 0.481 \end{bmatrix}$$

Therefore, the normalized columns of $(M')^p$ as $p \to \infty$ converge to the importance weights w' = (0.405, 0.114, 0.481).

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64 The sum of the eigenvalues of a matrix with elements $a_{i,i} = 1$ for $i = 1,2,\ldots,n$ is equal to n. If the matrix is consistent, then all eigenvalues are zero, except one, which is n (i.e., $\lambda_{max} = n$). Small variations of the $a_{i,j}$ keep the maximum eigenvalue λ_{max} close to n and the remaining eigenvalues close to zero.

In summary, if the idea that the normalized columns of a reciprocal matrix can be viewed as the relative importance weights of attributes (i.e., w' is a good proxy for w) then Saaty (1986) shows the following result.

Let M be a positive reciprocal matrix.

(i) If M is consistent then the principal eigenvector of M is given by any of its columns.

(ii) If M is inconsistent then the principal eigenvector is given by the limit of the normalized intensities of paths of length k,

$$w_i = \lim_{k\to\infty} \frac{a_{i,h}^{(k)}}{\sum_{j=1}^{n} a_{i,j}^{(k)}} \qquad i = 1,2,\ldots,n, \tag{4.23}$$

for all h = 1,2,3,...,n.

Furthermore, Saaty (1980) suggested that the variation of λ_{max} due to small changes in $a_{i,j}$ might be used as a measure of consistency and developed an index, the consistency index CI, to evaluate the closeness of a comparison matrix to a true consistent matrix,

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{4.24}$$

The closer CI is to zero the more consistent M is. The ratio CI/RI, called consistency ratio (CR), compares the consistency index (CI) given by a comparison matrix M with a random index (RI) given by a randomly generated reciprocal matrix of the same order as M and indicates whether the estimates in the comparison matrix are closer to being logically consistent, or closer to being random. A consistency ratio of 0.10 or less has been suggested as acceptable (Saaty, 1980). If this limit is exceeded, the decision maker may want to revise his pairwise judgments to improve consistency.

The random index (RI) was derived from a sample of size 100 of a randomly generated reciprocal matrix of size n using a scale where the elements $a_{i,j}$ (for all i = 1, 2, ..., n-1 and j = 2, 3, ..., n > i) could assume the following values: 1/9, 1/8, 1/7, 1/6, 1/5, 1/4, 1/3, 1/2, 1, 2, 3, 4, 5, 6, 7, 8 and 9. The procedure forced the creation of a reciprocal matrix by having the elements of the main diagonal, $a_{i,i}$ (for all i = 1, 2, ..., n), equal to unity and the elements below the main diagonal reciprocal to the elements above the main diagonal ($a_{j,i} = 1/ a_{i,j}$). The average RIs according to matrices of different dimensions are given in Table 4-2.

Matrix dimension	1	2	3	4	5	6	7	8	9	10	11	12
Random index (RI)	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48

Table 4-2: Random Consistency Index (Saaty, 1980)

Using (4.22) to find the value of λ_{max} in the above example gives:

$$\begin{bmatrix} 1 & 3 & 1 \\ 1/3 & 1 & 1/5 \\ 1 & 5 & 1 \end{bmatrix} * \begin{bmatrix} 0.405 \\ 0.114 \\ 0.481 \end{bmatrix} = \begin{bmatrix} 1.228 \\ 0.345 \\ 1.456 \end{bmatrix} = \lambda_{max} \begin{bmatrix} 0.405 \\ 0.114 \\ 0.481 \end{bmatrix}$$

and $\lambda_{max} = 3.029$. Thus, consistency index = 0.015 and consistency ratio = 0.025.

4.6 The Value Functions

The term "value function" is used in the literature to represent several different concepts. De Neufville (1990) considers the term "value" to define a function that determines the order of preference among single-attribute alternatives but says nothing about the intensity of the preferences, for example, alternative y_1 is preferred over alternative y_2, $y_1 \phi y_2$, only if its value is greater than the other's, $v(y_1) > v(y_2)$, but $v(y_1)$ and $v(y_2)$ do not provide any information about the intensity of preference of y_1 over y_2. According to de Neufville, value functions are never estimated for use in a decision analysis or an evaluation instead analysts use utility functions. These functions are a special kind of value function where units have meaning relative to each other allowing alternatives (consequences) to be evaluated analytically even when people have nonlinear preferences.

Gardiner (1974) used the term "utility" to account for situations where the function relating an outcome with the decision maker's relative worth (utility) for that outcome are created through lotteries (gambles) based on indifference judgments. He uses the term "value" to account for riskless choice contexts (the function relating an outcome with the worth perceived by the decision maker for that outcome is not based on gambles). Von Winterfeldt and Edwards (1986) believe the distinction between value and utility is illegitimate because (1) there are no such things as a sure outcome and values that are attached to presumable riskless outcomes are in fact attached to gambles; (2) risk aversion can frequently be explained by marginally decreasing value functions; and (3) error and method variance within value and utility measurement procedures overshadow to a great extent the subtle distinctions that one may extract from the theoretical differences.[65]

In this study the term "value function" is adopted to indicate a function that is used to transform an outcome (i.e., the performance level of an attribute) into the decision maker's relative worth for this outcome and that has its construction **not** based on lotteries (gambles). The decision to build functions based on a method other than the

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65 For a more elaborate discussion on this subject see von Winterfeldt and Edwards (1986), pp. 213-215.

indifference-preference lotteries used in the assembly of utility functions was made because of two main aspects of the desirability model: the use of a qualitative scale to measure the performance of the attributes and the desire to have a model that could be used for infrastructure projects of different nature and size. Utility functions would require the operationalization of attributes so that quantifiable measures could be used in the lotteries. It proved to be very difficult to choose appropriate quantitative constructs to represent the model attributes, and hence, the use of a qualitative scale, common to all attributes, was perceived to be the best alternative for the development of the Desirability Model. Moreover, the use of explicit qualitative scales would generate an extra attribute — project size — that influences several attributes (e.g., the utility of a potential promoter for a project in a country with a country index of X might be different if the project size is 3Y instead of Y) and would restrict the application of the model to projects of a particular size.

The worth score of an attribute is a non-dimensional number that represents its performance (quality) level in a specific project. In order to calculate the worth score of attribute *i*, it is first necessary to qualitatively assess its performance level, and then to use its value function to transform the subjective assessment into a numerical scale. The performance scale used to qualitatively evaluate attribute *i* is shown in Figure 4-4.[66] The numerical scale — called worth scale — ranges from 0 to 100 and is a special form of the cardinal scale: the ordered metric. This type of cardinal scale, also used for measurements of utility, differs from the more common cardinal scale, the ratio scale, in two ways: (De Neufville, 1990)

- Zero on an ordered metric scale has no absolute meaning; it is simply a reference point that could as well be any number (e.g., temperature scales). In ratio scale, zero indicates an absence of the phenomenon being observed.
- Ratios between measures on the ordered metric scale do not have any meaning.

The transformation of an attribute performance level to its worth score, via a value function, is more elaborate than directly estimating the performance (quality) level of an attribute through the use of a quantitative scale. For instance, to calculate the worth score of attribute "W" using "value functions" it is necessary to rate the performance (quality) level of "W" (in a project specific context) using a qualitative scale such as the one shown in Figure 4-4. Then, it is necessary to use a value curve to convert the qualitative assessment of the performance level of "W" (plotted in the x-axis) into an value on the worth scale (plotted in the y-axis). (See Figure 4-5.) However, the "value function" procedure is preferred over the "direct estimation" procedure because it allows the disassociation between the task of measuring the location of an attribute on the performance scale from the task of determining the worth of the attribute on the worth scale, that is, it separates qualitative judgments from quantitative ones. Such

66 Note that verbal expressions are similar to the ones used, by the eigenvalue method, in the determination of weights.

disassociation is particularly important in this study because of the understanding that an attribute might have different performance (quality) levels and yet have a similar worth score assigned to it.

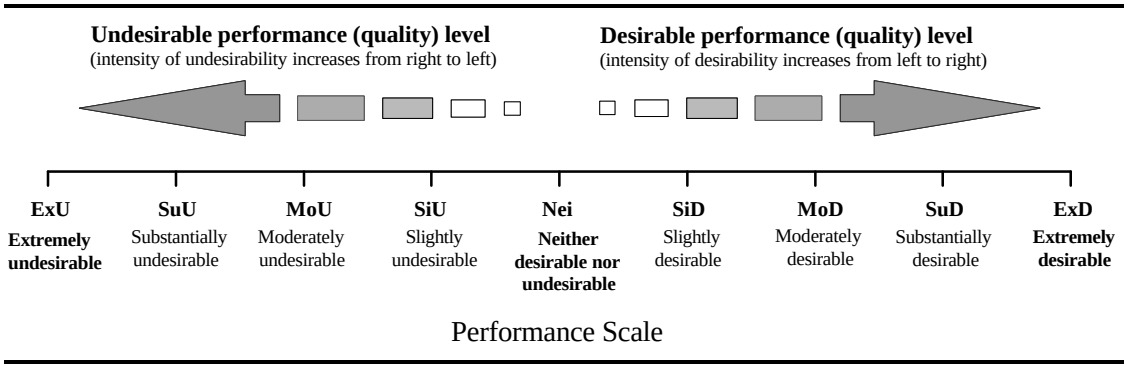

Figure 4-4: Qualitative Performance Scale

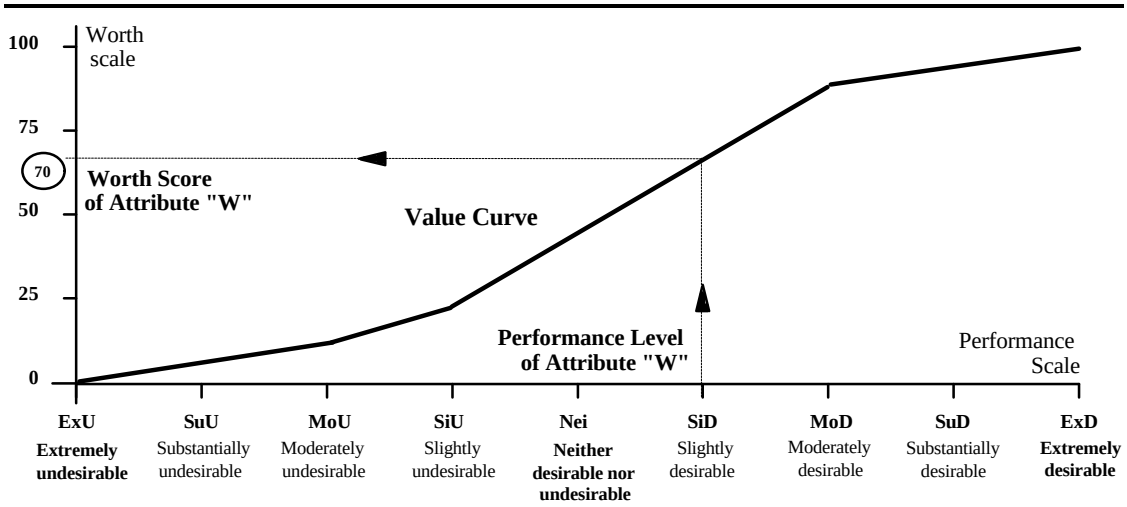

Figure 4-5: Value Curve for Attribute "W"

Constructing value curves is an important process in the development of a multiattribute model as they are used to convert the qualitative judgments about the performance (quality) level of the attributes into the worth scale. The construction involves the exploitation of the properties of the qualitative (i.e., performance) scale, namely monotonicity, single or multiple peakedness, linearity and concavity. Monotonicity refers to the fact that the worth score of an attribute always increases or decreases as the level of performance of this attribute increases. If this is the case, the

value curve is single peaked and this maximum value occurs at or near the extremes of the qualitative scale.

The definition of the attributes of the Desirability Model and the selection of the qualitative scale, as shown in Figure 4-4, assures monotonically increasing value functions.[67] Therefore, the remaining issue in the development of the value curves is concerned with the curve fitting procedure, particularly, the use of a linear or exponential (power) function and the determination of the number of points necessary to draw the curve.

On the use of linear or curvilinear functions, von Winterfeldt and Edwards (1986, pp. 238) comment "[W]e and other analysts find more regularity and more linearity in real-world problems and real-world experts than in most experiments." They believe value functions should be linear in appropriate qualitative scales and that nonlinear value functions are a multiattribute problem forced into a single-attribute mold. On the appropriate number of points necessary to draw the value curve, the literature suggests 3 to 5 points (i.e., the extreme points and 1 or 3 intermediate ones).

This study uses only two points, P1 and P2, to describe the value curve. P1, the minimum plausible performance level for an attribute, reflects the highest point on the performance scale where an attribute is worth its minimum (i.e., 0 worth points). P2, the maximum plausible performance level for an attribute, reflects the lowest point on the performance scale where an attribute is worth its maximum (i.e., 100 worth points). Note that "minimum and maximum plausible" is used instead of "minimum and maximum possible" because often, minimum plausible value is not total absence of the parameter. These two points characterize the generic form of the value curves used in this study by dividing the performance scale into three regions: (1) a low flat region, (2) an intermediate region, and (3) a high flat region. See Figure 4-6. An attribute is worth 0 points if it presents a performance (quality) level in region A ("low flat"), between 0 and 100 points if it presents a (quality) performance level in region B ("intermediate"), and 100 points in case its performance (quality) level is in region C ("high flat").

Region A ("low flat") is an extreme case of minimal return per unit of performance. It suggests that the characteristics and features of the attribute being evaluated do not need to be a "complete disaster" in order to have the attribute worth zero points.[68] Region C ("high flat") is the attribute performance interval that provides maximum worth. It suggests that the characteristics and features of the attribute being evaluated do not need to be "perfect" in order to have the attribute worth a hundred points.

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67 The definitions of all attributes of the Desirability Model are presented in Chapter 5.

68 Note that the worth scale is an ordered metric scale, therefore an attribute worth zero points does not indicate that it is absent of characteristics and features.

The decision to define only two points to describe the attribute value curves was made purely for implementation reasons. Because of the assumption that study respondents had no prior knowledge on developing value curves and the impossibility to directly interact with them (e.g., for training them to use a more complex methodology), it was presupposed that the use of extra points would not necessarily provide more accurate value curves, and hence would not improve the results given by the Desirability Model. The fact that the submodels, company competencies and project attractiveness, have nine and fourteen attributes also favors the use of two points, as local measurement errors might have a lesser impact into the overall model valuation.

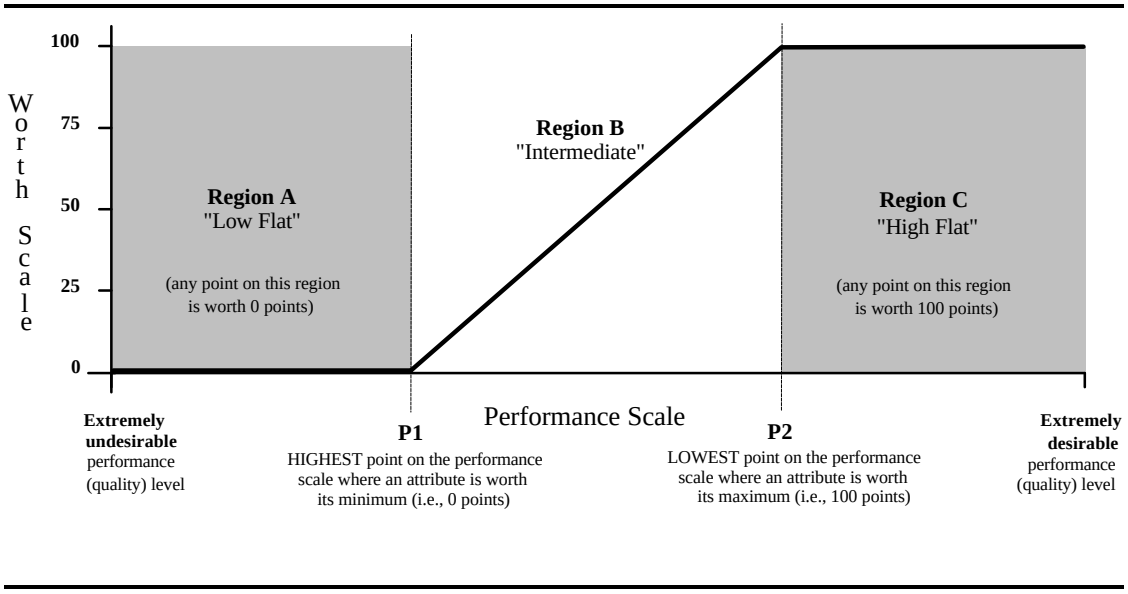

Figure 4-6: The Generic Form of the Value Curves of the Model Attributes

4.7 The Delta Dimension (δ)

Despite favoring the use of linear evaluation models, Edwards (1977) noted that respondents prefer model forms that have both additive and multiplicative components because, to these respondents, some dimensions (i.e., attributes) are so overwhelmingly important that if a particular entity (i.e., project) being evaluated scores zero on one or more of these dimensions, they want to have a zero score overall. O'Connor (1972), in his study on water quality indices, argued that certain model parameters behave like toxic substances in their extreme ranges and would not trade off in terms of quality with other dimensions. Obviously, additive models can not account for this type of behavior.

Some of the attributes of the Desirability Model behave in a similar manner. That is, if an important attribute has very undesirable intensities, regardless on how good the performance of the other attributes are, the decision maker wants the model to reflect the impossibility of the project to be privately promoted (or the company to become a project promoter). Anderson (1993) exemplifies the situation by saying that there are many countries where the possibility of having a privately-promoted infrastructure project is excluded, regardless of the project characteristics, because of the perceived general political risk in these countries.

The delta dimension, δ, is introduced in the Desirability Model to account for these situations where parameters having very undesirable performance levels are sufficient for companies to become incapable to promote projects and projects to become unattractive to be privately promoted.

The delta dimension is calculated by summing the "local deltas" (i.e., the delta of each model attribute), that is

$$\delta = \sum_{i=1}^{n} \delta_i \tag{4.25}$$

where δ_i is a binary variable (i.e., either -1 or 0) that represents the delta of attribute *i*. If the intensity of an attribute falls below a certain threshold (cut-off point), set by the decision maker, then its δ_i is set equal to "minus one," otherwise it is set to "zero." Hence, the δ of a project (company) is equal to zero only if all its attributes have intensities larger than their respective threshold levels (i.e., none of the attribute performance levels is sufficient to characterize the impossibility of the project to be privately promoted or the company to become a promoter). It has been assumed in this study that δ_i is set equal to "minus one" whenever a dominant attribute[69] *i* has a performance level that is inferior to its "P1" (i.e., dominant attribute *i* has a worth score, $v_i(x_i)$, equal to zero).

Projects (companies) with original $\delta < 0$ do not need to be rejected at once. The strategies suggested in Chapter 3 to mitigate and allocate risks might change the performance of the critical attributes to values above their threshold, therefore turning δ into zero. The flowchart on Figure 4-7 elucidates the procedure to be followed in order to determine the delta dimension of the project (company) being evaluated.

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69 An attribute is dominant when its low performance level is sufficient to reject the idea of project promotion without even considering the performance level of other attributes. See Section 5.4 for the list of dominant attributes.

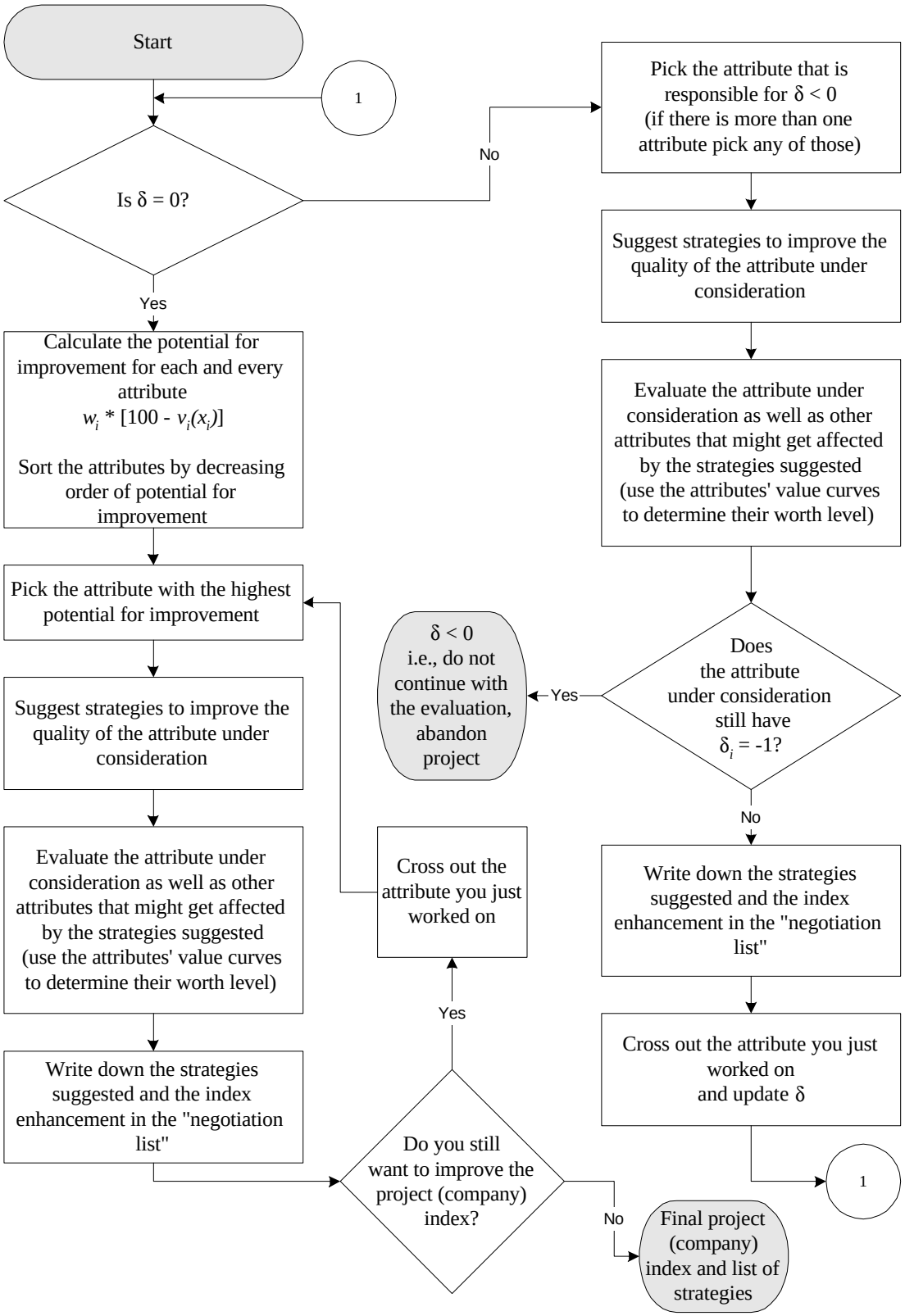

Figure 4-7: Delta Dimension Flowchart

4.8 Summary

The first two levels of the Desirability Model and the theoretical concepts necessary to formulate it have been presented in this chapter. It has been demonstrated that under additive difference independence and monotonicity conditions, an additive function such as

$$v(\bar{x}) = \sum_{i=1}^{n} w_i v_i(x_i) \tag{4.26}$$

can be used to aggregate the contribution of individual attributes. The two methods used to determine the relative importance of the attributes, w_i, have been described. The basic differences between these methods are:

- In the direct rating method, the importance ratios between the attributes are determined quantitatively (through the assignment of attribute values) while in the eigenvalue method, these ratios are determined through qualitative pairwise comparisons.

- Exact transitivity is implicitly assumed when using the direct rating method. This is not the case with the eigenvalue method as the comparison matrix might not be 100% consistent.

The rationale for using value curves to transform the attribute performance (quality) levels into worth scores, $v_i(x_i)$, has also been described. Finally, the delta dimension has been introduced as a tool used to signal if certain important parameters have, at least, minimum performance (quality) levels. In the next chapter, the 23 model attributes of the Desirability Model are described, the information obtained by the experts that participated in this study is presented and the study findings are discussed.

5 The Desirability Model: Study Results

"There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain by the new one."

Machiavelli, 1500's

The Desirability Model is a multiattribute evaluation model composed of two modules: company and project. The company module permits the evaluation of the capability of private-sector companies to provide and allocate the resources necessary to promote an infrastructure project. The project module allows the analysis of projects that are candidates to be privately promoted. The model was developed with information provided by fourteen experts.[70] Section 1.5 provides more detailed information about the model and the experts. Appendix B contains the four questionnaires used to gather data. This chapter presents the definitions of the twenty-three attributes that compose the model, reports and discusses the information provided by the experts, and utilizes an experimental procedure to validate the results obtained by the model in the evaluation of hypothetical companies and projects.

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[70] In total fifteen experts participated in the study, one expert however did not fully complete one of the questionnaires. The information provided by him was used elsewhere (i.e., Chapter 2) but is not included in this chapter.

5.1 The Structure of the Desirability Model

The category level of the Desirability Model, described in the previous chapter, was presented to the experts in the first questionnaire. Therewith we provided experts with several model attributes and asked them to classify these attributes into the different model categories. We also asked experts to add the attributes they judged necessary to enhance the quality of the model. The information gathered from the experts were compiled and resulted in nine company-related attributes and fourteen project-related attributes. These attributes constitute the third-level of the Desirability Model. Figures 1-3 and 1-4 show the relationships between the different attributes, categories and classes of the model. A discussion of each attribute, grouped by category, follows.

Internal Organization Characteristics

- **Quality of Management Team (QMT)** — Assessment of the aptitude of the company's management team to handle the project. This includes: (1) the presence of negotiation and political skills to negotiate and interact with the different partners, (2) the presence of the necessary skills to understand the complexity of the project and to select and acquire the right expertise, (3) past experience with similar projects, and (4) the existence of patience and resolve.

- **Fitting of Strategic Planning (FSP)** — Adequacy of the project in fulfilling corporate interests and objectives such as industry positioning (e.g., access to new markets and enhancement of corporate image), business expansion (or business survival in case of a weak market), and diversification of business line.

- **Compatibility with Potential Partners (CPP)** — Existence of similarities and synergy among potential partners.

Production Capability

- **Adequacy of Specialized Knowledge (ASK)** — Adequacy of the in-house expertise (technical, legal and/or financial) to properly handle the complexity and scope of the project tasks assigned to the company.

- **Overall Quality of Productive Resources (QPR)** — Evaluation of the characteristics, qualifications, and features of the company's productive resources (e.g., labor and equipment) to effectively perform the project tasks assigned to the company.

- **Availability of Productive Resources (APR)** — The company's ability to provide the necessary productive resources (e.g., labor and equipment) to be used during

the project either by using its actual available capacity or by expanding its capacity level.

Financial Resources & Constraints

- **Ability to Fund Initial Project Costs (FIC)** — The company's ability to share with other promoting partners the expenditures that incur during the initial stages of the project (e.g., feasibility studies, preliminary design, proposal preparation, and bid submission).

- **Ability to Supply Capital for the Project (SCP)** — The company's ability to commit and provide its own financial resources to (1) help funding the project, normally through equity infusions, and (2) back its project operations (e.g., "fund" incurred costs that have not been paid or billed).

- **Quality of Profitability (QP)** — Assessment of the quality of the project return on the company's investment in terms of its expected amount, its certainty (risk profile), and its timing (dividend and sell-out policies).

Promoting Team Characteristics

- **Character of Promoting Team's Management (CPT)** — Promoters' ability to create a management team that acts as an "owner" and is capable of identifying strategies and pursuing objectives that enhance the project's likelihood of success rather than making decisions based on what is best for individual promoters.

- **Strength of Promoting Team (SPT)** — The capability of the promoting team to handle the project based on its engineering talent and expertise, facility-operating experience, in-country knowledge, local contacts, negotiating and political skills to interact with the Principal ("Client"), financial strength and expertise, knowledge of competition, and the ability to identify and allocate risks to the participants best able to manage them.

- **Adequacy of Promoters Agreement (PA)** — Adequacy of the promoters agreement as a vehicle through which promoting partners work in cooperation to define the specific functions of each promoter and to structure the policies that govern the contract policies (e.g., transfer of shares, voting rights, dividend policy) and the operational details of the project (e.g., which project management system to use).

Technical Evaluation

- **Ability to Provide a Quality Design (QD)** — Promoters' ability to develop a design that (1) is compatible with the terms of the privatization or concession

agreement (e.g., project capacity, life expectancy, and quality of services), with local legislation (i.e., meeting local standards and regulations), and with existing associated facilities; (2) is functional; and (3) uses known, proven and reliable technology.

- **Ability to Provide a Feasible Construction Plan (FCP)** — Promoters' ability to provide a construction plan that is sensitive to the duration of the construction period while considering the final quality of the facility, the availability of labor, materials and equipment for the construction of the facility.

- **Ability to Provide an Adequate Operation-Transfer Package (OPT)** — Promoters' confidence in their ability to offer: (1) operational methods that are simple and efficient and that consider the availability of skilled personnel to operate the facility, training programs, the availability of raw materials necessary to run the facility, and the planning of time allowances for major maintenance work; and in "finite-concession" projects, (2) a transfer strategy that considers the training of client personnel, the quality of the facility at the time of transfer, and optional provisions that allow the client to sell the facility to the promoters or to further extend the concession period.

Financial Assessment

- **Availability of Adequate Financial Sources to Raise the Financing (SRF)** — Assessment of the availability of adequate financial sources to fund the project. It considers: (1) the existence of a well developed local capital market (e.g., possibility to raise long-term funds from local commercial sources), (2) the availability of loans and export credits from international commercial lenders and international financing institutions (e.g., the World Bank, EBRD, and international credit agencies) to supplement equity and local debt, and (3) the availability of the necessary financial instruments used to structure the financial package.

- **Financial Viability (FV)** — Assessment of the project's capacity to service principal and interest payments on the project debt over the term of the various loans and to provide a return on equity that is commensurate with whatever development and long term project risks the equity investors are being asked to take.

- **Certainty of Construction and Operational Costs (COC)** — Assessment of the certainty (i.e., risk profile) of the construction, operational and maintenance costs. It considers the promoter's cost exposure to: (1) uncertainties in the scope of work, (2) construction and operational risks (such as construction delays, cost overruns, contractor performance, unforeseen physical and weather conditions, accidental damage and failure of equipment), (3) the conditions of existing facilities that have been transferred to the promoters, and (4) alterations on macroeconomic factors (such as inflation, interest rates, and currency exchange rates).

- **Certainty of Revenues (CR)** — Assessment of the certainty (i.e., risk profile) of the project revenues. It considers the project's income potential and uncertainty based on: (1) demand forecasts, (2) the duration of the concession, (3) the identification of specific revenue streams, (4) the availability of revenues before construction completion, (5) the availability of commercial freedom to set and adjust utility (toll) prices, (6) the existence of other competing facilities, (7) the provision of contract led revenues, (8) the quality of receivables (i.e., the creditworthiness of the future users/tenants of the facility), (9) the elasticity of utility (toll) prices, and (10) alterations on macroeconomic factors (such as inflation, interest rates, and currency exchange rates).

Principal's Qualification & Local Conditions

- **Overall Quality of the Principal (OQP)** — Assessment of the overall quality of the principal (i.e., client) of the project. It considers: (1) the ability of the principal to provide financial (e.g., guarantees and stand-by financing) and logistical support, (2) the creditworthiness of the principal, (3) the integrity of the "procurement process" (e.g., the existence of an unbiased evaluation of the different proposals, the timeliness of the tendering and negotiating phases, and the implementation of agreements that spell out in detail the support to be provided by the principal and the rights and obligations of the project-owning company), and (4) the existence of a body formed by high rank (principal's) personnel that have the will and determination to "get the job done" and the necessary authority to commit their agencies/companies to the terms of the negotiations with the promoting team in a timely manner.

- **Level of Community Support (LCS)** — Assessment of the public support and acceptance of the project and its implications regarding user-pay policy (e.g., user resistance to pay tolls or user ineptitude to pay non-subsidized utilities), foreign ownership of assets, and environmental concerns.

- **Legal Environment (LE)** — Assessment of the maturity and reliability of the local basic legal and regulatory systems (e.g., labor and tax laws) and also of the particular legal and regulatory systems that regulate concession-financed projects and enforce concession contracts (e.g., legislation regarding the private ownership of assets, land acquisition, investment rules, toll and tariff indexation arrangements, and environmental concerns).

- **Political Environment (PE)** — Assessment of the political stability of the host country. It considers (1) the possibility of governments to take actions that directly affects the profitability level of the project (e.g., changes in environmental laws, taxation and controls on equity, repatriation of funds, fiscal and monetary controls, and exchange mechanisms; interference in operations and tariff policy; nationalization, and expropriation) and (2) the likelihood of having significant

changes in the political regime or significant levels of political inspired violence (e.g., possibility of riots, terrorism, general strikes, and wars).

5.2 Determination of Relative Weights

5.2.1 Category Level

On the first questionnaire respondents were given the three categories that formed the company capability (CC) class and the four that formed the project attractiveness (PA) class and were asked to estimate their relative importance using both weighting procedures described in Chapter 4. For the eigenvalue method, respondents had to fill out a comparison table similar to the one presented in Figure 5-1. Their task was to decide which of the categories, displayed at the table extremes was most important and then, using the scale provided in Table 4-1, to check how much more important that category was when compared with the other one. For the direct rating method, the respondents were asked to identify the least important category, to assign a value of 10 to it and them to assign values to other categories that reflected their relative importance to the least important category (e.g., a category with a value 30 is considered three times as important as the least important category). Appendix B contains an example illustrating the comparison procedures and the tables used to record the results of such comparisons.

The individual results for the eight insiders and the six outsiders, when using the EM, are presented respectively in Tables 5-1 and 5-2. The qualitative responses given by the respondents are transformed into a numerical scale according to Table 4-1 and are reported under "category comparisons." Values from 2 to 9 indicate that the category on the left is more important than the category on the right, 1 indicates that both categories are equally important, values from 1/2 to 1/9 indicate that the category on the left is less important than the category on the right. The category weights were calculated by normalizing the columns of the comparison matrices after they had being elevated to a certain power that makes the differences amongst their normalized columns negligible.[71]

Tables 5-3 and 5-4 show the individual responses of the insiders and the outsiders when applying the DRM. The values under "category comparisons" were provided by the participants, the normalized relative importance weights are given on the "category weights."

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[71] See Section 4.5.2 for a more detailed discussion on how to calculate relative weights using the EM.

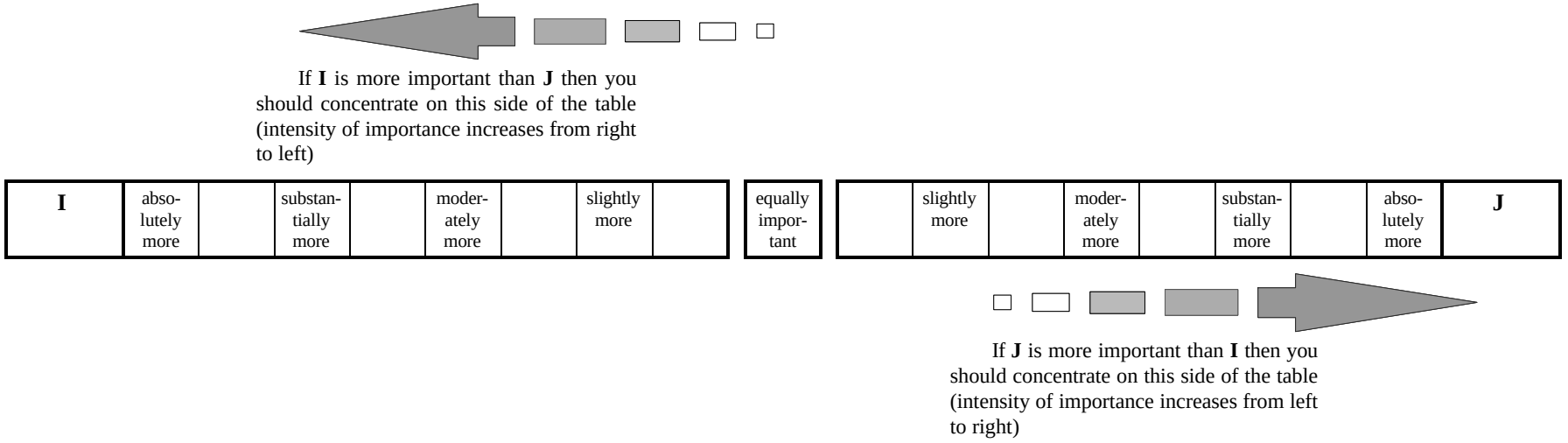

Figure 5-1: The Comparison Table

			I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Company Competencies										
Category comparisons										
IOC	vs.	PC	4	1/5	5	1	7	1	7	1/6
IOC	vs.	FRC	1/3	1/7	1/7	1/3	3	4	1/4	1/8
PC	vs.	FRC	1/5	1/5	1/8	1	1/3	3	1/8	1/7
Category weights										
		IOC	0.280	0.067	0.178	0.221	0.669	0.458	0.260	0.055
		PC	0.094	0.219	0.058	0.319	0.088	0.416	0.056	0.188
		FRC	0.627	0.715	0.763	0.460	0.243	0.126	0.684	0.758
Project Attractiveness										
Category comparisons										
PTC	vs.	TE	1	1/3	1/6	1	7	1/3	1	4
PTC	vs.	FA	1/3	1/7	1/9	1/5	3	1/7	1/8	1
PTC	vs.	PLC	1	1/5	1/9	4	3	1/3	1/3	1/6
TE	vs.	FA	1	1/5	1/8	1/3	1/5	1/4	1/8	1/5
TE	vs.	PLC	1	1/3	1/7	5	1/3	2	1/3	1/7
FA	vs.	PLC	2	3	5	6	3	5	8	1/5
Category weights										
		PTC	0.122	0.055	0.031	0.171	0.525	0.063	0.065	0.147
		TE	0.227	0.118	0.082	0.203	0.056	0.196	0.065	0.050
		FA	0.424	0.565	0.620	0.569	0.279	0.609	0.717	0.164
		PLC	0.227	0.262	0.267	0.056	0.139	0.132	0.152	0.639

Legend:		
	IOC	Internal Organization Characteristics
	PC	Production Capability
	FRC	Financial Resources and Constraints
	PTC	Promoting Team Characteristics
	TE	Technical Evaluation
	FA	Financial Assessment
	PLC	Principal's Qualification and Local Conditions

Table 5-1: Insiders' Category Weights (Comparisons Performed under the EM)

			O-01	O-02	O-03	O-04	O-05	O-06
Company Competencies								
Category comparisons								
IOC	vs.	PC	1/7	6	1/5	7	1/5	7
IOC	vs.	FRC	1/9	4	1/5	5	1/7	1/7
PC	vs.	FRC	1/3	4	1	1/5	1/5	1/7
Category weights								
		IOC	0.055	0.694	0.091	0.715	0.067	0.203
		PC	0.290	0.210	0.455	0.067	0.219	0.055
		FRC	0.655	0.096	0.455	0.219	0.715	0.742
Project Attractiveness								
Category comparisons								
PTC	vs.	TE	1/5	6	5	5	1/3	1/5
PTC	vs.	FA	1	4	1/3	7	1/7	1/7
PTC	vs.	PLC	1/3	2	3	1/3	7	1/7
TE	vs.	FA	1/5	1/4	1/7	3	1/5	1/5
TE	vs.	PLC	3	1	6	1/6	7	1/3
FA	vs.	PLC	7	2	1/3	1/7	7	1/7
Category weights								
		PTC	0.131	0.530	0.264	0.304	0.122	0.038
		TE	0.250	0.072	0.195	0.092	0.216	0.115
		FA	0.497	0.234	0.353	0.048	0.623	0.243
		PLC	0.122	0.164	0.188	0.557	0.039	0.605

Legend:		
	IOC	Internal Organization Characteristics
	PC	Production Capability
	FRC	Financial Resources and Constraints
	PTC	Promoting Team Characteristics
	TE	Technical Evaluation
	FA	Financial Assessment
	PLC	Principal's Qualification and Local Conditions

Table 5-2: Outsiders' Category Weights (Comparisons Performed under the EM)

		I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Company Competencies									
Category comparisons									
	IOC	15	10	10	20	60	30	30	10
	PC	10	20	20	10	10	15	10	20
	FRC	20	30	80	40	40	10	40	80
Category weights									
	IOC	0.333	0.167	0.091	0.286	0.545	0.545	0.375	0.091
	PC	0.222	0.333	0.182	0.143	0.091	0.273	0.125	0.182
	FRC	0.444	0.500	0.727	0.571	0.364	0.182	0.500	0.727
Project Attractiveness									
Category comparisons									
	PTC	10	10	10	20	55	10	10	20
	TE	12	20	30	20	10	25	10	10
	FA	13	40	45	40	50	50	50	20
	PLC	12	30	40	10	40	20	20	30
Category weights									
	PTC	0.213	0.100	0.080	0.222	0.355	0.095	0.111	0.250
	TE	0.255	0.200	0.240	0.222	0.065	0.238	0.111	0.125
	FA	0.277	0.400	0.360	0.444	0.323	0.476	0.556	0.250
	PLC	0.255	0.300	0.320	0.111	0.258	0.190	0.222	0.375

Legend:		
	IOC	Internal Organization Characteristics
	PC	Production Capability
	FRC	Financial Resources and Constraints
	PTC	Promoting Team Characteristics
	TE	Technical Evaluation
	FA	Financial Assessment
	PLC	Principal's Qualification and Local Conditions

Table 5-3: Insiders' Category Weights (Comparisons Performed under the DRM)

		O-01	O-02	O-03	O-04	O-05	O-06
Company Competencies							
Category comparisons							
	IOC	10	30	10	50	10	40
	PC	70	20	20	10	30	10
	FRC	80	10	20	30	40	80
Category weights							
	IOC	0.063	0.500	0.200	0.556	0.125	0.308
	PC	0.438	0.333	0.400	0.111	0.375	0.077
	FRC	0.500	0.167	0.400	0.333	0.500	0.615
Project Attractiveness							
Category comparisons							
	PTC	10	40	20	30	20	10
	TE	50	10	20	15	30	60
	FA	50	30	30	10	40	60
	PLC	30	20	10	40	40	40
Category weights							
	PTC	0.071	0.400	0.250	0.316	0.154	0.059
	TE	0.357	0.100	0.250	0.158	0.231	0.353
	FA	0.357	0.300	0.375	0.105	0.308	0.353
	PLC	0.214	0.200	0.125	0.421	0.308	0.235

Legend:		
	IOC	Internal Organization Characteristics
	PC	Production Capability
	FRC	Financial Resources and Constraints
	PTC	Promoting Team Characteristics
	TE	Technical Evaluation
	FA	Financial Assessment
	PLC	Principal's Qualification and Local Conditions

Table 5-4: Outsiders' Category Weights

The individual responses were consolidated into group responses to examine the similarities and differences between the insiders and outsiders. An attempt to generate group responses through group interaction was first carried out. The idea is borrowed from the Delphi technique developed by Dalkey (1969) and consists of providing respondents with an opportunity to reevaluate their initial assessments by given them their answers together with the answers of the other participants. The literature suggests (see works of Lintstone and Turoff, 1975; Azani and Khorramshahgol, 1990; and Shields et. al., 1990) that this type of process enables the decision analyst to bring together the opinion of individuals whose views are important for the decision process but who are located in different geographical areas.

In the second questionnaire, the respondents were provided with theirs and the other respondents' answers to the first questionnaire and were asked if they wanted to reevaluate their answers. The reevaluation was proposed not only to see if they would modify their responses based on the information provided by other respondents but also to give them a chance to reexamine their initial answers based on better defined model categories and a better understanding of the comparison procedures. Only two experts were willing to review their answers.[72] Two factors seem to explain the unwillingness of the experts to revise their responses: they understood the procedure well and had no problems performing the comparisons or, more importantly, they had their own formed opinion about the different categories and attributes and would not be willing to change their opinion just because other responses differed from them. Although valid and widely used, the idea of using a series of instruments to reach a consensus proved to be too difficult to implement in this study and was abandoned. The consolidation of individual responses into group responses were obtained through the use of two different procedures:

- The geometric mean of the individual "category comparisons" were used to calculate group weights for the EM;

- The average of the individual "category weights" were used for the DRM group weights.

The rationale for using the geometric mean, instead of the arithmetic mean, for consolidating individual comparisons in the EM has been provided by Aczel and Saaty (1983) and McCarthy (1992). According to them, the method used to group the individual judgments should preserve the reciprocal nature of the comparison matrix, that is, matrix elements $a_{i,i}$ should be 1 and $a_{j,i}$ should equal $1/a_{i,j}$. For instance, suppose five member of a group are evaluating a pair of categories and provide the following results: 4, 6, 5, 5, 7. The arithmetic mean of these comparisons is 5.4. The arithmetic mean of the reciprocals (i.e., 1/4, 1/6, 1/5, 1/5, 1/7) is 0.1919 which is different than the reciprocal of the arithmetic mean, 0.1852 (i.e., 1/5.4). On the other side, the geometric mean of the

[72] They made slight adjustments to their original responses.

same comparisons is 5.3046. The geometric mean of the reciprocals is 0.1885 which is the same as the reciprocal of the geometric mean, thus the group comparison matrix has the same properties of the matrix originally proposed by Saaty.

The group results for the categories in the CC index and in the PA index are shown in Table 5-5. For the CC index, the weights indicate that both insiders and outsiders consider the financial category as the most important, with the management and production categories coming in second and third. These results indicate that the companies' ability to fund the procurement process and to provide their own resources to finance part of the project, coupled with the quality of the investment in terms of potential return, is of vital importance for companies in their decision to get involved in the promotion of infrastructure projects. The relative low importance given to the production-related category appears to indicate that companies are not constrained by the availability of their equipment and human resources and/or the adequacy of their technical expertise as they can rely on third parties to bring the necessary resources and expertise to have the project developed and implemented.

		Insiders		**Outsiders**	
		EM	DRM	EM	DRM
Company Competencies					
1.	Internal Organization Characteristics	0.251	0.304	0.245	0.292
2.	Production Capability	0.171	0.194	0.229	0.289
3.	Financial Resources and Constraints	0.578	0.502	0.529	0.419
Project Attractiveness					
4.	Promoting Team Characteristics	0.121	0.178	0.220	0.208
5.	Technical Evaluation	0.125	0.182	0.188	0.241
6.	Financial Assessment	0.532	0.386	0.352	0.300
7.	Principal's Qualifications & Local Conditions	0.222	0.254	0.240	0.251

Table 5-5: Group Category Weights

In the case of the PA index, insiders and outsiders indicate the financial related category as the most important one; that is, a favorable financial assessment is essential for projects to attract private promoters. According to them, the second most important category refers to the ability of governments to provide the necessary conditions for the project to materialize and to be operated. Although the differences between the managerial and technical categories given by the insiders are small and so is the rank difference given by the outsiders' responses (i.e., using the EM the managerial category ranked ahead of the technical one and using the DRM the managerial category ranked behind the technical), there is a notable difference in the weights of these categories, as well as in the weights of the financial category, when both groups are compared. Insiders

input money in the process and are liable to lose their investment if the project fails. They appear to be confident about their ability to manage and to provide technical solutions to the project, hence they place a high importance on the project's ability to provide an adequate return on their investment and a relative low importance to the categories that they have more control over. Outsiders provide services, mainly management and legal expertise to principals and promoters, thus they put less importance on the financial assessment (although it is still the most important category). They emphasize the management and technical categories, perhaps indicating their concern that promoting companies have, in the past, performed poorly on the implementation of privately-promoted projects. Past projects, for example, have suffered from mismanagement (e.g., lack of owning company identity, poor interaction between promoters), project cost overruns, and schedule delays.

Two-tailed Student and paired t-tests were ran to verify if the weight difference given by insiders and outsiders were statistically significant. For each model category four t-tests were performed. Two Student t-tests were used to compare the category weights given by the insiders against the outsiders (one test considered the DRM and another the EM). Two paired t-tests were used to compare the weights given by the DRM against the EM (one test was performed in the insiders and the other on the outsiders). None of the Student t-test results rejected the hypotheses that the responses of insiders and outsiders were given by similar populations. None of the paired t-tests rejected the hypotheses that the weighting procedures provided comparable weights for the same category. The significance level (α) used was 1%.

5.2.2 Attribute Level

Local Weights

On the second questionnaire respondents performed comparisons among the attributes assigned to each of the model categories. In fact, the category level was created with the specific purpose of making attribute comparisons easier. The idea was to make the attribute comparisons more meaningful by only comparing attributes of the same nature and to decrease the number of comparisons required.[73] Tables 5-6 and 5-7 provide the individual responses given by insiders and outsiders for local attribute comparisons (i.e., importance judgments made among attributes of each category) when using the EM. Tables 5-8 and 5-9 show their individual responses when applying the DRM. Table 5-10 displays the group results for the local comparisons of attributes.

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[73] The introduction of the intermediate (i.e., category) level decreased the number of attribute comparisons, for the eigenvalue method, from 127 (i.e., (9*8)/2 + (14*13)/2) to 27 (i.e., 5*(3*2)/2+2*(4*3)/2).

			I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Internal Organization Characteristics										
Attribute comparisons										
QMT	vs.	FSP	5	5	3	5	1/5	7	5	5
QMT	vs.	CPP	2	3	1/5	7	7	3	7	7
FSP	vs.	CPP	1/5	1/3	1/7	3	7	1	5	6
Local attribute weights										
		QMT	0.559	0.637	0.188	0.731	0.240	0.682	0.715	0.708
		FSP	0.089	0.105	0.081	0.188	0.701	0.103	0.218	0.230
		CPP	0.352	0.258	0.731	0.081	0.059	0.216	0.067	0.062
Production Capability										
Attribute comparisons										
ASK	vs.	QPR	5	3	5	1	6	1/3	7	4
ASK	vs.	APR	7	5	5	4	7	3	4	6
QPR	vs.	APR	5	1/3	1	4	4	5	1/3	3
Local attribute weights										
		ASK	0.715	0.651	0.714	0.444	0.743	0.258	0.705	0.691
		QPR	0.218	0.127	0.143	0.444	0.187	0.637	0.084	0.218
		APR	0.067	0.223	0.143	0.111	0.070	0.105	0.211	0.091
Financial Resources and Constraints										
Attribute comparisons										
FIC	vs.	SCP	5	3	5	3	3	3	4	7
FIC	vs.	QP	1/5	1/5	7	1/5	4	1/5	1/6	1/3
SCP	vs.	QP	1/7	1/7	5	1/7	5	1/5	1/7	1/7
Local attribute weights										
		FIC	0.218	0.188	0.715	0.188	0.596	0.202	0.187	0.304
		SCP	0.067	0.081	0.218	0.081	0.308	0.097	0.070	0.063
		QP	0.715	0.731	0.067	0.731	0.096	0.701	0.743	0.633

Legend:				
	QMT	Quality of Management Team	APR	Avail. of Prod. Resources
	FSP	Fitting of Strategic Planning	FIC	Abil. Fund Init. Proj. Costs
	CPP	Compatibility with Potential Partners	SCP	Ability to Supply Capital
	ASK	Adequacy of Specialized Knowledge		for the Project
	QPR	Overall Quality of Productive Res.	QP	Quality of Profitability

Table 5-6: Insiders' Local Attribute Weights (Comparisons Performed under the EM)

			I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Promoting Team Characteristics										
Attribute comparisons										
CPT	vs.	SPT	2	1/3	1/5	1/6	1	3	1/7	1/7
CPT	vs.	PA	1/3	3	1/7	5	4	4	1/5	3
SPT	vs.	PA	1/4	5	1/3	8	3	1	5	8
Local attribute weights										
		CPT	0.238	0.258	0.072	0.193	0.458	0.634	0.067	0.153
		SPT	0.136	0.637	0.279	0.747	0.416	0.192	0.715	0.777
		PA	0.625	0.105	0.649	0.060	0.126	0.174	0.218	0.070
Technical Evaluation										
Attribute comparisons										
QD	vs.	FCP	2	5	1/9	1	3	1	1	1/3
QD	vs.	OTP	3	5	1/9	1	4	3	1	4
FCP	vs.	OTP	2	3	5	1	3	3	1	5
Local attribute weights										
		QD	0.540	0.701	0.046	0.333	0.614	0.429	0.333	0.280
		FCP	0.297	0.202	0.711	0.333	0.268	0.429	0.333	0.627
		OTP	0.163	0.097	0.243	0.333	0.117	0.143	0.333	0.094

Legend:		
	CPT	Charcter of Promoting Team's Management
	SPT	Strength of Promoting Team
	PA	Adequacy of Promoters Agreement
	QD	Ability to Provide a Quality Design
	FCP	Ability to Provide a Feasible Construction Plan
	OTP	Ability to Provide an Adequate Operational-Transfer Package

Table 5-6 (cont): Insiders' Local Attribute Weights (Comp. Performed under the EM)

			I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Financial Assessment										
Attribute comparisons										
SRF	vs.	FV	1	1/5	1	1	1/7	1/5	1/7	1/3
SRF	vs.	COC	1/4	1/5	3	1	1/5	1/5	1/4	8
SRF	vs.	CR	1/4	1/5	1	1	1/9	1/6	1/4	3
FV	vs.	COC	1	7	3	1	1	2	7	8
FV	vs.	CR	1	1	1	1	1/7	3	7	5
COC	vs.	CR	1	1/5	1/3	1	1/7	1	1	1/8
Local attribute weights										
		SRF	0.089	0.055	0.300	0.250	0.037	0.057	0.051	0.271
		FV	0.178	0.439	0.300	0.250	0.147	0.468	0.683	0.547
		COC	0.303	0.121	0.100	0.250	0.130	0.240	0.133	0.036
		CR	0.430	0.385	0.300	0.250	0.686	0.235	0.133	0.146
Principal's Qualification and Local Conditions										
Attribute comparisons										
OQP	vs.	LCS	4	1/7	1/7	7	7	1	4	1
OQP	vs.	LE	3	1	1/5	7	7	2	1	1
OQP	vs.	PE	1/5	1/7	1/7	7	3	2	1/3	3
LCS	vs.	LE	1/3	5	3	1	5	1	1/6	1
LCS	vs.	PE	1/7	1	1	1	3	1	1/7	3
LE	vs.	PE	1/5	1/5	1/3	1	1/5	1	1	3
Local attribute weights										
		OQP	0.211	0.067	0.047	0.700	0.611	0.346	0.170	0.300
		LCS	0.055	0.427	0.395	0.100	0.205	0.205	0.053	0.300
		LE	0.112	0.079	0.163	0.100	0.044	0.163	0.295	0.300
		PE	0.621	0.427	0.395	0.100	0.139	0.286	0.482	0.100

Legend:				
	SRF	Availability of Adequate Financial Sources to Raise the Financing	OQP	Overall Quality of the Principal
	FV	Financial Viability	LCS	Level of Community Support
	COC	Certainty of Construction and Operational Costs	LE	Legal Environment
	CR	Certainty of Revenues	PE	Political Environment

Table 5-6 (cont): Insiders' Local Attribute Weights (Comp. Performed under the EM)

			O-01	O-02	O-03	O-04	O-05	O-06
Internal Organization Characteristics								
Attribute comparisons								
QMT	vs.	FSP	5	4	1/3	7	9	4
QMT	vs.	CPP	1/7	4	3	3	1/7	1
FSP	vs.	CPP	1	1	3	1/5	1/9	1
Local attribute weights								
		QMT	0.266	0.661	0.281	0.649	0.205	0.203
		FSP	0.172	0.131	0.584	0.072	0.044	0.055
		CPP	0.561	0.208	0.135	0.279	0.751	0.742
Production Capability								
Attribute comparisons								
ASK	vs.	QPR	1/3	1	5	1	7	6
ASK	vs.	APR	1/3	1	5	3	7	4
QPR	vs.	APR	1	1/4	7	3	1	2
Local attribute weights								
		ASK	0.143	0.184	0.672	0.429	0.778	0.707
		QPR	0.429	0.232	0.257	0.429	0.111	0.170
		APR	0.429	0.584	0.070	0.143	0.111	0.123
Financial Resources and Constraints								
Attribute comparisons								
FIC	vs.	SCP	1/7	1	6	3	1	2
FIC	vs.	QP	1/7	1/4	1	1/7	1	2
SCP	vs.	QP	1	1/4	1/6	1/9	1	2
Local attribute weights								
		FIC	0.067	0.167	0.357	0.149	0.333	0.493
		SCP	0.467	0.167	0.075	0.066	0.333	0.311
		QP	0.467	0.667	0.567	0.785	0.333	0.196

Legend:				
	QMT	Quality of Management Team	APR	Avail. of Prod. Resources
	FSP	Fitting of Strategic Planning	FIC	Abil. Fund Init. Proj. Costs
	CPP	Compatibility with Potential Partners	SCP	Ability to Supply Capital
	ASK	Adequacy of Specialized Knowledge		for the Project
	QPR	Overall Quality of Productive Res.	QP	Quality of Profitability

Table 5-7: Outsiders' Local Attribute Weights (Comparisons Performed under the EM)

			O-01	O-02	O-03	O-04	O-05	O-06
Promoting Team Characteristics								
Attribute comparisons								
CPT	vs.	SPT	1/5	4	4	3	1/7	1/4
CPT	vs.	PA	5	4	1/4	1/7	5	1/4
SPT	vs.	PA	5	1	1	1/8	9	1
Local attribute weights								
		CPT	0.234	0.667	0.286	0.153	0.173	0.109
		SPT	0.685	0.167	0.143	0.070	0.772	0.345
		PA	0.080	0.167	0.571	0.777	0.055	0.547
Technical Evaluation								
Attribute comparisons								
QD	vs.	FCP	5	2	1	3	1	1/6
QD	vs.	OTP	7	1/4	1	3	7	1
FCP	vs.	OTP	1	2	1	3	7	6
Local attribute weights								
		QD	0.747	0.260	0.333	0.584	0.467	0.099
		FCP	0.134	0.328	0.333	0.281	0.467	0.745
		OTP	0.119	0.412	0.333	0.135	0.067	0.156

Legend:		
	CPT	Charcter of Promoting Team's Management
	SPT	Strength of Promoting Team
	PA	Adequacy of Promoters Agreement
	QD	Ability to Provide a Quality Design
	FCP	Ability to Provide a Feasible Construction Plan
	OTP	Ability to Provide an Adequate Operational-Transfer Package

Table 5-7 (cont): Outsiders' Local Attribute Weights (Comp. Performed under the EM)

			O-01	O-02	O-03	O-04	O-05	O-06
Financial Assessment								
Attribute comparisons								
SRF	vs.	FV	1/7	1/6	1/6	1/7	1	1
SRF	vs.	COC	1/3	1/4	1/4	1/7	1	1/5
SRF	vs.	CR	1/5	1/4	1/6	1/7	1	1/3
FV	vs.	COC	9	6	4	1	1	1/7
FV	vs.	CR	7	4	1	1	1	1
COC	vs.	CR	1	1	1/4	3	1	3
Local attribute weights								
		SRF	0.050	0.058	0.054	0.043	0.250	0.095
		FV	0.701	0.616	0.406	0.303	0.250	0.118
		COC	0.111	0.157	0.134	0.417	0.250	0.595
		CR	0.139	0.170	0.406	0.236	0.250	0.191
Principal's Qualification and Local Conditions								
Attribute comparisons								
OQP	vs.	LCS	1	2	6	3	9	1/5
OQP	vs.	LE	3	1	4	1/3	7	1/3
OQP	vs.	PE	1/7	1/6	2	1/5	1	1/3
LCS	vs.	LE	1	1	1/6	1/5	1/7	1
LCS	vs.	PE	1/3	1	1/6	1/5	1/9	1
LE	vs.	PE	1/5	1/4	1/6	3	1/5	1
Local attribute weights								
		OQP	0.157	0.132	0.449	0.123	0.453	0.086
		LCS	0.139	0.129	0.046	0.061	0.033	0.333
		LE	0.096	0.195	0.131	0.492	0.114	0.291
		PE	0.609	0.543	0.374	0.324	0.400	0.291

Legend:				
SRF	Availability of Adequate Financial Sources to Raise the Financing	OQP	Overall Quality of the Principal
FV	Financial Viability	LCS	Level of Community Support
COC	Certainty of Construction and Operational Costs	LE	Legal Environment
CR	Certainty of Revenues	PE	Political Environment

Table 5-7 (cont): Outsiders' Local Attribute Weights (Comp. Performed under the EM)

		I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Internal Organization Characteristics									
Attribute comparisons									
	QMT	20	30	20	30	40	18	40	50
	FSP	10	10	10	20	50	10	20	30
	CPP	18	20	50	10	10	13	10	10
Local attribute weights									
	QMT	0.417	0.500	0.250	0.500	0.400	0.439	0.571	0.556
	FSP	0.208	0.167	0.125	0.333	0.500	0.244	0.286	0.333
	CPP	0.375	0.333	0.625	0.167	0.100	0.317	0.143	0.111
Production Capability									
Attribute comparisons									
	ASK	30	30	20	20	40	10	40	30
	QPR	20	10	10	20	20	16	10	20
	APR	10	20	10	10	10	12	20	10
Local attribute weights									
	ASK	0.500	0.500	0.500	0.400	0.571	0.263	0.571	0.500
	QPR	0.333	0.167	0.250	0.400	0.286	0.421	0.143	0.333
	APR	0.167	0.333	0.250	0.200	0.143	0.316	0.286	0.167
Financial Resources and Constraints									
Attribute comparisons									
	FIC	20	20	40	20	30	14	20	30
	SCP	10	10	20	10	20	10	10	10
	QP	30	40	10	30	10	16	50	40
Local attribute weights									
	FIC	0.333	0.286	0.571	0.333	0.500	0.350	0.250	0.375
	SCP	0.167	0.143	0.286	0.167	0.333	0.250	0.125	0.125
	QP	0.500	0.571	0.143	0.500	0.167	0.400	0.625	0.500

Legend:				
	QMT	Quality of Management Team	APR	Avail. of Prod. Resources
	FSP	Fitting of Strategic Planning	FIC	Abil. Fund Init. Proj. Costs
	CPP	Compatibility with Potential Partners	SCP	Ability to Supply Capital
	ASK	Adequacy of Specialized Knowledge		for the Project
	QPR	Overall Quality of Productive Res.	QP	Quality of Profitability

Table 5-8: Insiders' Local Attribute Weights (Comparisons Performed under the DRM)

		I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Promoting Team Characteristics									
Attribute comparisons									
	CPT	12	30	10	20	20	20	10	20
	SPT	10	20	40	40	20	10	40	50
	PA	15	10	50	10	10	18	20	10
Local attribute weights									
	CPT	0.324	0.500	0.100	0.286	0.400	0.417	0.143	0.250
	SPT	0.270	0.333	0.400	0.571	0.400	0.208	0.571	0.625
	PA	0.405	0.167	0.500	0.143	0.200	0.375	0.286	0.125
Technical Evaluation									
Attribute comparisons									
	QD	15	40	10	10	30	12	10	20
	FCP	12	20	70	10	20	12	10	30
	OTP	10	10	50	10	10	10	10	10
Local attribute weights									
	QD	0.405	0.571	0.077	0.333	0.500	0.353	0.333	0.333
	FCP	0.324	0.286	0.538	0.333	0.333	0.353	0.333	0.500
	OTP	0.270	0.143	0.385	0.333	0.167	0.294	0.333	0.167

Legend:		
	CPT	Charcter of Promoting Team's Management
	SPT	Strength of Promoting Team
	PA	Adequacy of Promoters Agreement
	QD	Ability to Provide a Quality Design
	FCP	Ability to Provide a Feasible Construction Plan
	OTP	Ability to Provide an Adequate Operational-Transfer Package

Table 5-8 (cont): Insiders' Local Attribute Weights (Comp. Performed under the DRM)

		I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Financial Assessment									
Attribute comparisons									
	SRF	10	20	20	10	10	10	10	60
	FV	12	40	20	10	50	20	50	80
	COC	14	10	10	10	30	17	20	10
	CR	15	40	20	10	100	17	20	40
Local attribute weights									
	SRF	0.196	0.182	0.286	0.250	0.053	0.156	0.100	0.316
	FV	0.235	0.364	0.286	0.250	0.263	0.313	0.500	0.421
	COC	0.275	0.091	0.143	0.250	0.158	0.266	0.200	0.053
	CR	0.294	0.364	0.286	0.250	0.526	0.266	0.200	0.211
Principal's Qualification and Local Conditions									
Attribute comparisons									
	OQP	20	10	10	30	40	16	20	20
	LCS	10	30	40	10	30	15	10	20
	LE	15	10	20	10	10	10	25	20
	PE	30	30	40	10	20	13	30	10
Local attribute weights									
	OQP	0.267	0.125	0.091	0.500	0.400	0.296	0.235	0.286
	LCS	0.133	0.375	0.364	0.167	0.300	0.278	0.118	0.286
	LE	0.200	0.125	0.182	0.167	0.100	0.185	0.294	0.286
	PE	0.400	0.375	0.364	0.167	0.200	0.241	0.353	0.143

Legend:		
	SRF	Availability of Adequate Financial Sources to Raise the Financing
	FV	Financial Viability
	COC	Certainty of Construction and Operational Costs
	CR	Certainty of Revenues
	OQP	Overall Quality of the Principal
	LCS	Level of Community Support
	LE	Legal Environment
	PE	Political Environment

Table 5-8 (cont): Insiders' Local Attribute Weights (Comp. Performed under the DRM)

		O-01	O-02	O-03	O-04	O-05	O-06
Internal Organization Characteristics							
Attribute comparisons							
	QMT	40	30	15	30	40	20
	FSP	10	10	15	10	10	10
	CPP	40	20	10	20	80	20
Local attribute weights							
	QMT	0.444	0.500	0.375	0.500	0.308	0.400
	FSP	0.111	0.167	0.375	0.167	0.077	0.200
	CPP	0.444	0.333	0.250	0.333	0.615	0.400
Production Capability							
Attribute comparisons							
	ASK	20	10	20	15	30	40
	QPR	40	15	15	15	10	20
	APR	10	20	10	10	10	10
Local attribute weights							
	ASK	0.286	0.222	0.444	0.375	0.600	0.571
	QPR	0.571	0.333	0.333	0.375	0.200	0.286
	APR	0.143	0.444	0.222	0.250	0.200	0.143
Financial Resources and Constraints							
Attribute comparisons							
	FIC	10	10	20	15	10	20
	SCP	50	10	10	10	10	20
	QP	60	30	22	30	10	10
Local attribute weights							
	FIC	0.083	0.200	0.385	0.273	0.333	0.400
	SCP	0.417	0.200	0.192	0.182	0.333	0.400
	QP	0.500	0.600	0.423	0.545	0.333	0.200

Legend:				
	QMT	Quality of Management Team	APR	Avail. of Prod. Resources
	FSP	Fitting of Strategic Planning	FIC	Abil. Fund Init. Proj. Costs
	CPP	Compatibility with Potential Partners	SCP	Ability to Supply Capital
	ASK	Adequacy of Specialized Knowledge		for the Project
	QPR	Overall Quality of Productive Res.	QP	Quality of Profitability

Table 5-9: Outsiders' Local Attribute Weights (Comparisons Performed under the DRM)

		O-01	O-02	O-03	O-04	O-05	O-06
Promoting Team Characteristics							
Attribute comparisons							
	CPT	40	30	15	15	20	10
	SPT	40	10	10	10	40	20
	PA	10	10	15	40	10	20
Local attribute weights							
	CPT	0.444	0.600	0.375	0.231	0.286	0.200
	SPT	0.444	0.200	0.250	0.154	0.571	0.400
	PA	0.111	0.200	0.375	0.615	0.143	0.400
Technical Evaluation							
Attribute comparisons							
	QD	60	30	10	30	30	10
	FCP	50	20	10	20	30	20
	OTP	10	10	10	10	10	10
Local attribute weights							
	QD	0.500	0.500	0.333	0.500	0.429	0.250
	FCP	0.417	0.333	0.333	0.333	0.429	0.500
	OTP	0.083	0.167	0.333	0.167	0.143	0.250

Legend:		
	CPT	Charcter of Promoting Team's Management
	SPT	Strength of Promoting Team
	PA	Adequacy of Promoters Agreement
	QD	Ability to Provide a Quality Design
	FCP	Ability to Provide a Feasible Construction Plan
	OTP	Ability to Provide an Adequate Operational-Transfer Package

Table 5-9 (cont): Outsiders' Local Attribute Weights (Comp. Performed under the DRM)

		O-01	O-02	O-03	O-04	O-05	O-06
Financial Assessment							
Attribute comparisons							
	SRF	10	10	10	10	10	10
	FV	80	40	22	30	10	20
	COC	70	20	12	30	10	20
	CR	70	20	20	30	10	20
Local attribute weights							
	SRF	0.043	0.111	0.156	0.100	0.250	0.143
	FV	0.348	0.444	0.344	0.300	0.250	0.286
	COC	0.304	0.222	0.188	0.300	0.250	0.286
	CR	0.304	0.222	0.313	0.300	0.250	0.286
Principal's Qualification and Local Conditions							
Attribute comparisons							
	OQP	10	20	20	15	30	10
	LCS	30	10	10	10	10	10
	LE	30	25	15	25	20	10
	PE	50	30	15	20	30	10
Local attribute weights							
	OQP	0.083	0.235	0.333	0.214	0.333	0.250
	LCS	0.250	0.118	0.167	0.143	0.111	0.250
	LE	0.250	0.294	0.250	0.357	0.222	0.250
	PE	0.417	0.353	0.250	0.286	0.333	0.250

Legend:		
	SRF	Availability of Adequate Financial Sources to Raise the Financing
	FV	Financial Viability
	COC	Certainty of Construction and Operational Costs
	CR	Certainty of Revenues
	OQP	Overall Quality of the Principal
	LCS	Level of Community Support
	LE	Legal Environment
	PE	Political Environment

Table 5-9 (cont): Outsiders' Local Attribute Weights (Comp. Performed under the DRM)

	Insiders		Outsiders	
	EM	DRM	EM	DRM
Internal Organization Characteristics				
1.1 Quality of Management Team	0.614	0.454	0.435	0.421
1.2 Fitting of Strategic Planning	0.200	0.275	0.161	0.183
1.3 Compatibility with Potential Partners	0.186	0.271	0.404	0.396
Production Capability				
2.1 Adequacy of Specialized Knowledge	0.642	0.476	0.486	0.416
2.2 Overall Quality of Productive Resources	0.231	0.292	0.295	0.350
2.3 Availability of Productive Resources	0.128	0.233	0.219	0.234
Financial Resources and Constraints				
3.1 Ability to Fund Initial Project Costs	0.353	0.375	0.251	0.279
3.2 Ability to Supply Capital for the Project	0.130	0.199	0.216	0.287
3.3 Quality of Profitability	0.517	0.426	0.533	0.434
Promoting Team Characteristics				
4.1 Character of Promoting Team's Management	0.255	0.302	0.312	0.356
4.2 Strength of Promoting Team	0.523	0.422	0.360	0.337
4.3 Adequacy of Promoters Agreement	0.222	0.275	0.329	0.307
Technical Evaluation				
5.1 Ability to Provide a Quality Design	0.381	0.363	0.408	0.419
5.2 Ability to Provide a Feasible Construction Plan	0.425	0.375	0.394	0.391
5.3 Abil. Prov. an Adequate Oper-Transfer Pack.	0.195	0.261	0.198	0.190
Financial Assessment				
6.1 Availability of Sources to Raise the Financing	0.117	0.192	0.085	0.134
6.2 Financial Viability	0.388	0.329	0.396	0.329
6.3 Certainty Construction and Operational Costs	0.163	0.179	0.265	0.258
6.4 Certainty of Revenues	0.331	0.299	0.254	0.279
Principal's Qualifications & Local Conditions				
7.1 Overall Quality of the Principal	0.277	0.275	0.216	0.242
7.2 Level of Community Support	0.216	0.252	0.105	0.173
7.3 Legal Environment	0.171	0.192	0.211	0.271
7.4 Political Environment	0.335	0.280	0.468	0.315

Table 5-10: Group Weights for the Comparison of Attributes Within their Categories

Composite Weights

The composite weight of an attribute represents its relative importance to the class (i.e., index), either the CC or PA,[74] it belongs to. They are obtained by multiplication of the local attribute weights by the corresponding category weights. For instance, the composite weight of the attribute *overall quality of the principal* is determined by multiplying the local weight of this attribute and the weight of the category *principal's qualifications and local conditions*. Therefore, the composite weight of this attribute is 0.222 * 0.277 = 0.0616.[75] Tables 5-11 and 5-12 provide the individual composite weights of insiders and outsiders under the EM. Note that the weights of the top nine attributes as well as the weights of the bottom fourteen sum to unity. Tables 5-13 and 5-14 display their individual composite weights under the DRM.

Three procedures have been employed in the verification of the similarities between the individual composite weights obtained through the use of the DRM and the EM. The first procedure is a visual inspection of the relationship between both weighting methods. In Figure 5-2 each *x,y* pair corresponds to the individual weights obtained from the DRM and the EM for each attribute belonging to the CC index and for each expert. Thus, Figure 5-2 shows 72 crosses (i.e., nine attributes * eight insiders) and 54 circles (i.e., nine attributes * six outsiders). The 45-degree line displays the expected trend of the scatter in the absence of bias. A systematic bias can be seen in the results. On the most important attributes the EM provides higher weights than the DRM while on the least important attributes the weights derived from the use of the EM are smaller than the ones from the DRM.[76] Figure 5-3 displays the individual weights of the attributes of the PA index, a tendency similar to that of Figure 5-2 can also be observed. A possible explanation for these biases is that respondents might unconscientiously use a larger scale when applying the EM and thus, the resulting weights are more differentiated. This is because respondents might be more comfortable in using the extremes of the qualitative scale provided by the EM than to suggest large quantitative ratio judgments. Another plausible explanation comes directly from the critiques of Dyer and Wendell (1984) about the relation between the verbal expressions of the EM scale and the intensities of importance. It is not the purpose of this study to explore the reasons for these distinctions but to verify if the results obtained by both procedures are comparable and can be applied to rate companies and projects.

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74 The top nine attributes shown in Table 5-10 (from 1.1 to 3.3) are used in the CC index, while the bottom fourteen attributes (from 4.1 to 7.4) are part of the PA index.

75 These numbers refer to weights provided by the insiders group when using the EM.

76 It is obvious the second statement is a direct result of the first, or vice-versa, as the sum of the attribute weights of each index must sum to unity.

	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Internal Organization Characteristics								
1.1. Quality of Management Team	15.64	4.26	3.36	16.15	16.06	31.21	18.55	3.86
1.2. Fitting of Strategic Planning	2.48	0.70	1.44	4.17	46.96	4.69	5.67	1.25
1.3. Compatibility with Potential Partners	9.85	1.73	13.03	1.79	3.92	9.88	1.73	0.34
Production Capability								
2.1. Adequacy of Specialized Knowledge	6.69	14.22	4.17	14.17	6.53	10.75	3.97	13.00
2.2. Overall Quality of Productive Resources	2.05	2.77	0.83	14.17	1.64	26.50	0.47	4.09
2.3. Availability of Productive Resources	0.63	4.86	0.83	3.54	0.62	4.36	1.19	1.72
Financial Resources & Constraints								
3.1. Ability to Fund Initial Project Costs	13.69	13.46	54.55	8.67	14.45	2.55	12.77	23.05
3.2. Ability to Supply Capital for the Project	4.19	5.79	16.68	3.72	7.48	1.22	4.81	4.75
3.3. Quality of Profitability	44.79	52.22	5.10	33.61	2.33	8.83	50.82	47.95

Table 5-11: Insiders' EM Composite Weights for the Attributes that Belong to the CC Index (x 10 E-2)

	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Promoting Team Characteristics								
4.1. Character of Promoting Team's Management	2.92	1.43	0.22	3.31	24.06	4.01	0.44	2.25
4.2. Strength of Promoting Team	1.67	3.52	0.86	12.78	21.86	1.22	4.66	11.40
4.3. Adequacy of Promoters Agreement	7.65	0.58	1.99	1.03	6.62	1.10	1.42	1.03
Technical Evaluation								
5.1. Ability to Provide a Quality Design	12.25	8.23	0.38	6.77	3.47	8.39	2.17	1.40
5.2. Ability to Provide a Feasible Construction Plan	6.74	2.37	5.83	6.77	1.52	8.39	2.17	3.14
5.3. Abil. to Prov. an Adeq. Oper-Transfer Package	3.71	1.14	2.00	6.77	0.66	2.80	2.17	0.47
Financial Assessment								
6.1. Availability of Sources to Raise the Financing	3.77	3.11	18.61	14.24	1.04	3.49	3.62	4.44
6.2. Financial Viability	7.54	24.82	18.61	14.24	4.10	28.46	48.98	8.96
6.3. Certainty of Construction and Operational Costs	12.83	6.84	6.20	14.24	3.62	14.61	9.56	0.59
6.4. Certainty of Revenues	18.23	21.73	18.61	14.24	19.12	14.31	9.56	2.39
Principal's Qualification & Local Conditions								
7.1. Overall Quality of the Principal	4.80	1.75	1.26	3.94	8.52	4.58	2.60	19.18
7.2. Level of Community Support	1.26	11.20	10.54	0.56	2.86	2.71	0.80	19.18
7.3. Legal Environment	2.54	2.07	4.34	0.56	0.62	2.16	4.49	19.18
7.4 Political Environment	14.11	11.20	10.54	0.56	1.94	3.77	7.35	6.39

Table 5-11 (cont): Insiders' EM Composite Weights for the Attributes that Belong to the PA Index (x 10 E-2)

	O-01	O-02	O-03	O-04	O-05	O-06
Internal Organization Characteristics						
1.1. Quality of Management Team	1.46	45.87	2.55	46.39	1.37	4.11
1.2. Fitting of Strategic Planning	0.94	9.10	5.31	5.14	0.29	1.12
1.3. Compatibility with Potential Partners	3.08	14.45	1.23	19.94	5.02	15.04
Production Capability						
2.1. Adequacy of Specialized Knowledge	4.14	3.87	30.56	2.86	16.99	3.92
2.2. Overall Quality of Productive Resources	12.42	4.88	11.69	2.86	2.43	0.94
2.3. Availability of Productive Resources	12.42	12.29	3.20	0.95	2.43	0.68
Financial Resources & Constraints						
3.1. Ability to Fund Initial Project Costs	4.37	1.59	16.25	3.25	23.82	36.60
3.2. Ability to Supply Capital for the Project	30.59	1.59	3.41	1.44	23.82	23.06
3.3. Quality of Profitability	30.59	6.37	25.79	17.16	23.82	14.52

Table 5-12: Outsiders' EM Composite Weights for the Attributes that Belong to the CC Index (x 10 E-2)

		O-01	O-02	O-03	O-04	O-05	O-06
Promoting Team Characteristics							
4.1.	Character of Promoting Team's Management	3.07	35.34	7.53	4.65	2.12	0.41
4.2.	Strength of Promoting Team	8.98	8.83	3.77	2.14	9.44	1.30
4.3.	Adequacy of Promoters Agreement	1.05	8.83	15.06	23.57	0.67	2.06
Technical Evaluation							
5.1.	Ability to Provide a Quality Design	18.65	1.86	6.51	5.37	10.06	1.13
5.2.	Ability to Provide a Feasible Construction Plan	3.33	2.35	6.51	2.58	10.06	8.57
5.3.	Abil. to Prov. an Adeq. Oper-Transfer Package	2.98	2.95	6.51	1.24	1.44	1.80
Financial Assessment							
6.1.	Availability of Sources to Raise the Financing	2.48	1.35	1.91	0.21	15.58	2.31
6.2.	Financial Viability	34.85	14.40	14.34	1.44	15.58	2.86
6.3.	Certainty of Construction and Operational Costs	5.51	3.68	4.74	1.99	15.58	14.44
6.4.	Certainty of Revenues	6.91	3.97	14.34	1.13	15.58	4.64
Principal's Qualification & Local Conditions							
7.1.	Overall Quality of the Principal	1.91	2.17	8.44	6.85	1.76	5.19
7.2.	Level of Community Support	1.70	2.12	0.87	3.40	0.13	20.14
7.3.	Legal Environment	1.17	3.21	2.46	27.40	0.44	17.57
7.4	Political Environment	7.42	8.93	7.02	18.04	1.55	17.57

Table 5-12 (cont): Outsiders' EM Composite Weights for the Attributes that Belong to the PA Index (x 10 E-2)

	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Internal Organization Characteristics								
1.1. Quality of Management Team	13.89	8.33	2.27	14.29	21.82	23.95	21.43	5.05
1.2. Fitting of Strategic Planning	6.94	2.78	1.14	9.52	27.27	13.30	10.71	3.03
1.3. Compatibility with Potential Partners	12.50	5.56	5.68	4.76	5.45	17.29	5.36	1.01
Production Capability								
2.1. Adequacy of Specialized Knowledge	11.11	16.67	9.09	5.71	5.19	7.18	7.14	9.09
2.2. Overall Quality of Productive Resources	7.41	5.56	4.55	5.71	2.60	11.48	1.79	6.06
2.3. Availability of Productive Resources	3.70	11.11	4.55	2.86	1.30	8.61	3.57	3.03
Financial Resources & Constraints								
3.1. Ability to Fund Initial Project Costs	14.81	14.29	41.56	19.05	18.18	6.36	12.50	27.27
3.2. Ability to Supply Capital for the Project	7.41	7.14	20.78	9.52	12.12	4.55	6.25	9.09
3.3. Quality of Profitability	22.22	28.57	10.39	28.57	6.06	7.27	31.25	36.36

Table 5-13: Insiders' DRM Composite Weights for the Attributes that Belong to the CC Index (x 10 E-2)

	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08
Promoting Team Characteristics								
4.1. Character of Promoting Team's Management	6.90	5.00	0.80	6.35	14.19	3.97	1.59	6.25
4.2. Strength of Promoting Team	5.75	3.33	3.20	12.70	14.19	1.98	6.35	15.63
4.3. Adequacy of Promoters Agreement	8.63	1.67	4.00	3.17	7.10	3.57	3.17	3.13
Technical Evaluation								
5.1. Ability to Provide a Quality Design	10.35	11.43	1.85	7.41	3.23	8.40	3.70	4.17
5.2. Ability to Provide a Feasible Construction Plan	8.28	5.71	12.92	7.41	2.15	8.40	3.70	6.25
5.3. Abil. to Prov. an Adeq. Oper-Transfer Package	6.90	2.86	9.23	7.41	1.08	7.00	3.70	2.08
Financial Assessment								
6.1. Availability of Sources to Raise the Financing	5.42	7.27	10.29	11.11	1.70	7.44	5.56	7.89
6.2. Financial Viability	6.51	14.55	10.29	11.11	8.49	14.88	27.78	10.53
6.3. Certainty of Construction and Operational Costs	7.59	3.64	5.14	11.11	5.09	12.65	11.11	1.32
6.4. Certainty of Revenues	8.14	14.55	10.29	11.11	16.98	12.65	11.11	5.26
Principal's Qualification & Local Conditions								
7.1. Overall Quality of the Principal	6.81	3.75	2.91	5.56	10.32	5.64	5.23	10.71
7.2. Level of Community Support	3.40	11.25	11.64	1.85	7.74	5.29	2.61	10.71
7.3. Legal Environment	5.11	3.75	5.82	1.85	2.58	3.53	6.54	10.71
7.4 Political Environment	10.21	11.25	11.64	1.85	5.16	4.59	7.84	5.36

Table 5-13 (cont): Insiders' DRM Composite Weights for the Attributes that Belong to the PA Index (x 10 E-2)

	O-01	O-02	O-03	O-04	O-05	O-06
Internal Organization Characteristics						
1.1. Quality of Management Team	2.78	25.00	7.50	27.78	3.85	12.31
1.2. Fitting of Strategic Planning	0.69	8.33	7.50	9.26	0.96	6.15
1.3. Compatibility with Potential Partners	2.78	16.67	5.00	18.52	7.69	12.31
Production Capability						
2.1. Adequacy of Specialized Knowledge	12.50	7.41	17.78	4.17	22.50	4.40
2.2. Overall Quality of Productive Resources	25.00	11.11	13.33	4.17	7.50	2.20
2.3. Availability of Productive Resources	6.25	14.81	8.89	2.78	7.50	1.10
Financial Resources & Constraints						
3.1. Ability to Fund Initial Project Costs	4.17	3.33	15.38	9.09	16.67	24.62
3.2. Ability to Supply Capital for the Project	20.83	3.33	7.69	6.06	16.67	24.62
3.3. Quality of Profitability	25.00	10.00	16.92	18.18	16.67	12.31

Table 5-14: Outsiders' DRM Composite Weights for the Attributes that Belong to the CC Index (x 10 E-2)

	O-01	O-02	O-03	O-04	O-05	O-06
Promoting Team Characteristics						
4.1. Character of Promoting Team's Management	3.17	24.00	9.38	7.29	4.40	1.18
4.2. Strength of Promoting Team	3.17	8.00	6.25	4.86	8.79	2.35
4.3. Adequacy of Promoters Agreement	0.79	8.00	9.38	19.43	2.20	2.35
Technical Evaluation						
5.1. Ability to Provide a Quality Design	17.86	5.00	8.33	7.89	9.89	8.82
5.2. Ability to Provide a Feasible Construction Plan	14.88	3.33	8.33	5.26	9.89	17.65
5.3. Abil. to Prov. an Adeq. Oper-Transfer Package	2.98	1.67	8.33	2.63	3.30	8.82
Financial Assessment						
6.1. Availability of Sources to Raise the Financing	1.55	3.33	5.86	1.05	7.69	5.04
6.2. Financial Viability	12.42	13.33	12.89	3.16	7.69	10.08
6.3. Certainty of Construction and Operational Costs	10.87	6.67	7.03	3.16	7.69	10.08
6.4. Certainty of Revenues	10.87	6.67	11.72	3.16	7.69	10.08
Principal's Qualification & Local Conditions						
7.1. Overall Quality of the Principal	1.79	4.71	4.17	9.02	10.26	5.88
7.2. Level of Community Support	5.36	2.35	2.08	6.02	3.42	5.88
7.3. Legal Environment	5.36	5.88	3.13	15.04	6.84	5.88
7.4 Political Environment	8.93	7.06	3.13	12.03	10.26	5.88

Table 5-14 (cont): Outsiders' DRM Composite Weights for the Attributes that Belong to the PA Index (x 10 E-2)

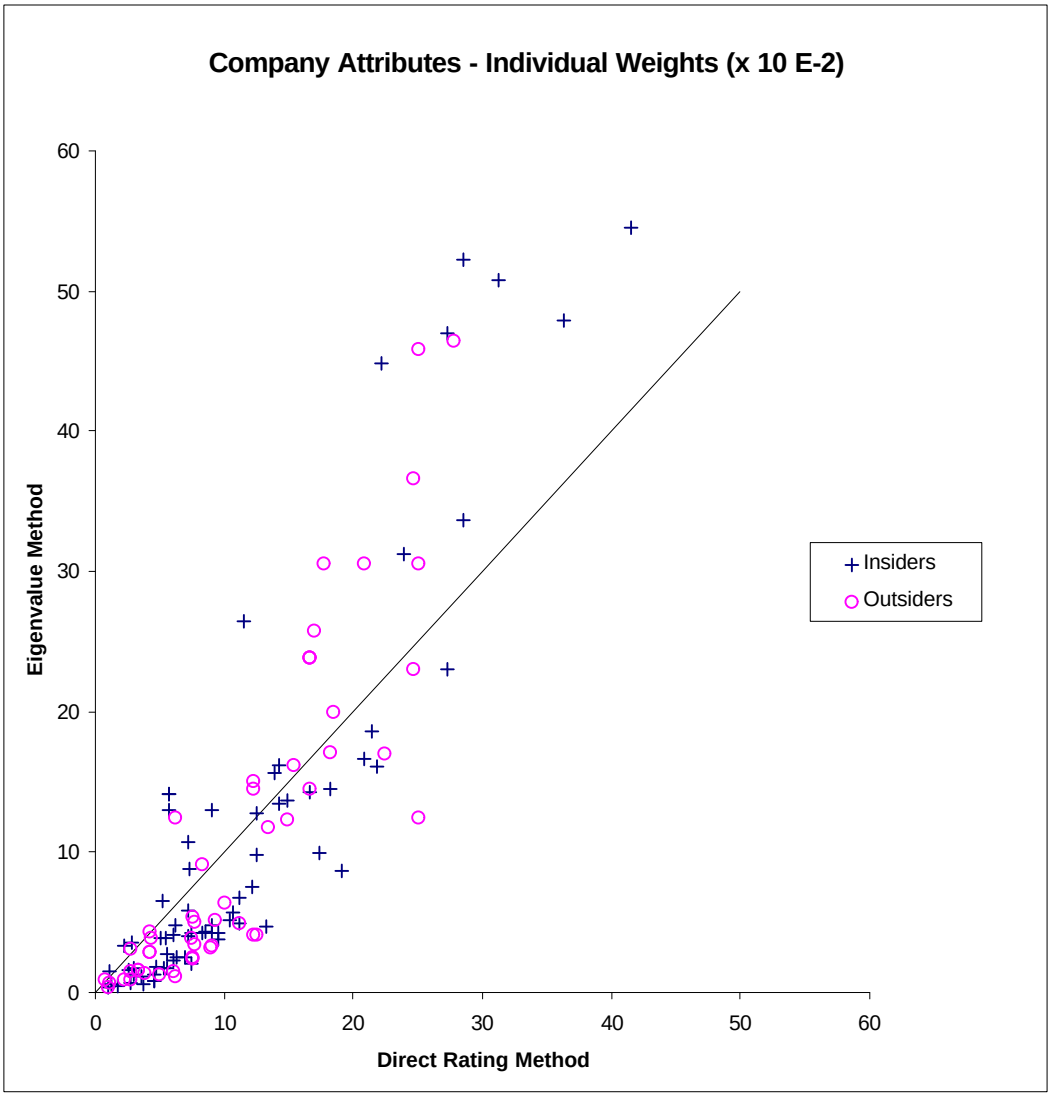

Figure 5-2: Equivalence Between the Weights Obtained from the DRM and the EM for the Company Attributes

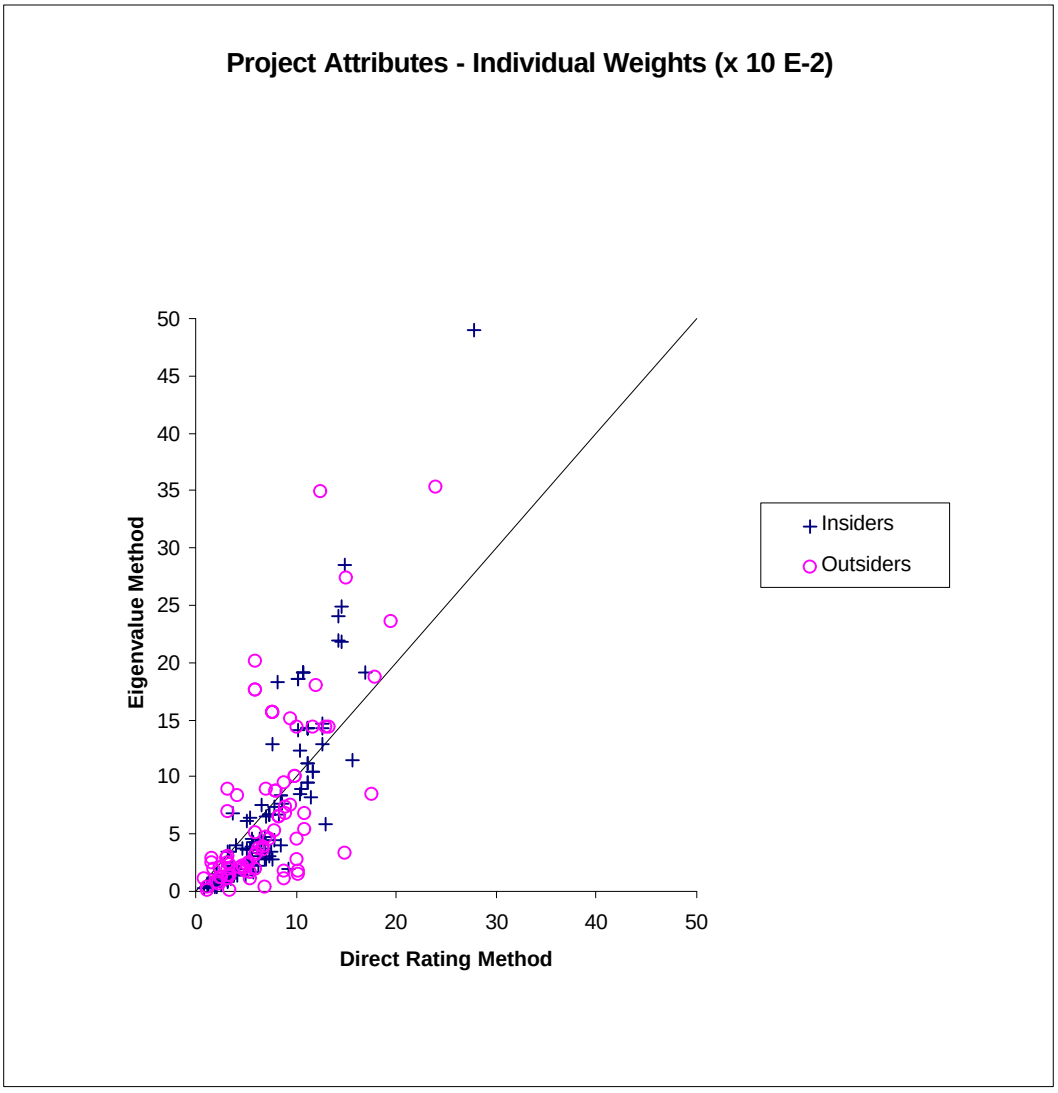

Figure 5-3: Equivalence Between the Weights Obtained from the DRM and the EM for the Project Attributes

The second procedure, Pearson's product-moment correlation, is used to determine how the weights provided by the DRM and the EM are related. Table 5-15 presents, for each respondent, the correlation between the composite weights obtained from both weighting procedures. It shows that the majority of the correlations between the methods are strong.[77] The third procedure, a two-tailed paired t-test, was ran to test the hypothesis that the differences between the weights created with the EM and the DRM for each model attribute had a mean of zero, that is, to verify the hypothesis that both methods yield similar weights. The significance level (α) of the test was set to 1%. For the insiders, two attributes had their hypothesis rejected, *ability to supply capital for the project* and *adequacy of promoters agreement*. For the outsiders all attributes had their hypothesis accepted.

	Insiders			**Outsiders**	
	Company Competencies	Project Attractiveness		Company Competencies	Project Attractiveness
I-01	0.934	0.748	**O-01**	0.805	0.569
I-02	0.947	0.895	**O-02**	0.908	0.970
I-03	0.953	0.710	**O-03**	0.951	0.760
I-04	0.754	0.969	**O-04**	0.952	0.938
I-05	0.881	0.909	**O-05**	0.878	0.424
I-06	0.707	0.910	**O-06**	0.915	0.152
I-07	0.953	0.976			
I-08	0.965	0.785			

Table 5-15: Correlation Between the Attribute Composite Weights Obtained from the DRM and the EM

Table 5-16 presents the group results for the composite weights for each one of the model attributes.[78] The correlation coefficients between DRM and EM group weights are: (1) for CC attributes, 0.972 (insiders) and 0.930 (outsiders), and (2) for PA attributes, 0.976 (insiders) and 0.798 (outsiders). Figures 5-4 and 5-5 displays the *x,y* pair of group weights, the systematic biases between the DRM and EM weights are still present but have intensities that are smaller than the ones detected in the individual weights. This occurs because group composite weights have a smaller range of values than individual

[77] Devore (1987) provides the following heuristic to evaluate the strength of correlations: "the correlation is weak if the absolute value of the correlation coefficient is smaller than 0.5, strong if it is larger than 0.8, and moderate otherwise."

[78] Group composite weights are obtained through the use of the same procedure used to calculate individual ones, that is, by multiplying the group local attribute weights by the group category weights.

weights. The discussion about one weighting method outperforming and being more appropriate than the other is carried out later in this chapter.

Figures 5-6 and 5-7 display, respectively, the "DRM" and the "EM" composite weights of the attributes that constitute the CC index. In each figure, every attribute is associated with two columns, the column on the left (just above the attribute designation) contains information provided by the insiders, the column on the right contains the outsiders' information. For each attribute, the bottom part of the two columns indicate the minimum importance weights assigned by the respondents (insiders on the left column and outsiders on the right column). Analogously, the top of the columns indicate the maximum weights assigned by the respondents. The line in the middle of the darker region reflects the attribute group weight,[79] the darker region represents the standard deviation of the individual attribute weights (one half of the standard deviation is placed above the group weight while the other half is placed below it). Similarly, Figures 5-8 and 5-9 display the "DRM" and the "EM" weights of the attributes that compose the PA index.

An examination of the aforementioned figures show differences between the weights of the attributes across the two groups. However, these differences do not appear to be large enough to support the fact that insiders and outsiders represent distinct populations. First, there are only two attributes were the difference between the insiders' group weight and the outsider's group weight is not within one standard deviation of either the outsiders' or the insiders' individual weights. They are: *Certainty of Revenues* (using weights computed through the EM) and *Availability of Sources to Raise the Financing* (using weights computed through the DRM). Second, a set of two-tailed Student's t-test was performed to examine the hypothesis that the individual attribute composite weights provided by the insiders and outsiders came from the same population. The significance level of the test was set to 1%. All attributes had the hypothesis accepted.

5.3 Establishment of Value Functions

In order to calculate the individual contributions of the attributes to either the CC or the PA index, it is necessary to multiply their relative importance weights by their worth scores, that is

*Attribute contribution = attribute composite weight * attribute worth score.*

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79 This information is provided in Table 5-16 and is calculated as follows: (1) for the DRM, by multiplying the average of the category weights given by the insiders (outsiders)and the average of the local attribute weights given by the insiders (outsiders); and (2) for the EM, by multiplying the group category weights and the group local attribute weights. Note that, for the EM, group weights are obtained by taking the geometric mean of the individual "pairwise" comparisons (see Section 5.2.1).

	Insiders		Outsiders	
	EM	DRM	EM	DRM
Internal Organization Characteristics				
1.1 Quality of Management Team	15.44	13.81	10.66	12.29
1.2 Fitting of Strategic Planning	5.03	8.35	3.93	5.33
1.3 Compatibility with Potential Partners	4.67	8.25	9.90	11.56
Production Capability				
2.1 Adequacy of Specialized Knowledge	10.98	9.22	11.14	12.04
2.2 Overall Quality of Productive Resources	3.95	5.65	6.75	10.11
2.3 Availability of Productive Resources	2.18	4.51	5.00	6.75
Financial Resources and Constraints				
3.1 Ability to Fund Initial Project Costs	20.39	18.82	13.18	11.70
3.2 Ability to Supply Capital for the Project	7.50	10.01	11.36	12.05
3.3 Quality of Profitability	29.88	21.37	28.07	18.18
Promoting Team Characteristics				
4.1 Character of Promoting Team's Management	3.08	5.39	6.86	7.42
4.2 Strength of Promoting Team	6.32	7.53	7.92	7.01
4.3 Adequacy of Promoters Agreement	2.69	4.90	7.23	6.40
Technical Evaluation				
5.1 Ability to Provide a Quality Design	4.76	6.61	7.66	10.11
5.2 Ability to Provide a Feasible Construction Plan	5.31	6.83	7.41	9.44
5.3 Abil. to Prov. an Adequate Oper-Transfer Pack.	2.44	4.76	3.73	4.60
Financial Assessment				
6.1 Availability of Sources to Raise the Financing	6.23	7.42	3.00	4.01
6.2 Financial Viability	20.66	12.69	13.96	9.85
6.3 Certainty of Construction and Operational Costs	8.68	6.92	9.34	7.74
6.4 Certainty of Revenues	17.63	11.55	8.93	8.36
Principal's Qualifications & Local Conditions				
7.1 Overall Quality of the Principal	6.16	6.99	5.18	6.05
7.2 Level of Community Support	4.79	6.41	2.51	4.34
7.3 Legal Environment	3.81	4.89	5.06	6.78
7.4 Political Environment	7.44	7.12	11.21	7.89

Table 5-16: Group Composite Weights (x 10 E-2)

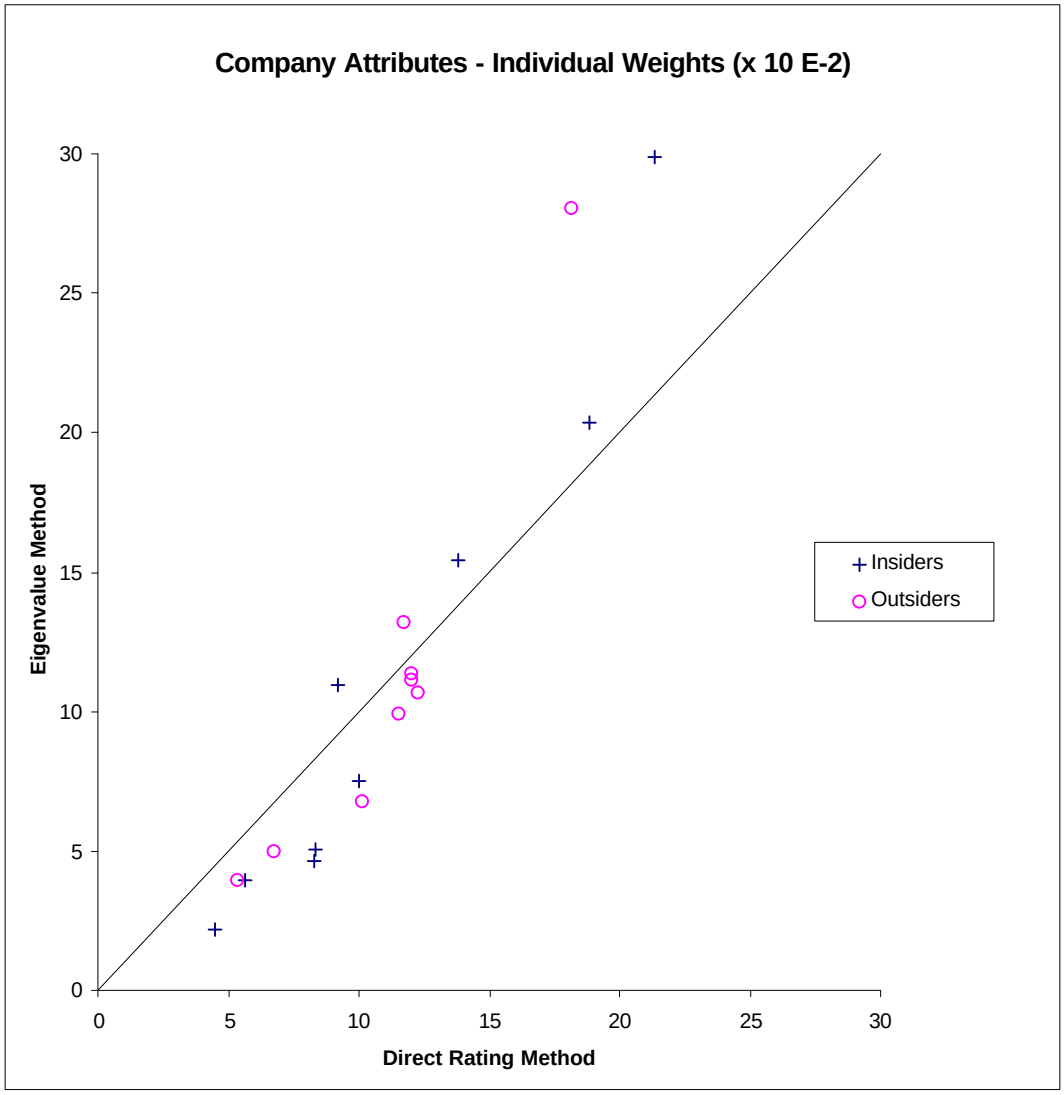


Figure 5-4: Equivalence Between the GROUP Weights Obtained from the DRM and the EM for the Company Attributes

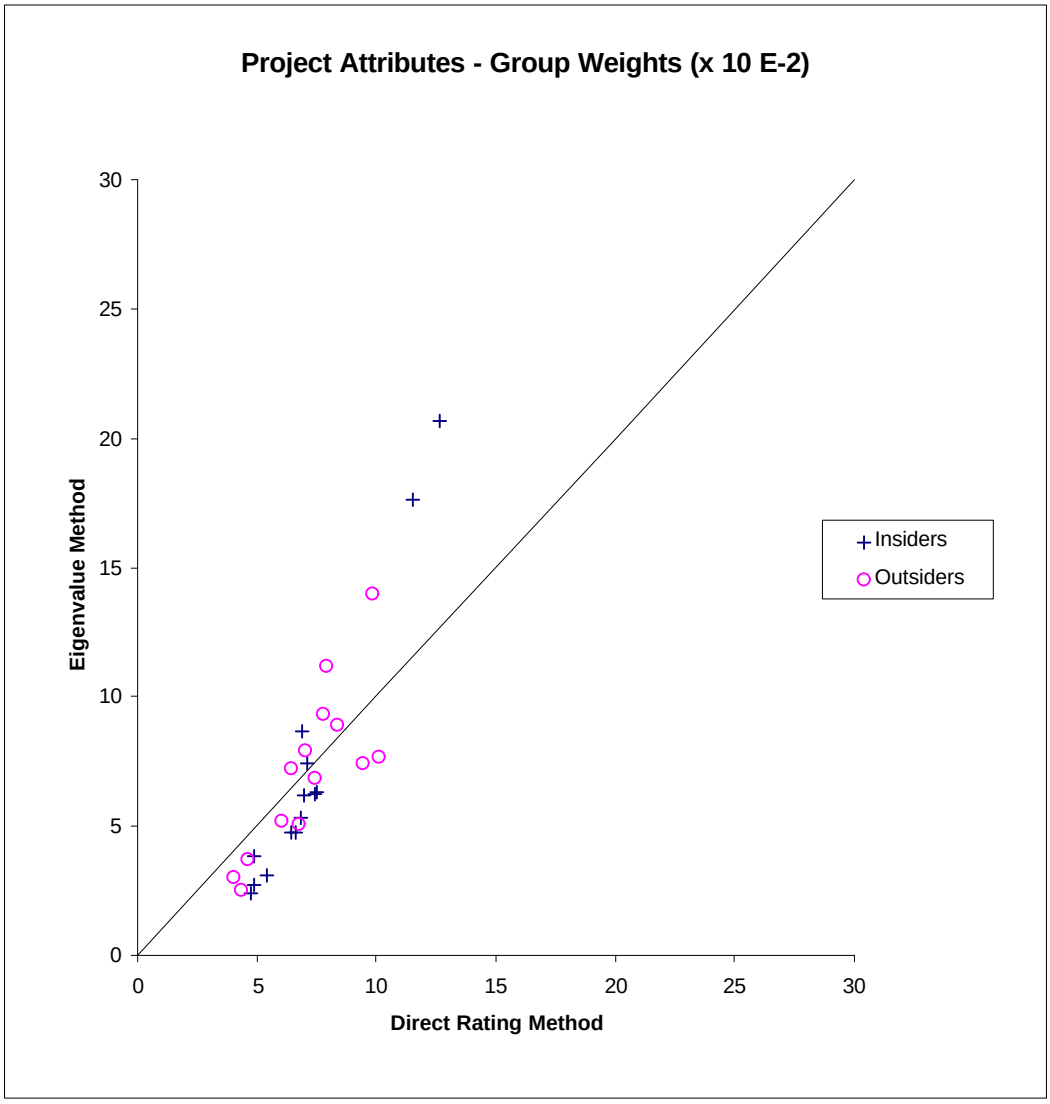


Figure 5-5: Equivalence Between the GROUP Weights Obtained from the DRM and the EM for the Project Attributes

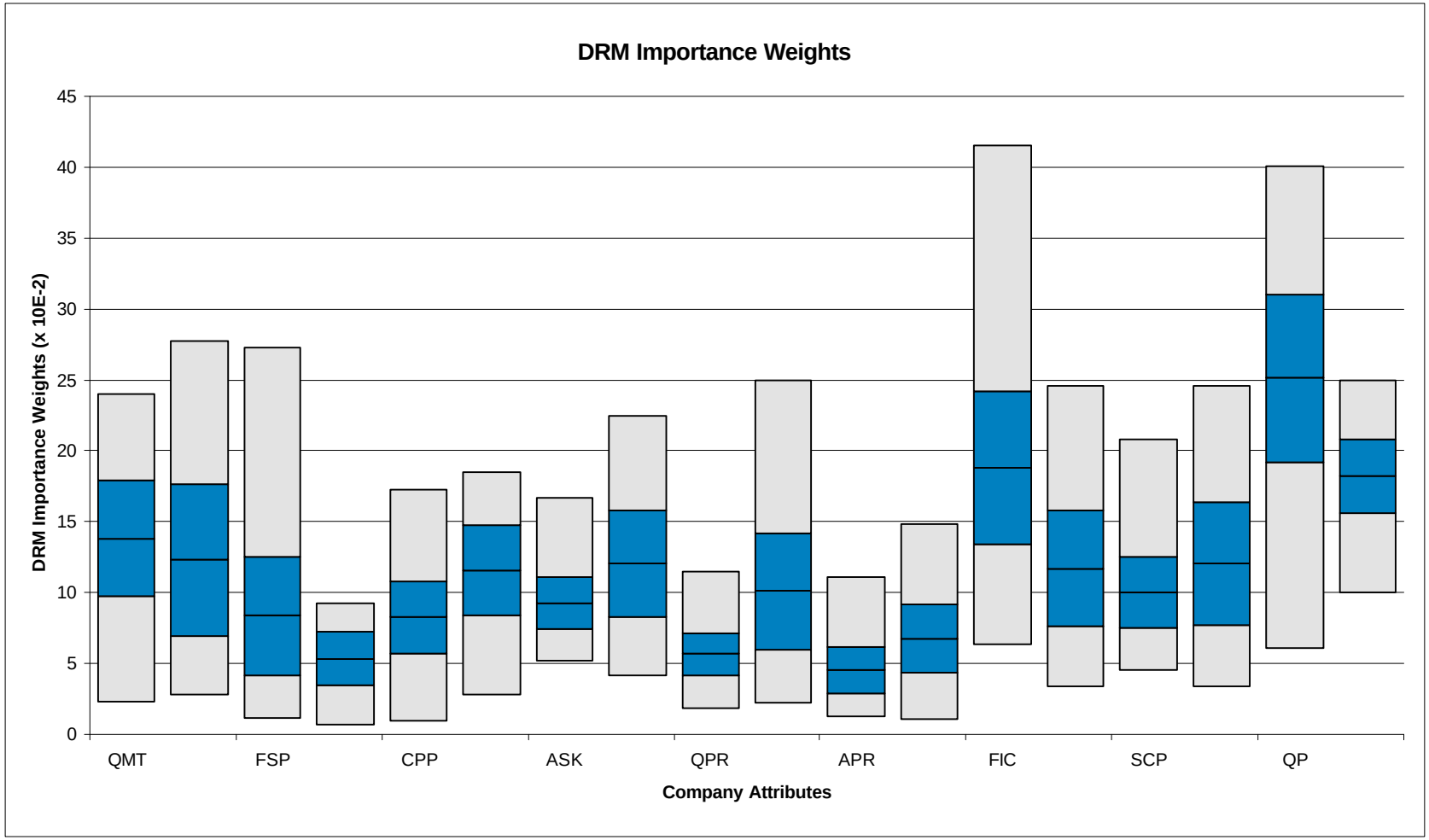


Figure 5-6: Group Weights and Range of Individual Weights for the Attributes Belonging to the CC Index (within each attribute, the column on the left displays information provided by the insiders and the column on the right contains outsiders' information)

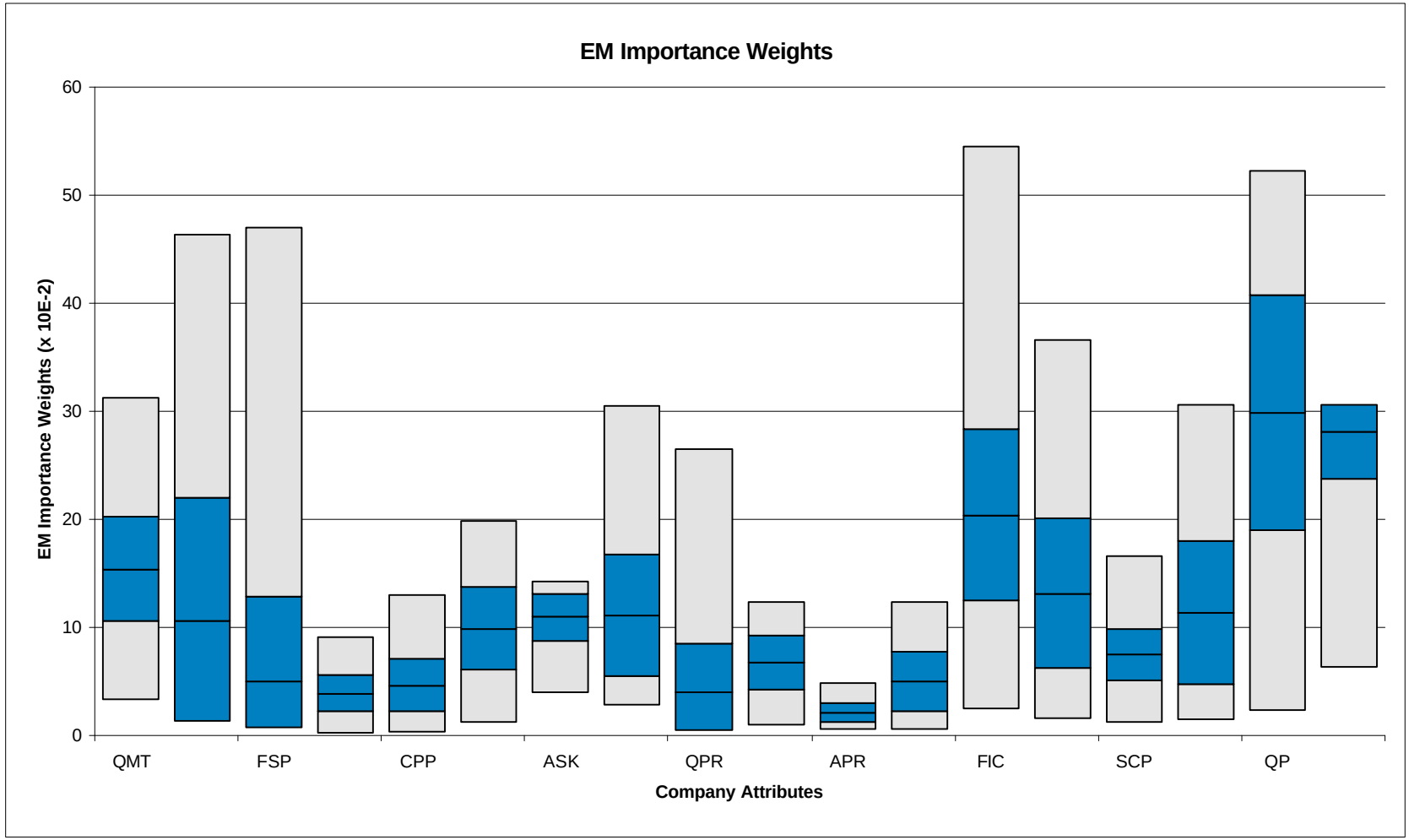


Figure 5-7: Group Weights and Range of Individual Weights for the Attributes Belonging to the CC Index
(within each attribute, the column on the left displays information provided by the insiders
and the column on the right contains outsiders' information)

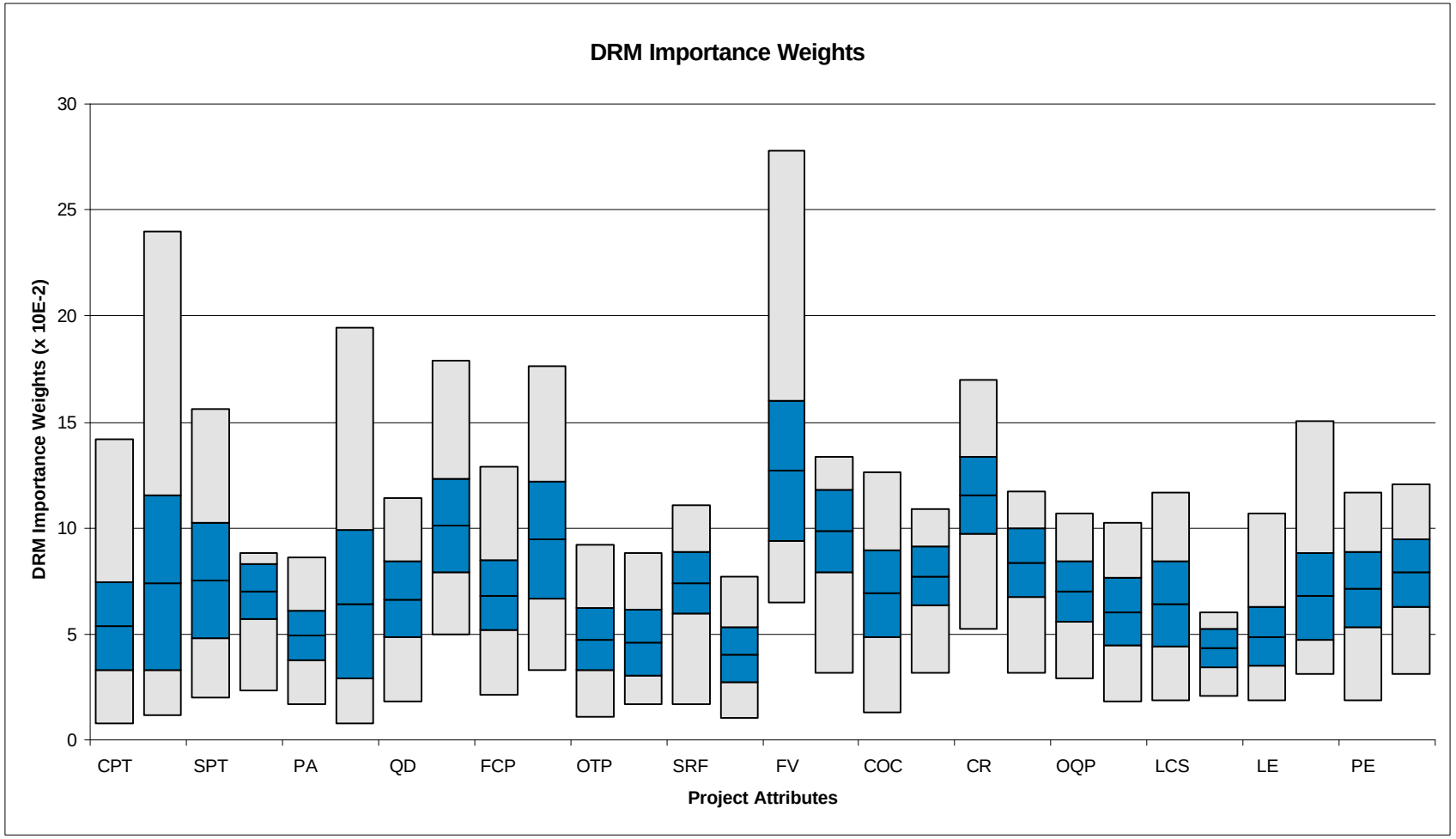


Figure 5-8: Group Weights and Range of Individual Weights for the Attributes Belonging to the PA Index (within each attribute, the column on the left displays information provided by the insiders and the column on the right contains outsiders' information)

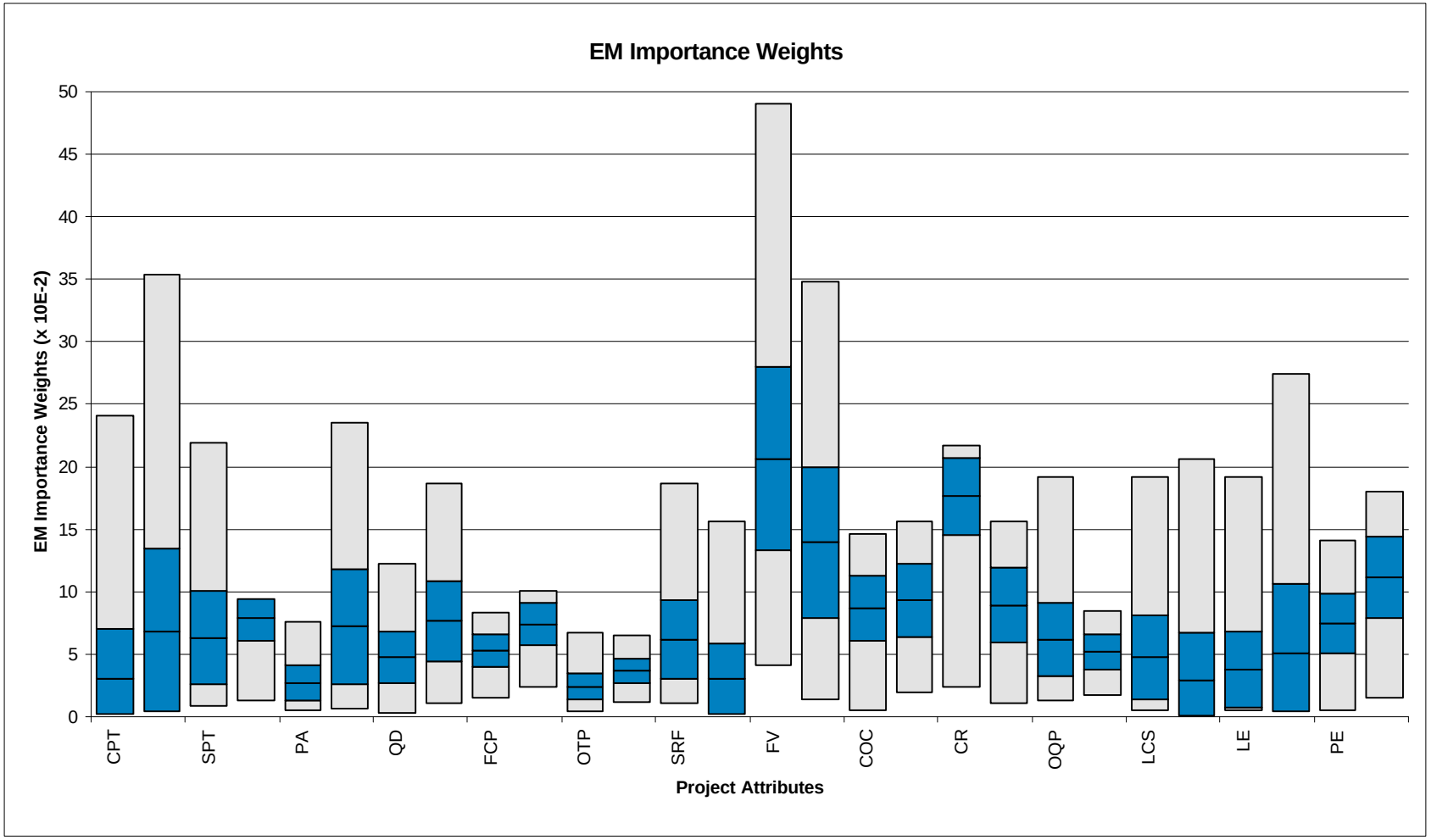


Figure 5-9: Group Weights and Range of Individual Weights for the Attributes Belonging to the PA Index (within each attribute, the column on the left displays information provided by the insiders and the column on the right contains outsiders' information)

The composite weights of the attributes reflect their relative importance in the index without considering any project in specific. The previous section provides the weights of all the attributes according to the experts that participated in the study. The worth score of an attribute is a non-dimensional number that measures the value of an attribute in a specific project. In order to determine an attribute worth score it is necessary to evaluate the performance (quality) level of this attribute and then to use a value function to transform it into an equivalent worth score.

The third questionnaire was used to identify, for each attribute, two points (i.e., P1 and P2) that characterize their respective value curves. In order to determine the location of point P2 on the value curve of an attribute, say attribute "X," the respondents answered the following question:

> **Which is the LOWEST point (P2) on the performance scale that you would consider appropriate to demonstrate your complete SATISFACTION with the performance (quality) level of the characteristics and features of attribute "X"?**

The performance scale used is bipolar (i.e., ranges from desirable to undesirable performance levels) and have the same verbal expressions as the one used in the relative importance comparisons between model categories and attributes. Figure 5-10 displays the qualitative performance scale with its numerical equivalents.[80] The answer "MoD" (moderately desirable) for the above question means that attribute "X" is worth 100 points (i.e., maximum value) when its performance (quality) level is "moderately desirable or better" and improvements on the characteristics and features of attribute "X" to raise its performance (quality) level beyond "MoD" do not provide any extra value to the project. This suggests that the characteristics and features of attribute "X" do not need to be "perfect" in order to have the attribute worth 100 points. Figure 5-11 illustrates the placement of P2.

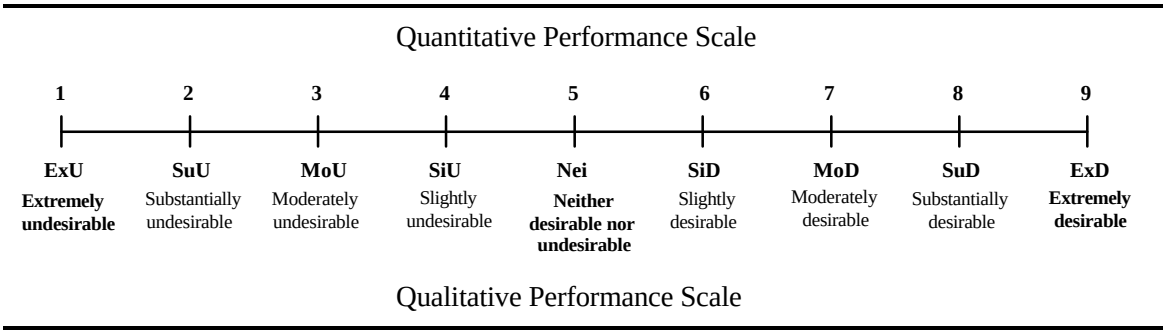


Figure 5-10: Equivalence Between Qualitative (bottom) and Quantitative (top) Performance Scales

[80] Intermediate judgments between adjacent scale values were allowed.

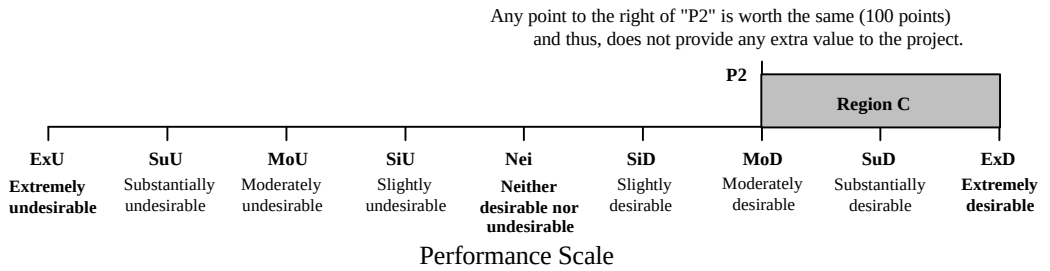


Figure 5-11: Placement of Point "P2"

To establish the location of point P1, respondents answered the following question:

> **Which is the HIGHEST point (P1) on the performance scale that you would consider appropriate to translate your complete DISCONTENT with the performance (quality) level of the characteristics and features of attribute "X"?**

The answer "SiU" (slightly undesirable) for the above question means that attribute "X" is worth 0 points (i.e., minimum value) when its performance (quality) level is "slightly undesirable or worse" and any deterioration on the characteristics and features of attribute "X" worsening its performance (quality) level below the value "SiU" does not decrease the value of the project further. This suggests that the characteristics and features of attribute "X" do not need to be a "complete disaster" in order to have the attribute worth 0 points. Figure 5-12 illustrates the placement of P1.

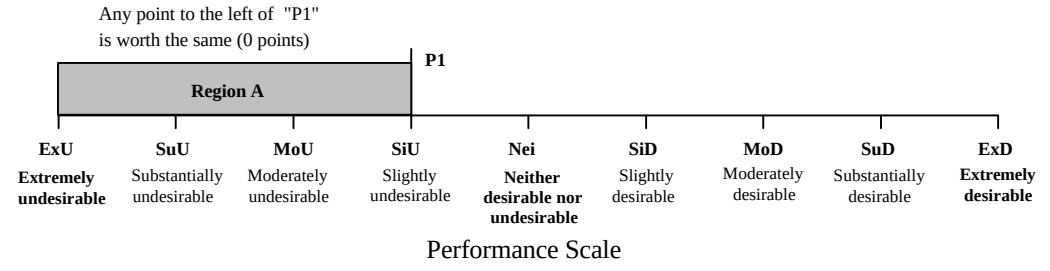


Figure 5-12: Placement of Point "P1"

The determination of P1 and P2 is sufficient to characterize a value curve, and hence, to determine the worth score of an attribute based on its performance (quality) level. Once the worth score and the relative weight of each attribute are known, it is possible to compute the contribution of the different attributes to the indices that assess the capability of companies and the feasibility of projects. For example, suppose one wants to figure out the contribution of attribute "X" to an index for a roadway project in country "Z" and that

the relative weight of attribute “X” is 0.30. Assume that the analysis of the characteristic and features of “X” for this specific project results in a performance level “slightly desirable” (SiD). Using the value curve given in Figure 5-13 (developed with the information provided in Figures 5-11 and 5-12) it is possible to convert the performance level of “X” into an value on the worth scale (in this particular example the worth score of “X” is 67), and therefore, to calculate the contribution given by “X” to the index which, in this example, amounts to 20.10 points (i.e., 0.30*67).

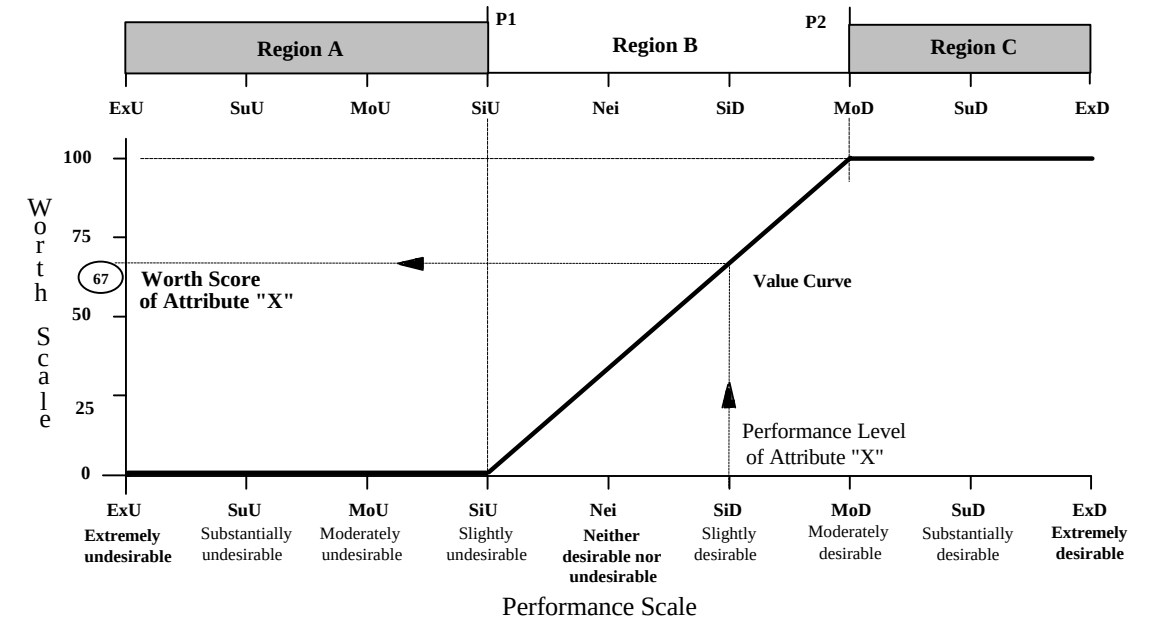


Figure 5-13: Using the Value Curve of Attribute "X" to Convert its Performance Level into Worth Points

Tables 5-17 and 5-18 display the location of points P1 and P2 in the performance scale according to the assessment of individual insiders and outsiders. It is interesting to note that for approximately 80% of the attributes, the outsiders have provided average P1 values that are larger than the ones provided by the insiders. In contrast only 40% of the average P2 values are larger for the outsiders than for the insiders. As a result, outsiders have, on average, steeper value curves than insiders for all attributes. This means that the extreme regions of the value curve (where the worth score is either zero or one hundred) are larger while the intermediate region is smaller for the outsiders than for the insiders.

	I-01		I-02		I-03		I-04		I-05		I-06		I-07		I-08	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Internal Organization Characteristics																
1.1. Quality of Management Team	6.0	7.5	3.0	8.0	3.5	7.0	7.0	9.0	4.0	7.0	3.5	7.5	4.0	8.0	3.5	6.5
1.2. Fitting of Strategic Planning	4.0	6.5	3.0	7.0	5.0	5.5	4.0	6.5	2.0	6.0	3.0	7.0	3.0	7.0	3.5	5.5
1.3. Compatibility with Potential Partners	5.0	7.0	3.0	7.0	4.0	6.0	7.0	9.0	2.5	6.0	3.5	7.5	3.0	7.0	4.0	7.0
Production Capability																
2.1. Adequacy of Specialized Knowledge	6.0	7.5	3.0	8.0	3.0	7.0	5.0	8.0	3.5	6.0	3.0	7.5	3.0	8.0	6.5	7.5
2.2. Overall Quality of Productive Resources	3.5	6.5	3.0	7.0	4.0	5.5	7.0	9.0	2.0	7.0	2.5	7.5	3.0	7.5	3.5	5.5
2.3. Availability of Productive Resources	2.5	6.0	3.0	7.0	3.0	6.5	4.5	7.5	2.0	7.0	2.5	7.5	3.0	7.0	7.0	8.0
Financial Resources & Constraints																
3.1. Ability to Fund Initial Project Costs	4.0	7.0	4.0	8.0	2.0	8.0	5.0	7.5	4.0	8.0	2.5	7.0	2.5	6.5	3.0	7.0
3.2. Ability to Supply Capital for the Project	3.0	7.0	3.0	7.0	3.0	7.5	6.0	9.0	3.0	8.0	3.0	8.0	2.5	6.5	3.0	5.5
3.3. Quality of Profitability	6.5	8.0	5.0	9.0	3.0	7.0	5.0	9.0	4.0	6.5	2.5	8.0	4.0	8.0	7.0	8.5

Table 5-17: Location of Points P1 and P2 in the Performance Scale of the Attributes that Belong to the CC index — Insiders' Assessments

	I-01		I-02		I-03		I-04		I-05		I-06		I-07		I-08	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Promoting Team Characteristics																
4.1. Character of Promoting Team's Management	4.0	7.5	3.0	7.0	3.0	6.0	6.0	8.5	4.0	7.0	2.5	8.0	3.0	7.5	3.0	6.0
4.2. Strength of Promoting Team	6.0	7.5	3.0	7.0	4.0	7.0	6.0	8.5	4.0	7.5	3.0	7.5	3.5	8.0	6.5	8.5
4.3. Adequacy of Promoters Agreement	4.0	7.5	3.0	7.0	4.5	8.0	5.5	8.0	2.0	6.0	3.0	7.0	3.5	7.5	4.5	5.5
Technical Evaluation																
5.1. Ability to Provide a Quality Design	4.5	7.0	4.0	8.0	4.5	7.0	5.5	8.0	2.5	8.0	2.0	8.0	3.0	7.5	6.5	8.5
5.2. Ability to Provide a Feasible Construction Plan	4.0	7.5	4.0	7.0	4.0	7.5	4.0	7.5	2.5	7.5	2.5	7.5	3.0	7.5	7.5	8.5
5.3. Abil. to Prov. an Adeq. Oper-Transfer Package	4.0	7.5	3.0	7.0	2.5	7.0	5.5	8.5	2.0	8.0	2.5	7.5	3.0	7.5	4.5	5.5
Financial Assessment																
6.1. Availability of Sources to Raise the Financing	5.5	8.0	5.0	8.0	4.5	8.0	7.0	9.0	3.5	8.0	1.5	8.0	3.0	8.0	7.0	8.5
6.2. Financial Viability	6.5	8.0	5.0	8.0	4.0	8.5	7.0	9.0	3.5	8.5	2.0	8.0	4.0	8.5	7.0	8.5
6.3. Certainty of Construction and Operational Costs	5.5	8.0	4.0	8.0	4.0	8.0	7.0	9.0	2.5	6.5	1.5	8.0	3.0	7.0	6.5	7.5
6.4. Certainty of Revenues	5.5	8.0	4.0	8.0	4.0	8.0	7.0	9.0	3.0	7.5	1.5	9.0	3.0	7.5	7.0	9.0
Principal's Qualification & Local Conditions																
7.1. Overall Quality of the Principal	5.5	8.0	3.0	7.0	4.0	7.0	7.0	8.0	3.0	8.5	1.5	8.0	3.5	8.0	3.5	7.0
7.2. Level of Community Support	3.5	7.0	4.0	8.0	4.5	8.0	4.5	7.0	2.5	7.0	2.5	8.0	2.5	6.5	5.5	8.0
7.3. Legal Environment	5.5	8.0	3.0	7.0	3.5	6.5	4.5	7.0	4.0	7.5	2.5	7.5	3.5	8.0	6.0	8.0
7.4 Political Environment	5.5	8.0	4.0	8.0	3.5	6.5	4.5	7.0	4.0	8.5	2.5	7.5	3.0	8.0	6.5	8.5

Table 5-17 (cont): Location of Points P1 and P2 in the Performance Scale of the Attributes that Belong to the PA index — Insiders' Assessments

Company Competencies	O-01		O-02		O-03		O-04		O-05		O-06	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Internal Organization Characteristics												
1.1. Quality of Management Team	4.5	6.5	6.5	8.0	2.5	7.5	4.0	8.0	4.0	8.0	6.5	7.5
1.2. Fitting of Strategic Planning	4.5	5.5	4.0	7.0	3.5	7.5	3.0	6.0	2.0	6.0	4.5	6.5
1.3. Compatibility with Potential Partners	4.5	5.5	5.0	7.0	3.5	7.5	3.0	7.0	3.0	8.0	7.5	8.5
Production Capability												
2.1. Adequacy of Specialized Knowledge	3.5	6.5	3.5	6.5	3.5	7.0	3.0	7.0	4.0	8.0	5.5	7.5
2.2. Overall Quality of Productive Resources	4.5	6.5	3.5	6.5	3.5	7.5	3.0	7.0	3.0	8.0	5.5	7.5
2.3. Availability of Productive Resources	3.5	4.5	3.5	6.5	3.5	7.5	2.0	6.0	3.0	8.0	4.5	6.5
Financial Resources & Constraints												
3.1. Ability to Fund Initial Project Costs	4.5	6.5	7.5	8.5	3.0	7.0	4.0	7.0	4.0	8.0	7.5	8.5
3.2. Ability to Supply Capital for the Project	4.5	5.5	5.0	7.0	3.5	7.0	2.0	6.0	4.0	8.0	7.5	8.5
3.3. Quality of Profitability	6.5	7.5	7.0	8.0	3.5	7.0	4.0	8.0	3.0	8.0	6.5	8.5

Table 5-18: Location of Points P1 and P2 in the Performance Scale of the Attributes that Belong to the CC index — Outsiders' Assessments

Project Attractiveness	O-01		O-02		O-03		O-04		O-05		O-06	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Promoting Team Characteristics												
4.1. Character of Promoting Team's Management	4.5	5.5	7.5	8.5	3.0	7.0	4.0	8.0	4.0	8.0	6.5	8.5
4.2. Strength of Promoting Team	4.5	5.5	6.0	7.5	3.0	7.5	3.0	7.0	4.0	8.0	5.5	7.5
4.3. Adequacy of Promoters Agreement	6.5	7.5	6.5	8.0	3.0	6.5	4.0	8.0	4.0	8.0	4.5	7.5
Technical Evaluation												
5.1. Ability to Provide a Quality Design	5.5	7.5	8.0	9.0	4.5	7.0	3.0	8.0	4.0	8.0	5.5	7.5
5.2. Ability to Provide a Feasible Construction Plan	3.5	4.5	8.0	9.0	4.5	6.0	3.0	8.0	4.0	8.0	7.5	8.5
5.3. Abil. to Prov. an Adeq. Oper-Transfer Package	4.5	5.5	7.0	8.0	4.0	8.0	3.0	7.0	4.0	8.0	5.5	8.5
Financial Assessment												
6.1. Availability of Sources to Raise the Financing	4.5	5.5	8.0	9.0	4.0	8.0	4.0	7.0	4.0	8.0	5.5	7.5
6.2. Financial Viability	2.5	3.5	8.5	9.0	5.0	9.0	5.0	8.0	4.0	8.0	4.5	8.5
6.3. Certainty of Construction and Operational Costs	2.5	3.5	6.5	8.0	5.0	7.0	3.0	7.0	4.0	8.0	4.5	7.5
6.4. Certainty of Revenues	1.5	2.5	6.5	8.0	7.0	9.0	4.0	8.0	4.0	8.0	4.5	7.5
Principal's Qualification & Local Conditions												
7.1. Overall Quality of the Principal	3.5	4.5	7.0	8.5	5.0	7.0	3.0	7.0	4.0	8.0	7.5	8.5
7.2. Level of Community Support	4.5	6.5	7.0	8.0	4.0	8.0	4.0	7.0	3.0	7.0	7.5	8.5
7.3. Legal Environment	4.5	6.5	6.0	8.0	3.5	7.0	3.0	6.0	3.0	7.0	7.5	8.5
7.4 Political Environment	4.5	5.5	6.5	8.0	5.5	7.5	4.0	7.0	4.0	8.0	7.5	8.5

Table 5-18 (cont): Location of Points P1 and P2 in the Performance Scale of the Attributes that Belong to the CC index — Outsiders' Assessments

5.4 Determination of Attribute Delta Dimensions

As described in Chapter 4, the delta dimension is used to indicate unacceptable levels of attribute performance (quality.) This concept arose from the fact that a very low performance (quality) level of certain attributes might be sufficient to reject the idea of project promotion without even considering the performance (quality) level of other attributes. In order to determine the existence of such dominant parameters in the Desirability Model, the following hypothetical question was presented in questionnaire three:

> **Would you consider supporting a project where the performance (quality) level of attribute "X" resides in REGION A of its value curve (left side of "P1") while the performance (quality) levels of all other model attributes reside in REGION C of their respective value curves (right side of "P2")?**

It has been assumed that, for any dominant attribute, the region of "absolute project (company) rejection" coincides with region A (left side of P1) on the performance scale. Table 5-19 shows the answers provided by the experts and denotes the attributes that must present a minimum level to permit the project (company) to be considered for promotion (involvement in the promotion.) The column "Yes" means that the level of the particular attribute is not sufficient to reject the project. The column "δ" indicates the dominant attributes (i.e., the ones where a worth score of zero implies $\delta_i = -1$). For an attribute to be non-dominant it is necessary that the number of responses "Yes" be greater than the number of responses "No."

For insiders two thirds of the company-related attributes and six sevenths of the project related ones are dominant, the outsiders consider eight ninths of the company and all of the project attributes to be dominant. This clearly indicates that a candidate project for private promotion cannot be carried further if extreme levels of undesirable performance characterize some of its attributes even if others (including the ones with highest weights) have a high level of performance. Projects must have some minimum levels across all attributes. Similar reasoning applies in the analysis of a company seeking to get involved in the private promotion of a project.

5.5 Model Validation

5.5.1 Background

The use of external criteria to objectively assess the validity of decomposed evaluation models is a difficult issue as multiattribute decision models are essentially subjective in

	Insiders			Outsiders		
	δ	Yes	No	δ	Yes	No
Internal Organization Characteristics						
1.1 Quality of Management Team	(*)	1	7	(*)	1	5
1.2 Fitting of Strategic Planning		7	1		4	2
1.3 Compatibility with Potential Partners	(*)	4	4	(*)	3	3
Production Capability						
2.1 Adequacy of Specialized Knowledge	(*)	2	6	(*)	2	4
2.2 Overall Quality of Productive Resources		6	2	(*)	3	3
2.3 Availability of Productive Resources		6	2	(*)	3	3
Financial Resources and Constraints						
3.1 Ability to Fund Initial Project Costs	(*)	4	4	(*)	3	3
3.2 Ability to Supply Capital for the Project	(*)	4	4	(*)	3	3
3.3 Quality of Profitability	(*)	0	8	(*)	0	6
Promoting Team Characteristics						
4.1 Character of Promoting Team's Management	(*)	2	6	(*)	1	5
4.2 Strength of Promoting Team	(*)	1	7	(*)	3	3
4.3 Adequacy of Promoters Agreement	(*)	4	4	(*)	1	5
Technical Evaluation						
5.1 Ability to Provide a Quality Design	(*)	3	5	(*)	1	5
5.2 Ability to Provide a Feasible Construction Plan	(*)	2	6	(*)	1	5
5.3 Abil. Prov. an Adequate Oper-Transfer Pack.		5	3	(*)	3	3
Financial Assessment						
6.1 Availability of Sources to Raise the Financing	(*)	2	6	(*)	2	4
6.2 Financial Viability	(*)	0	8	(*)	1	5
6.3 Certainty Construction and Operational Costs	(*)	2	6	(*)	3	3
6.4 Certainty of Revenues	(*)	2	6	(*)	3	3
Principal's Qualifications & Local Conditions						
7.1 Overall Quality of the Principal	(*)	3	5	(*)	2	4
7.2 Level of Community Support		5	3	(*)	2	4
7.3 Legal Environment	(*)	3	5	(*)	2	4
7.4 Political Environment	(*)	3	5	(*)	1	5

Table 5-19: Answers to the Question About Attribute Delta Dimensions
(*) Denotes Dominant Attribute

nature. Therefore, researchers have relied mostly on indirect approaches, such as convergent validation, predictive validation, and axiomatic validation, to validate their models.

Convergent validation consists of comparing the results obtained by a multiattribute decomposed model with holistic (i.e., intuitive) evaluations made by the decision maker. In using this approach, several alternatives (e.g., projects) are defined and then, evaluations based on the model and on the decision maker's judgments are compared as to how they rate and/or rank these alternatives. A high positive correlation between holistic and decomposed evaluations are expected to occur if, in fact, the decomposed model is capturing the holistic evaluation preferences. Von Winterfeldt and Edwards (1986) and Gardiner (1974) provide a summary of multiattributte decision models that shows correlations between both types of evaluation in the 0.70 to 0.95 range.[81] They interpret these findings as supporting the convergent validity of multiattribute decomposed models but point to the fact that these correlations tend to decrease as the number of attributes increase because the reliability of holistic judgments decreases with an increase in the quantity of model attributes.

Predictive validation correlates model results with appropriate probabilistic indices of the eventual success or failure of an action taken on the basis of the evaluation. For example, the decomposed evaluation of applicants for admission to graduate school should be able to predict the future success of the applicants (Cook and Stuart, 1975). In order to use the predictive validation it is necessary to have information about the successes and failures of the alternatives being evaluated. In the graduate applicants example, it is necessary to know the level of the attributes that compose the model when the student applied and his/her degree of success when finishing graduate school. Such information however is rarely found.

Axiomatic validation is used to verify whether or not the model assumptions are likely to fail. For example, in testing the Desirability Model, one could verify if the assumption about attribute independence is violated by the respondents. According to von Winterfeldt and Edwards (1986), the problem with axiomatic tests is that they are very strong and almost inevitably prove the model wrong. Therefore, one needs to consider if violations can be disregarded and the model applied or if they influence and distort the judgments required to build the model itself making it unacceptable and useless.

This study uses the first approach — convergent validation — to try to validate the Desirability Model. In the fourth questionnaire nine hypothetical company profiles and ten project profiles were presented to respondents who were asked to perform an intuitive evaluation and to rate them using a 0-100 scale. The reasons for the creation of hypothetical profiles is twofold. The first reason is to vary the CC and PA indices through a wide range so that the model performance could be evaluated for companies and projects of diverse characteristics. The second, and most important reason, was that no

[81] The decomposition of the models reviewed range from one to nine attributes.

data about real companies and/or projects could be found that would permit the model to be validated.

Single-factor ANOVA tests were ran on the CC and PA indices of the different profiles. The index of each profile was calculated for every respondent and tests were performed to verify whether or not there are differences in the averages of the profiles. For each model class (i.e., CC and PA) four tests (indices obtained from insiders using the DRM weights, insiders using the EM weights, outsiders applying the DRM weights, and outsiders applying the EM weights) were carried before the fourth questionnaire was sent out and two additional tests (indices obtained through insiders and outsiders holistic judgments) were done at a latter stage. A significance level (alpha) of 1% was used, the hypotheses that the average indices of the various profiles are similar was rejected in eleven of those tests. The only test that could not reject the hypotheses was the one performed for company profiles with information provided by the outsiders using the EM method. This test had a P-value of 0.014.

The profiles provided the performance level of all the necessary model attributes. This approach forced respondents to imaginatively compose a company (project) with pre-determined characteristics before evaluating it. Ideally, respondents should have been provided with descriptions of companies (projects) and asked to assign performance levels to each of their attributes. Apparently, this latter procedure would allow the respondents to have a better understanding about the companies (projects) being evaluated which might have facilitated their holistic assessments. However, a descriptive approach proved to be impossible to use as the conception of imaginary companies (projects) would require the generation of a fairly extensive amount of information. Appendix B provides an example of the procedure used by the respondents to carry out the analysis of the company and project profiles.

5.5.2 Evaluation Results

The company profiles used to validate the CC index are shown in Table 5-20. It has been assumed that these profiles reflect the performance (quality) level of different companies with respect to a particular privately promoted project. The outcomes of the decomposed evaluations (i.e., the index values obtained according to Eq. 4.24) are calculated by transforming the performance level of each of the company profile attributes into worth scores (through the use of the information contained in Tables 5-17 and 5-18) and multiplying it by the relative importance weights of the attributes (available on Tables 5-11 through 5-14.) Since the sum of either the company or project attribute weights is equal to unity and the worth scores are bounded between 0 and 100, the CC and the PA indices fall between 0 and 100. Table 5-21 provides the holistic evaluation of insiders and outsiders to each company profile together with the results provided by their decomposed evaluations (using both EM and DRM).

Company Competencies Attributes	C1	C2	C3	C4	C5	C6	C7	C8	C9
Quality of Management Team	5	4	9	7	6	9	5	8	9
Fitting of Strategic Planning	7	5	7	6	7	8	6	5	7
Compatibility with Potential Partners	7	6	8	7	5	8	7	7	7
Adequacy of Specialized Knowledge	7	5	8	6	4	8	9	8	8
Overall Quality of Productive Resources	7	7	8	5	5	8	8	8	7
Availability of Productive Resources	8	8	7	8	8	6	7	6	6
Ability to Fund Initial Project Costs	7	5	9	8	9	7	9	7	6
Ability to Supply Capital for the Project	5	3	8	7	8	6	8	6	4
Quality of Profitability	7	6	5	4	7	8	7	7	5

Table 5-20: Hypothetical Company Profiles

The holistic and decomposed evaluations of every respondent were compared using Pearson's product-moment and Spearman's rank-order correlations. The results, shown in Tables 5-22, reveal that most holistic-decomposed product-moment and rank-order correlations range from moderate to strong and appear to indicate that the decomposed model reasonably captures the holistic evaluations preferences. The individual evaluations were also used to compute regression lines. Figures 5-14 and 5-15 display plots of the outcomes for the different company profiles obtained from the direct assessment of each insider and outsider against the results derived from their decomposed evaluations using, respectively, the EM and the DRM. The individual regression lines are also shown and indicate the trend between the respondents' direct assessments and their holistic evaluations. The 45-degree line represents the case where both procedures would provide equal profile assessments. An examination of the aforementioned figures shows:

- Some subjects provide direct assessments that overrate their decomposed models while some others provide assessments that underrate their models, and

- The existence of varying distances between the individual regression lines and the 45-degree line representing the instance of equal profile assessments.

For instance, on the top chart of Figure 5-14, three insiders provide intuitive ratings that are mostly higher than their decomposed models (with distances increasing as one moves to the region of low-level holistic evaluations) and the other five provide lower ratings than their models (with distances increasing as one moves to the region of high-level holistic evaluations).

		C1	C2	C3	C4	C5	C6	C7	C8	C9
I-01	holistic	45.0	15.0	90.0	35.0	27.0	80.0	65.0	70.0	60.0
	EM	50.2	13.2	55.2	41.8	36.9	99.0	54.0	67.6	47.5
	DRM	63.9	25.1	77.8	56.9	44.0	98.1	69.9	79.2	67.3
I-02	holistic	80.0	20.0	95.0	75.0	80.0	100.0	95.0	95.0	80.0
	EM	62.2	32.2	47.8	39.7	58.6	80.9	71.2	67.5	35.5
	DRM	70.2	41.3	71.4	59.6	63.5	84.7	80.0	76.2	56.2
I-03	holistic	20.0	15.0	80.0	70.0	78.0	65.0	85.0	75.0	60.0
	EM	79.7	48.4	97.5	93.0	89.1	85.2	98.1	83.8	66.2
	DRM	80.2	48.2	94.8	86.1	88.2	85.5	98.7	84.4	64.1
I-04	holistic	35.0	30.0	95.0	80.0	81.0	89.0	83.0	86.0	40.0
	EM	40.9	13.6	56.6	21.5	35.7	76.4	55.5	56.5	39.7
	DRM	45.7	13.8	62.5	34.6	52.1	72.9	58.3	50.5	38.6
I-05	holistic	20.0	10.0	90.0	80.0	50.0	85.0	70.0	75.0	60.0
	EM	81.2	50.8	98.6	95.5	87.6	93.3	89.3	81.5	85.3
	DRM	73.6	42.3	96.4	90.5	86.0	90.3	85.5	83.5	77.3
I-06	holistic	40.0	30.0	90.0	45.0	40.0	88.0	50.0	85.0	75.0
	EM	73.1	52.4	94.7	70.2	58.9	98.2	76.0	93.0	88.4
	DRM	76.9	50.8	95.2	77.2	67.6	95.6	77.4	85.5	85.1
I-07	holistic	60.0	50.0	90.0	65.0	69.0	87.0	75.0	78.0	72.0
	EM	70.7	41.3	61.9	41.3	73.7	99.1	72.0	83.6	56.9
	DRM	72.1	41.6	76.6	56.9	72.1	98.3	73.4	85.2	70.0
I-08	holistic	30.0	10.0	85.0	60.0	70.0	90.0	55.0	55.0	40.0
	EM	42.7	19.1	50.3	38.0	37.2	82.3	48.4	50.0	41.7
	DRM	54.7	26.5	60.6	53.0	51.5	84.8	58.1	59.8	48.3

Table 5-21: Results of the Holistic and Decomposed Evaluations Performed by Insiders on the Company Profiles

		C1	C2	C3	C4	C5	C6	C7	C8	C9
O-01	holistic	46.0	28.0	65.0	22.0	48.0	80.0	65.0	69.0	58.0
	EM	68.3	31.5	69.4	59.4	70.0	100.0	83.6	84.2	37.7
	DRM	75.0	41.7	75.0	54.2	56.3	100.0	85.4	87.2	53.1
O-02	holistic	66.0	54.0	77.0	65.0	65.0	77.0	73.0	70.0	67.0
	EM	44.6	29.4	93.6	56.1	27.7	95.6	44.7	83.1	88.4
	DRM	58.3	40.7	90.0	62.1	36.6	92.5	62.2	77.0	80.9
O-03	holistic	55.0	50.0	80.0	60.0	70.0	90.0	65.0	60.0	75.0
	EM	94.5	56.6	84.2	59.4	64.3	97.8	96.2	94.3	74.8
	DRM	88.6	56.1	88.3	67.9	70.1	94.5	91.7	89.2	73.3
O-04	holistic	65.0	40.0	80.0	35.0	50.0	95.0	75.0	90.0	75.0
	EM	60.6	33.7	87.1	69.1	59.0	100.0	60.9	94.0	85.3
	DRM	73.1	42.7	86.4	71.7	67.1	100.0	74.6	92.4	80.3
O-05	holistic	55.0	50.0	90.0	75.0	70.0	80.0	85.0	65.0	60.0
	EM	64.6	32.1	85.2	63.7	73.1	81.2	92.7	75.3	47.5
	DRM	68.5	38.6	88.5	64.3	63.1	84.5	90.7	79.4	59.0
O-06	holistic	40.0	30.0	90.0	50.0	50.0	80.0	40.0	60.0	70.0
	EM	9.1	1.7	66.4	22.9	53.6	29.0	58.1	13.4	10.4
	DRM	15.3	4.3	69.2	25.3	47.3	41.3	52.3	24.3	25.3

Table 5-21 (cont): Results of the Holistic and Decomposed Evaluations Performed by Outsiders on the Company Profiles

	Correlation between Holistic and Decomposed (EM weights) Evaluations		**Correlation between Holistic and Decomposed (DRM weights) Evaluations**	
	Pearson's coeficient.	Spearman's rank coeficient	Pearson's coeficient.	Spearman's rank coeficient
Insiders				
I-01	0.792	0.933	0.914	0.950
I-02	0.688	0.807	0.896	0.904
I-03	0.782	0.900	0.765	0.933
I-04	0.601	0.833	0.739	0.867
I-05	0.829	0.867	0.870	0.867
I-06	0.958	0.933	0.888	0.967
I-07	0.651	0.550	0.824	0.833
I-08	0.752	0.567	0.820	0.683
Outsiders				
O-01	0.695	0.833	0.831	0.811
O-02	0.711	0.733	0.794	0.852
O-03	0.356	0.411	0.481	0.445
O-04	0.796	0.811	0.849	0.943
O-05	0.845	0.833	0.822	0.800
O-06	0.364	0.529	0.606	0.582

Table 5-22: Correlations Between Holistic and Decomposed Evaluations Taken Across Company Profiles

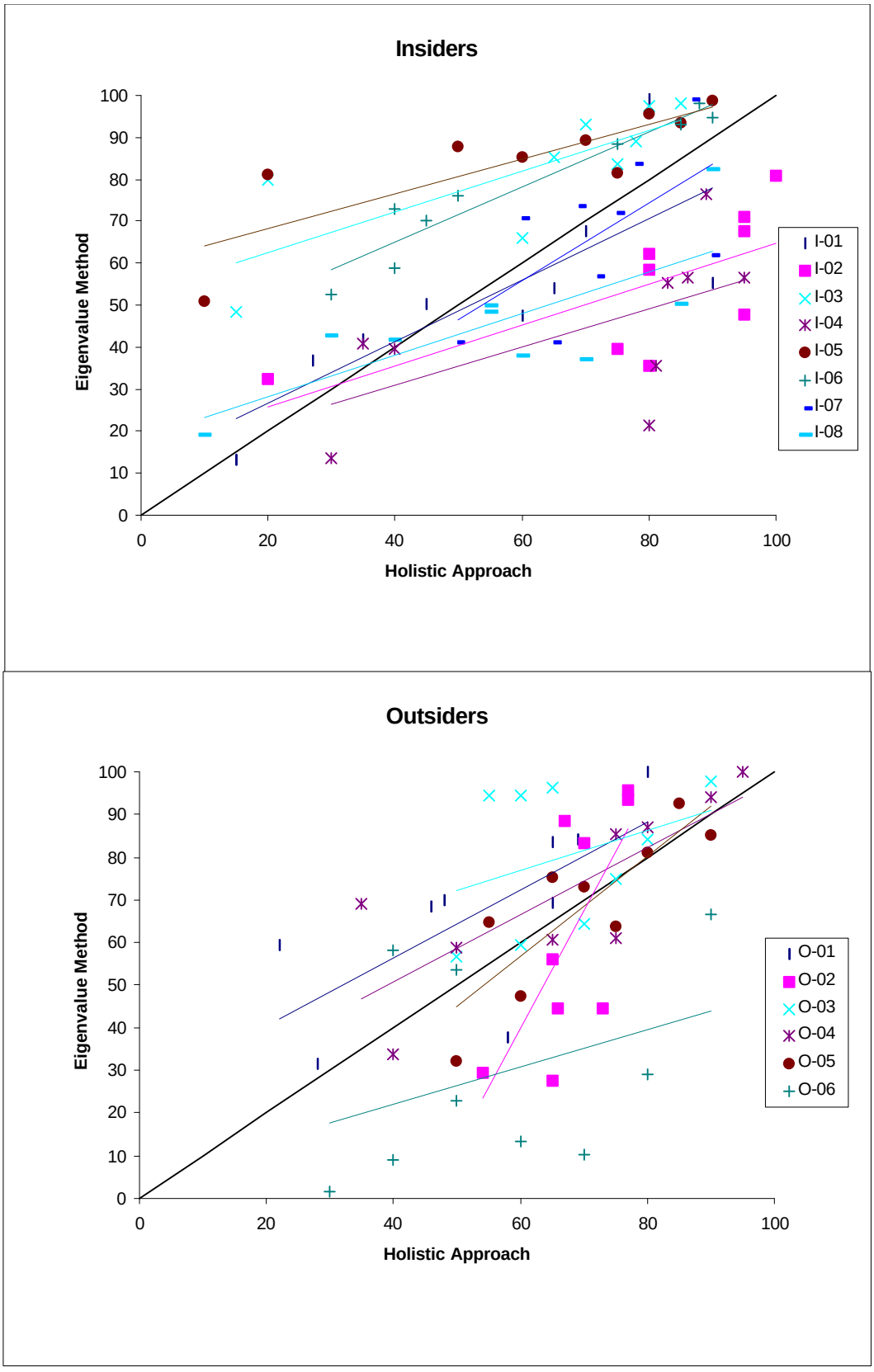


Figure 5-14: Correlation Between the Results Obtained from the Evaluation of Company Profiles Using the Holistic and the Decomposed (EM weights) Approaches

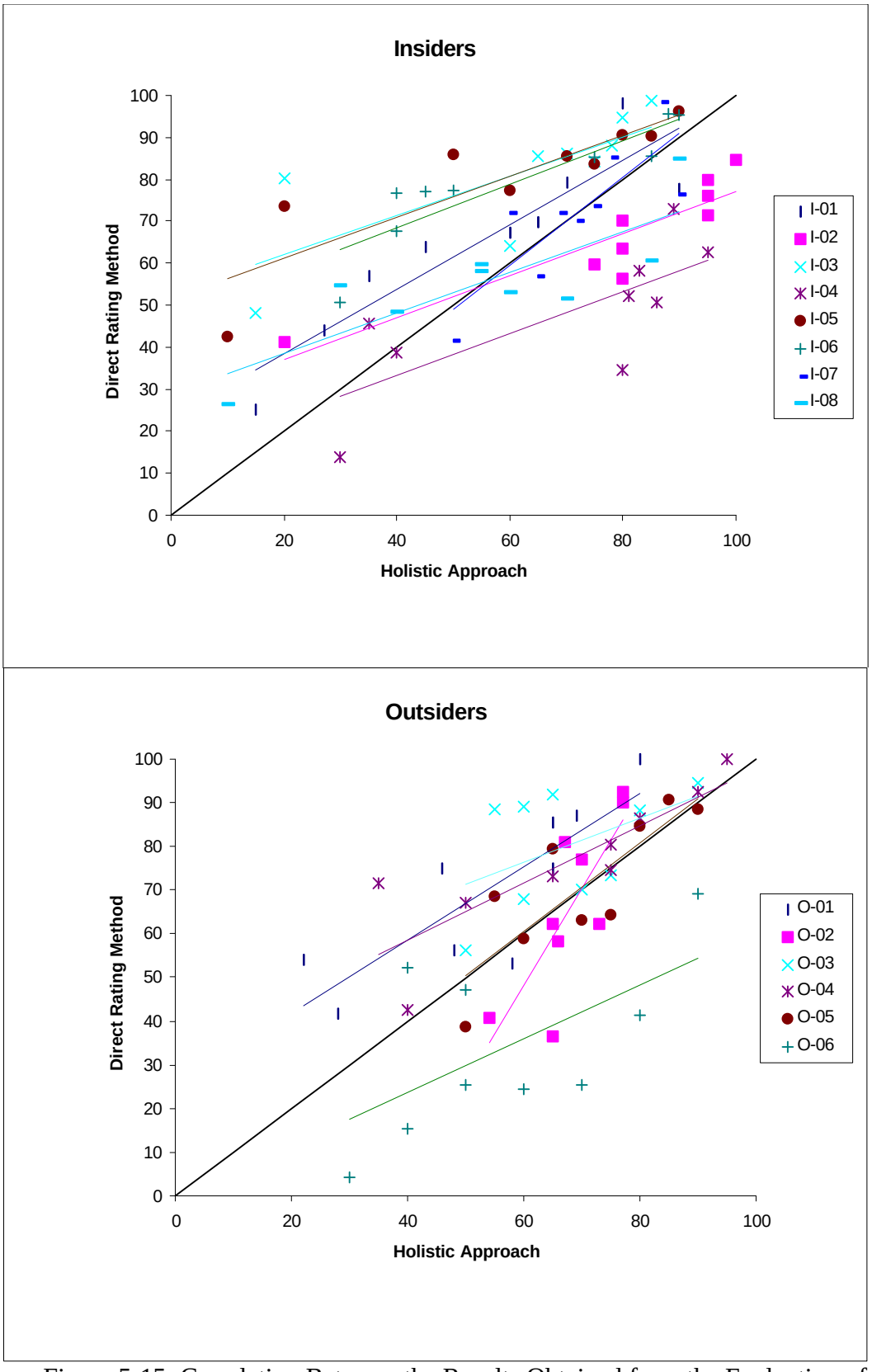


Figure 5-15: Correlation Between the Results Obtained from the Evaluation of Company Profiles Using the Holistic and the Decomposed (DRM weights) Approaches

The explanations for these disparities appear to be threefold. First, the respondents had difficulty to conceptualize companies with the specific attribute performance levels defined by the profiles presented in this study. Second, the respondents had difficulty to provide consistent judgments as several attributes had to be considered at the same time. Third, evaluation biases existed. That is, respondents might have overrated (underrated) a p9rofile because an attribute that they considered very important had a high (low) performance level, tended to overshadow other attributes, and dominated their reasoning when performing the evaluation.

The project profiles used to validate the PA index are shown in Table 5-23. It has been assumed that these profiles reflect the performance (quality) level of different projects from the viewpoint of one company. Table 5-24 shows the outcomes provided by the holistic evaluations of insiders and outsiders together with their decomposed evaluations. Table 5-25 presents the correlations between the holistic and decomposed approaches. It is interesting to note that although the PA index is composed of 14 attributes and the CC index is composed 9, on average, the correlations obtained from the evaluations of project profiles are higher than the ones given by the evaluations of company profiles. One possible explanation for this fact is that projects are simpler entities to evaluate than companies, and hence, respondents had less difficulty in the assessment of projects. Another possibility is that the project attributes capture the respondents' preferences better than those for companies.

Project Attractiveness Attributes	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Character of Promoting Team's Mngt.	6	7	4	7	8	6	8	5	6	6
Strength of Promoting Team	8	8	5	8	7	7	7	6	6	7
Adequacy of Promoters Agreement	5	6	4	7	8	7	8	5	6	7
Ability to Provide a Quality Design	7	9	7	8	7	6	8	6	7	8
Ability to Prov. a Feasible Constr. Plan	5	8	3	9	6	6	7	3	5	7
Abil. Prov. an Adeq. Oper-Transf Pack.	7	9	5	8	7	6	7	3	6	6
Avail. Adeq. Fin. Source to Raise Financ.	7	9	6	8	8	4	3	2	6	7
Financial Viability	6	8	8	5	7	5	6	5	7	6
Certainty of Constr. & Operational Costs	6	8	6	7	7	6	6	4	5	8
Certainty of Revenues	5	7	7	5	7	5	5	5	8	6
Overall Quality of the Principal	7	8	4	8	8	7	5	3	6	8
Level of Community Support	5	7	8	5	6	4	7	6	7	7
Legal Environment	7	9	5	7	8	6	4	2	3	8
Political Environment	8	8	3	9	8	7	5	2	3	7

Table 5-23: Hypothetical Project Profiles

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
I-01	holistic	55.0	90.0	15.0	62.0	70.0	38.0	40.0	5.0	34.0	65.0
	EM	46.8	89.0	36.4	65.9	78.2	37.3	36.7	11.3	46.0	65.3
	DRM	54.4	92.1	29.7	76.1	81.9	43.3	47.6	13.1	41.7	70.5
I-02	holistic	80.0	100.0	70.0	90.0	90.0	70.0	75.0	50.0	75.0	90.0
	EM	50.0	91.6	67.3	48.8	76.1	32.3	47.0	18.8	62.7	65.3
	DRM	58.0	93.1	57.1	65.2	80.2	40.9	54.4	20.8	58.9	73.0
I-03	holistic	85.0	95.0	70.0	80.0	90.0	72.0	73.0	5.0	75.0	87.0
	EM	52.4	89.1	56.1	60.4	79.1	34.9	40.4	14.8	54.2	70.2
	DRM	58.4	90.7	46.7	71.9	80.5	49.4	55.9	15.2	50.5	77.8
I-04	holistic	69.0	90.0	45.0	79.0	85.0	65.0	80.0	40.0	70.0	73.0
	EM	20.8	66.2	11.9	43.6	32.6	13.0	25.4	1.7	15.0	32.2
	DRM	24.5	68.9	12.2	50.8	41.6	16.9	33.0	2.6	15.8	38.6
I-05	holistic	45.0	90.0	65.0	55.0	75.0	20.0	25.0	15.0	35.0	60.0
	EM	71.6	96.5	41.9	84.4	90.7	66.9	74.9	41.3	71.5	78.4
	DRM	69.8	95.8	49.5	79.9	88.9	62.7	68.4	38.6	69.5	79.7
I-06	holistic	40.0	90.0	30.0	45.0	85.0	50.0	42.0	25.0	40.0	55.0
	EM	67.6	94.7	68.6	73.5	83.9	60.0	68.4	39.5	69.7	80.1
	DRM	69.6	94.1	62.0	79.9	85.4	62.0	68.6	35.5	67.0	82.8
I-07	holistic	72.0	90.0	60.0	79.0	86.0	61.0	70.0	50.0	65.0	79.0
	EM	59.8	92.9	68.7	55.1	80.3	43.2	49.8	23.0	59.5	65.1
	DRM	65.5	94.3	59.4	69.2	85.7	51.7	53.8	24.1	58.0	74.2
I-08	holistic	50.0	90.0	25.0	75.0	80.0	45.0	40.0	10.0	30.0	60.0
	EM	45.7	80.9	29.2	54.9	57.2	27.4	27.4	5.9	30.5	59.7
	DRM	42.7	78.6	23.4	59.9	49.9	27.4	29.5	7.9	29.2	49.0

Table 5-24: Results of the Holistic and Decomposed Evaluations Performed by Insiders on the Project Profiles

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
O-01	holistic	48.0	85.0	27.0	76.0	69.0	50.0	28.0	20.0	58.0	62.0
	EM	93.0	98.9	72.7	98.2	94.9	81.0	92.6	63.7	85.7	99.5
	DRM	90.7	99.2	59.8	95.6	94.2	78.0	88.6	47.4	80.5	99.6
O-02	holistic	63.0	79.0	54.0	71.0	73.0	58.0	61.0	41.0	59.0	69.0
	EM	19.4	33.6	3.4	30.3	48.5	11.8	32.4	0.0	4.0	20.1
	DRM	18.0	43.0	4.6	31.0	45.9	10.4	25.3	0.0	6.7	26.0
O-03	holistic	55.0	85.0	35.0	75.0	83.0	70.0	45.0	25.0	45.0	80.0
	EM	57.1	79.7	32.0	70.7	76.0	55.6	50.8	19.2	53.2	66.9
	DRM	58.1	83.2	37.8	73.8	78.0	51.7	56.0	20.3	53.4	68.6
O-04	holistic	65.0	90.0	25.0	62.0	85.0	50.0	45.0	10.0	22.0	75.0
	EM	72.8	86.8	33.3	88.4	96.0	81.9	63.3	14.9	33.7	89.4
	DRM	67.8	87.7	37.0	83.8	92.5	72.2	70.1	20.6	47.7	86.1
O-05	holistic	75.0	90.0	65.0	85.0	80.0	53.0	55.0	50.0	60.0	70.0
	EM	56.3	95.2	53.5	72.0	78.0	37.8	49.1	18.3	56.9	73.3
	DRM	65.8	95.9	38.4	83.2	82.9	51.0	52.8	17.4	47.0	78.8
O-06	holistic	70.0	80.0	40.0	80.0	90.0	70.0	90.0	50.0	60.0	60.0
	EM	23.0	61.7	25.1	50.0	45.3	11.6	14.4	2.1	11.9	35.1
	DRM	31.0	74.4	33.1	63.6	53.0	15.4	28.7	6.1	29.2	42.6

Table 5-24 (cont): Results of the Holistic and Decomposed Evaluations Performed by Outsiders on the Project Profiles

	Correlation between Holistic and Decomposed (EM weights) Evaluations		**Correlation between Holistic and Decomposed (DRM weights) Evaluations**	
	Pearson's coeficient.	Spearman's rank coeficient	Pearson's coeficient.	Spearman's rank coeficient
Insiders				
I-01	0.946	0.939	0.982	0.988
I-02	0.801	0.657	0.956	0.939
I-03	0.832	0.830	0.892	0.976
I-04	0.821	0.927	0.865	0.903
I-05	0.557	0.697	0.703	0.733
I-06	0.819	0.721	0.817	0.867
I-07	0.821	0.651	0.947	0.912
I-08	0.936	0.855	0.952	0.952
Outsiders				
O-01	0.778	0.830	0.794	0.830
O-02	0.810	0.903	0.912	0.964
O-03	0.942	0.970	0.914	0.920
O-04	0.934	0.867	0.938	0.903
O-05	0.898	0.891	0.883	0.879
O-06	0.457	0.438	0.495	0.368

Table 5-25: Correlations Between Holistic and Decomposed Evaluations Taken Across Project Profiles

Figures 5-16 and 5-17 show the plots of the outcomes of the intuitive judgments of insiders and outsiders for different project profiles against the results of their decomposed evaluations and also display the individual regression lines. The differences encountered in the comparison between holistic and decomposed evaluations for the company profiles are also present in the assessment of the project-profile outcomes.

Group results, for the holistic and decomposed evaluations, are calculated by averaging the individual responses. Table 5-26 provides the group outcomes of the evaluations performed by insiders and outsiders on the different company and project profiles. The charts on Figures 5-18 and 5-19 plot the group results of the holistic and decomposed evaluations for company and project profiles.

Figures 5-20 displays the capability index provided by the insiders and the outsiders on each and every company profile. Figure 5-21 displays the attractiveness index provided by the insiders and the outsiders on each and every project profile . In each figure, every company (project) profile is associated with three columns. The column on the left displays information on the capability (attractiveness) index for experts evaluating a company (project) using the holistic approach, the middle column provides similar information for experts using the "EM," the column on the right contains information for experts using the "DRM."

For each profile, the bottom of each of the three columns indicates the minimum value of the desirability index for the set of insiders (top chart of Figures 5-20 and 5-21) and outsiders (bottom charts). Analogously, the top of the columns indicates the maximum value of the desirability index for the corresponding set of respondents. The line in the middle of the darker region reflects the group results (i.e., the arithmetic average of the individual indexes). The darker region represents one half standard deviation (above and below the corresponding average) of the individual evaluations. The discussion about the results presented in this sub-section follows below.

5.5.3 Discussion

One of the objectives of this study is to develop two indices to help companies in their decision to participate in the promotion of infrastructure projects. In pursuing this goal three distinct topics of interest have arisen: (1) the agreement of the different weighting procedures in the determination of CC or PA indices for companies or projects, (2) the appropriateness of the Desirability Model to capture holistic judgments, and hence, be used to determine the degree of company competence to seek project promotion and the degree of project attractiveness to be pursued by private promotion, and (3) the differences and similarities between two distinct participants in the process, the insiders and the outsiders. These topics will be discussed separately below. Two other issues will also merit some investigation: model sensitivity and index thresholds.

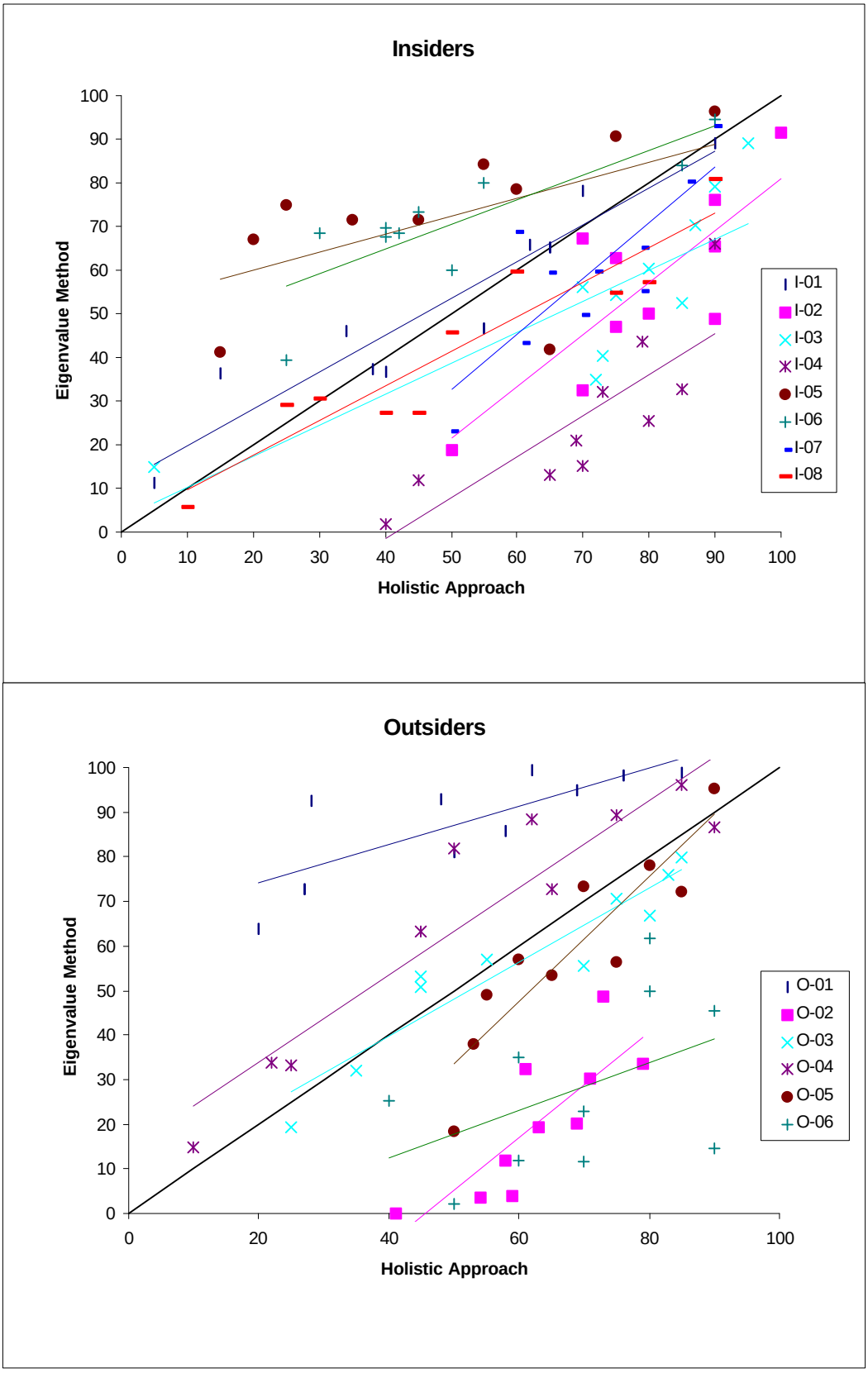


Figure 5-16: Correlation Between the Results Obtained from the Evaluation of Project Profiles Using the Holistic and the Decomposed (EM weights) Approaches

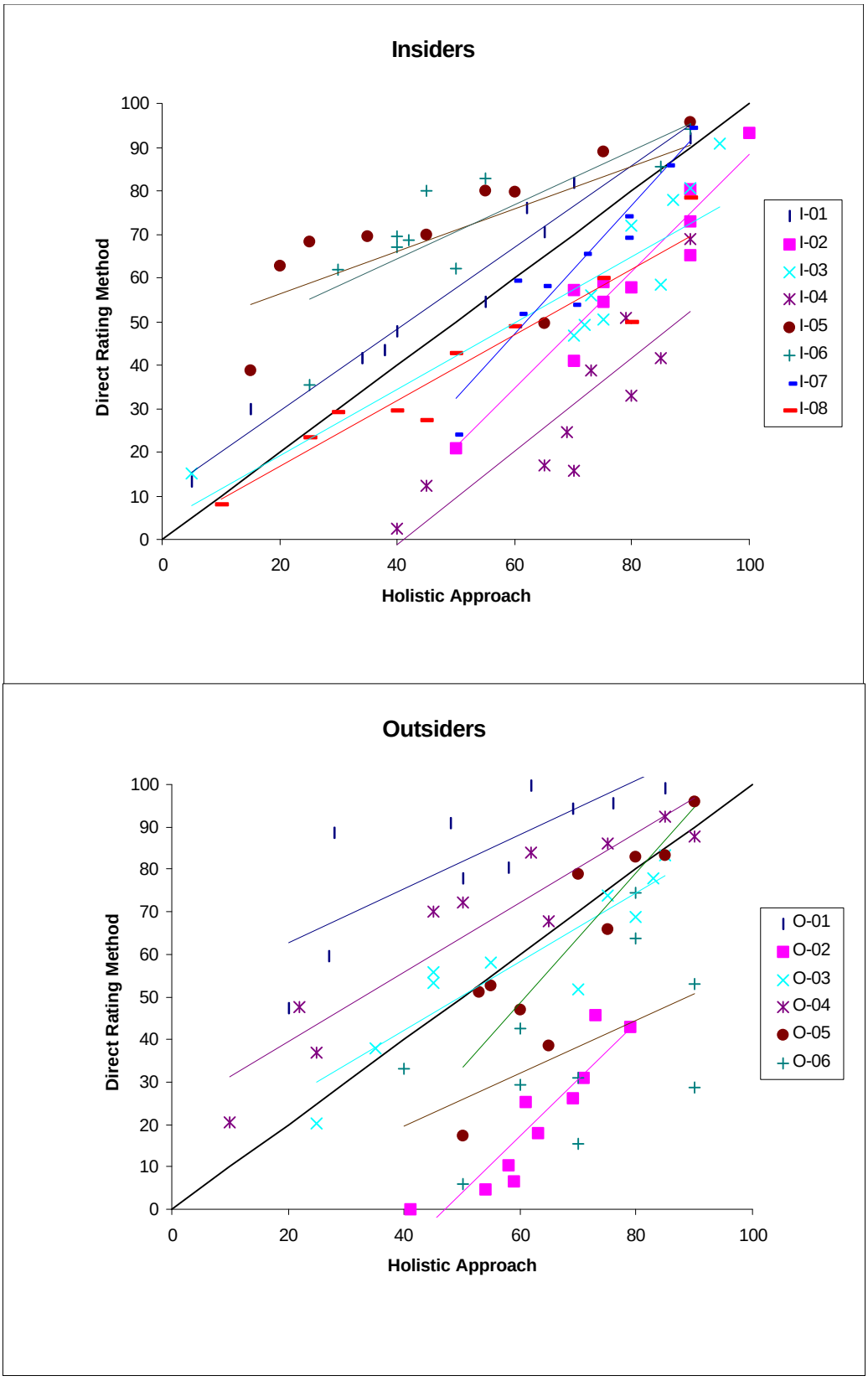


Figure 5-17: Correlation Between the Results Obtained from the Evaluation of Project Profiles Using the Holistic and the Decomposed (DRM weights) Approaches

	Insiders			Outsiders		
	Hol.	EM	DRM	Hol.	EM	DRM
Company Profiles						
C1	41.3	62.6	67.2	54.5	56.9	63.1
C2	22.5	33.9	36.2	42.0	30.8	37.4
C3	89.4	70.3	79.4	80.3	81.0	82.9
C4	63.8	55.1	64.4	51.2	55.1	57.6
C5	61.9	59.7	65.6	58.8	57.9	56.7
C6	85.5	89.3	88.8	83.7	83.9	85.5
C7	72.3	70.6	75.2	67.2	72.7	76.2
C8	77.4	72.9	75.5	69.0	74.1	74.9
C9	60.9	57.7	63.4	67.5	57.4	62.0
Project Profiles						
P1	62.0	51.8	55.4	62.7	53.6	55.2
P2	91.9	87.6	88.4	84.8	76.0	80.6
P3	47.5	47.5	42.5	41.0	36.7	35.1
P4	70.6	60.8	69.1	74.8	68.2	71.8
P5	82.6	72.3	74.3	80.0	73.1	74.4
P6	52.6	39.4	44.3	58.5	46.6	46.4
P7	55.6	46.3	51.4	54.0	50.4	53.6
P8	25.0	19.5	19.7	32.7	19.7	18.6
P9	53.0	51.1	48.8	50.7	40.9	44.1
P10	71.1	64.5	68.2	69.3	64.1	67.0

Table 5-26: Company and Project Profile Evaluations - Group Results

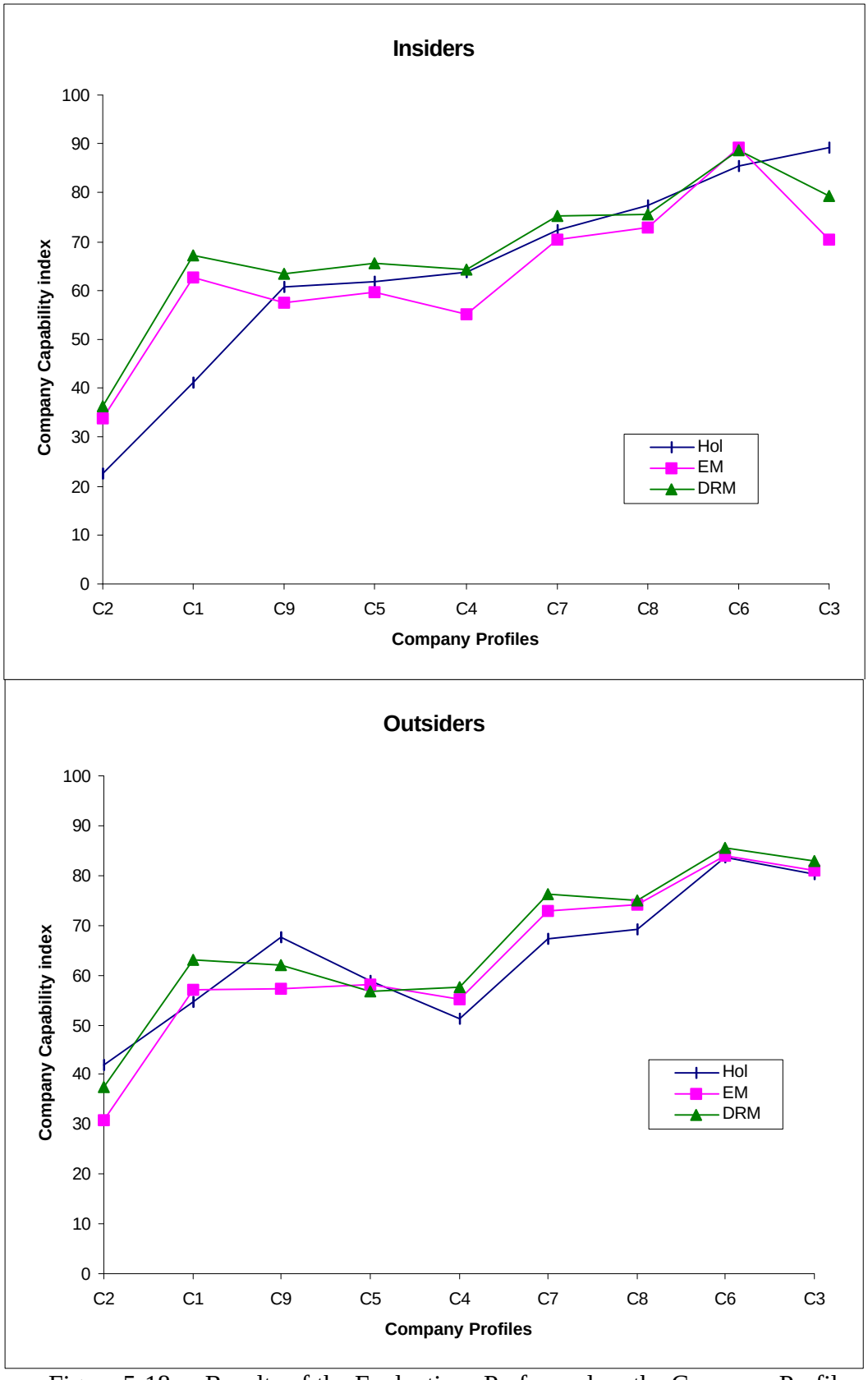


Figure 5-18: Results of the Evaluations Performed on the Company Profiles

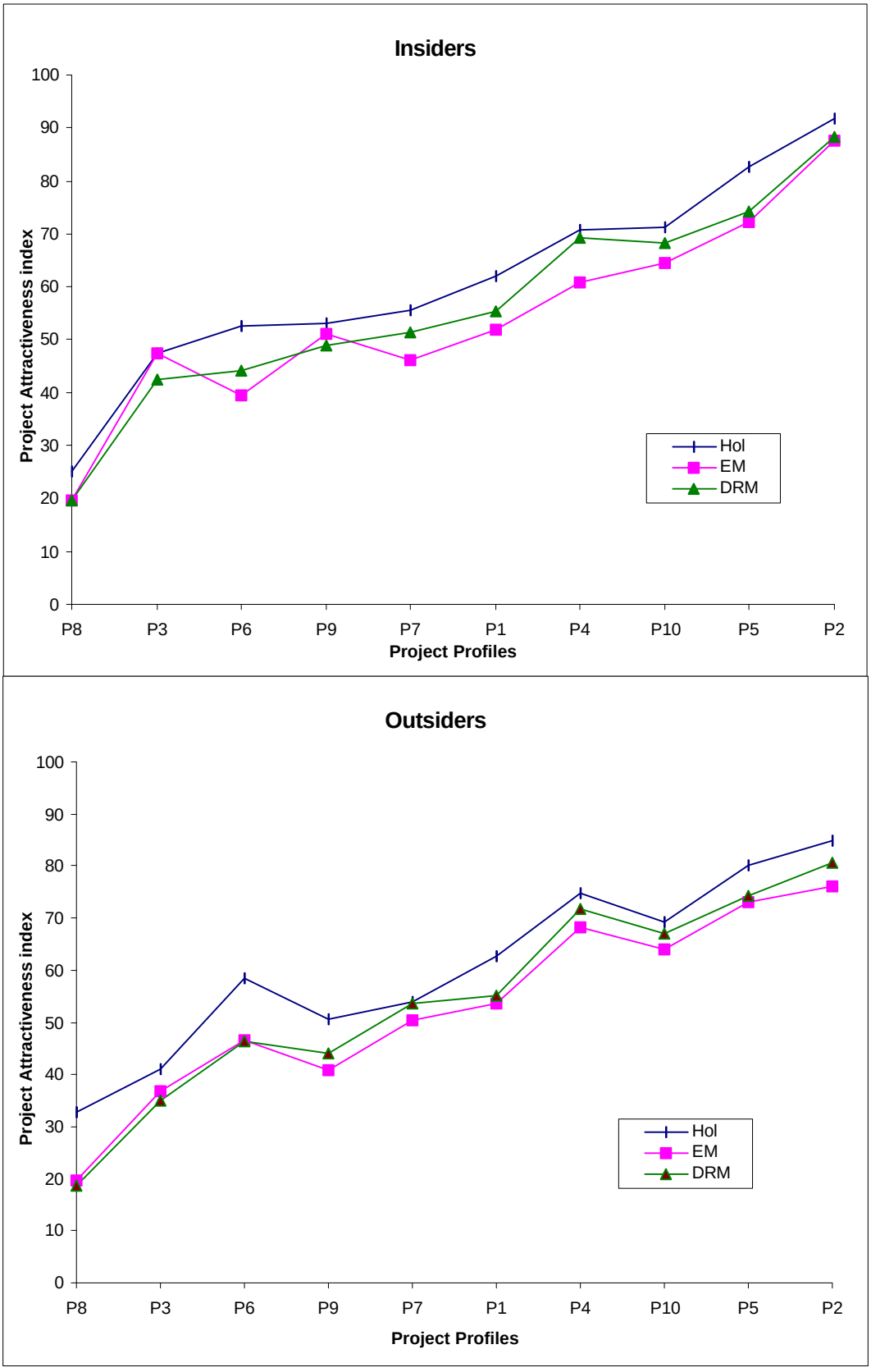


Figure 5-19: Results of the Evaluations Performed on the Project Profiles

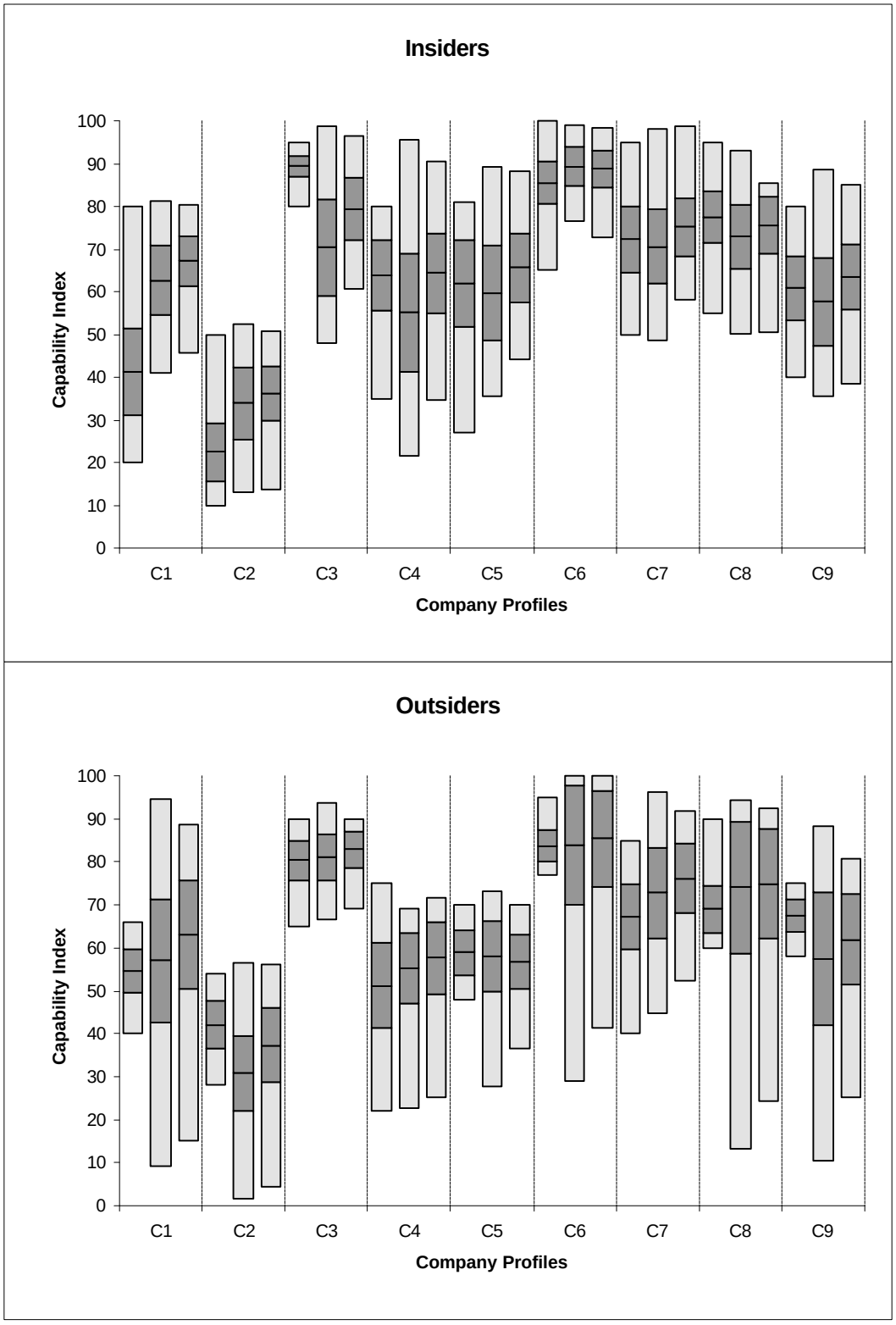


Figure 5-20: Group Average and Range of Individual Capability Indexes for the Nine Company Profiles Used in the Model Validation

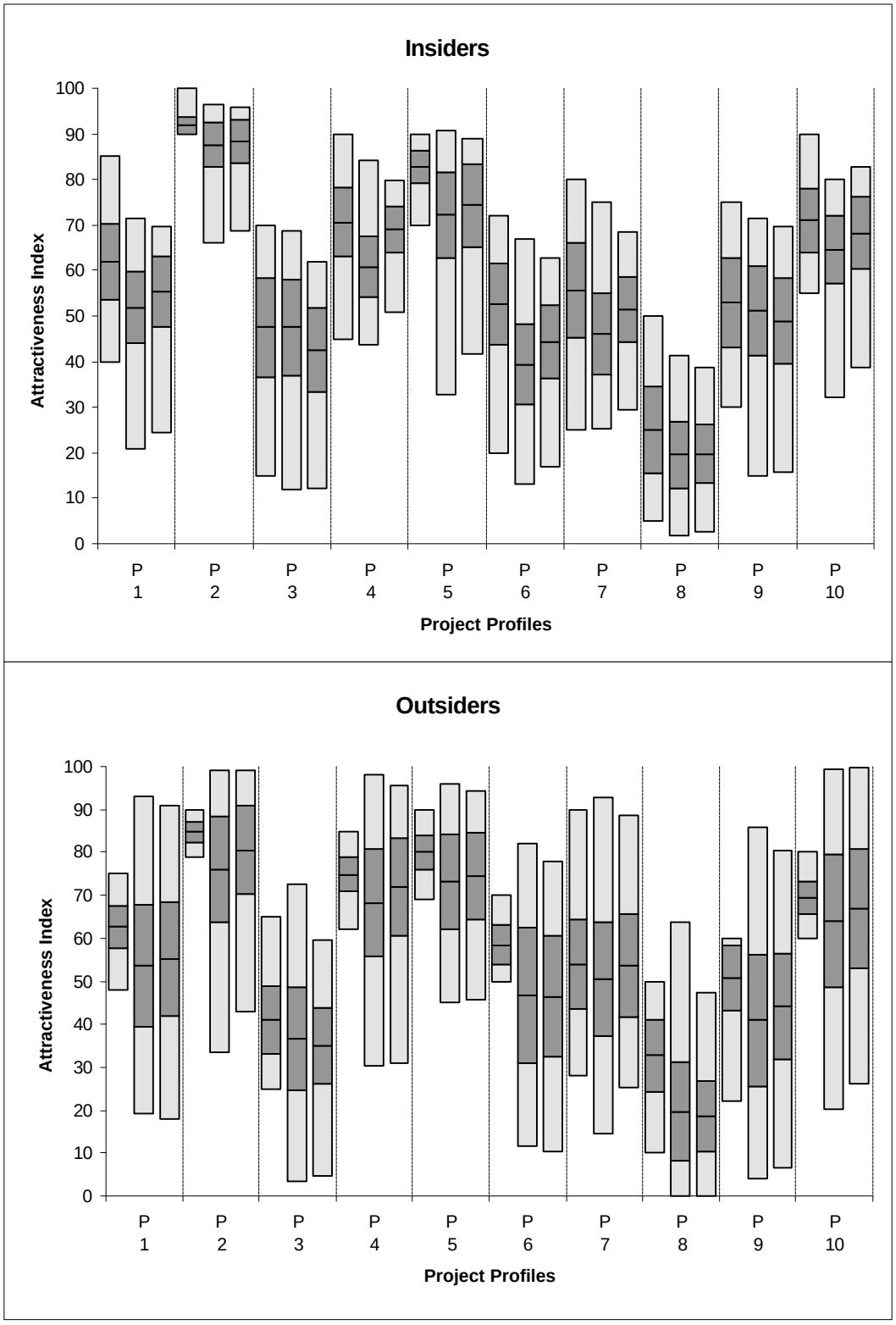


Figure 5-21: Group Average and Range of Individual Attractiveness Indexes for the Ten Project Profiles Used in the Model Validation

Correspondence Between the Results of Decomposed Evaluations Obtained Through the Use of the Eigenvalue and the Direct-Rating Weighting Procedures

The individual outcomes of the company and project profiles, when applying decomposed evaluations, are shown in Tables 5-21 and 5-24 and are plotted in Figures 5-22 and 5-23. The examination of these graphs show much less scatter than the ones that compared the decomposed evaluations with the holistic judgments (see Figures 5-14 through 5-17). The regression lines are closer and more parallel to the 45-degree line than the regression lines computed from the results of the decomposed evaluations and the respondent's direct assessment indicating that biases between the indices obtained from the "EM" decomposed evaluations and the "DRM" decomposed evaluations are greatly reduced. The correlations between both decomposed evaluations, across project and company profiles, are very high (mostly in the 0.95 neighborhood) and are displayed in Table 5-27. These results suggest that both decomposed evaluations provide comparable results.

There is however a difference in the "index scale," that is, company and project profiles tend to present slightly higher indices when the attribute importance weights developed from the DRM are used over the EM weights. A set of two-tailed paired t-tests was ran to investigate the significance of these differences. The hypothesis was: the average difference between the indices produced by both evaluation procedures is equal to zero. A significance level of 1% was used. Thirty-six tests had the hypotheses accepted while two tests had the hypotheses rejected. They were *insiders evaluating profile P4* and *insiders evaluating profile P9*.

Figure 5-24 displays the plot comparing the group results obtained through the decomposed evaluations using the DRM with the ones using the EM. The regression lines, once again, seem to suggest that the DRM for both groups provide slightly higher indices than the EM. For the company profiles, the Pearson's correlation coefficient between both procedures is 0.978 for the insiders' group and 0.990 for the outsiders'. The Spearman's rank correlations are, respectively, 0.933 and 0.867. For the project profiles, the Pearson's correlations are 0.980 for the group of insiders and 0.927 for the outsiders while the Spearman's figures are 0.997 and 1.000. These results indicate that either the DRM or the EM can be used to weight the relative importance of the attributes of the Desirability Model but evaluations using direct-rating weights tend to provide higher indices than evaluations using eigenvalue weights.

The Suitability of the Model to Capture Holistic Judgments

Another set of t-paired tests was performed to verify the hypotheses that the average difference between the outcomes of the decomposed evaluations and the holistic

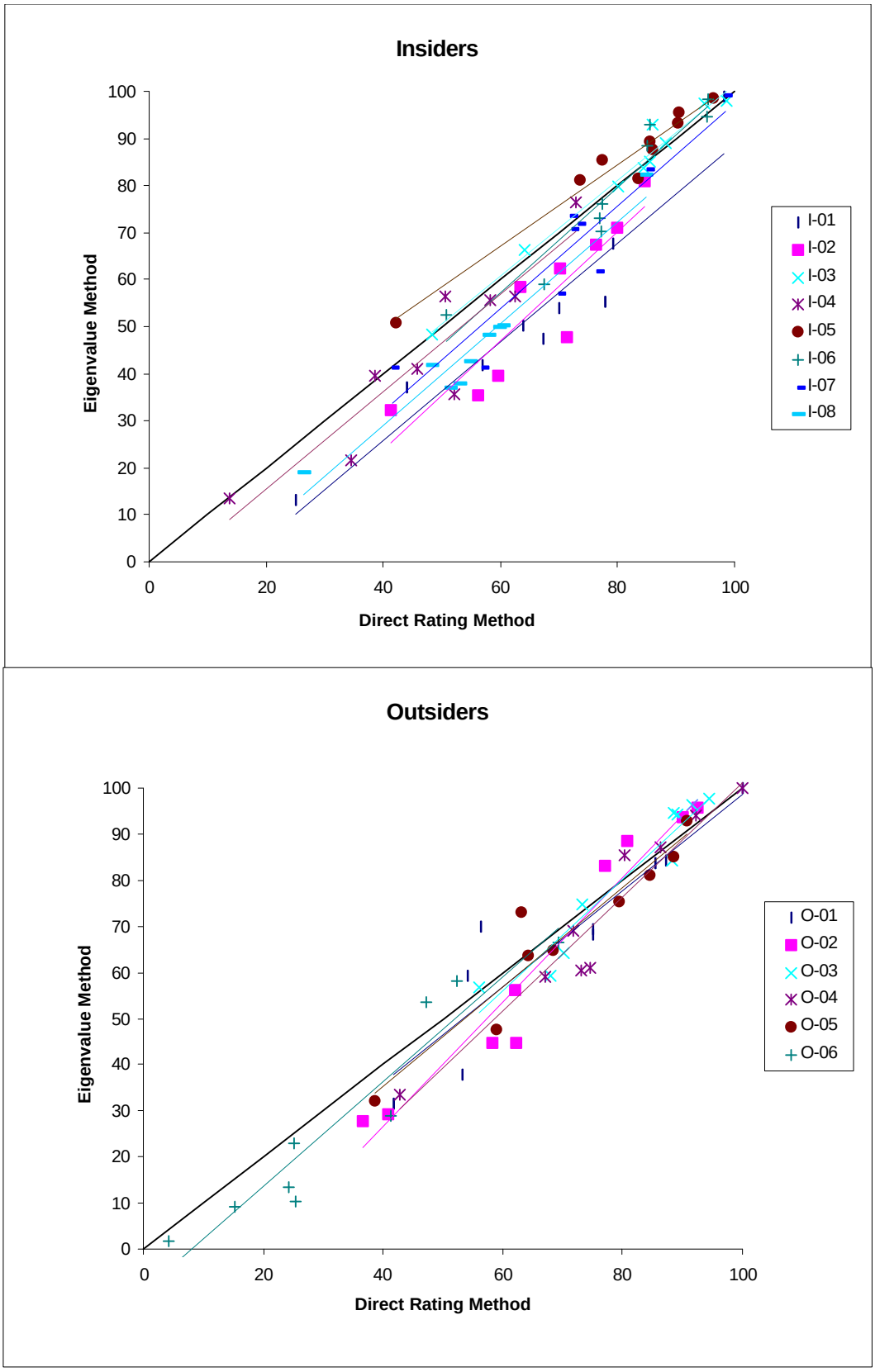
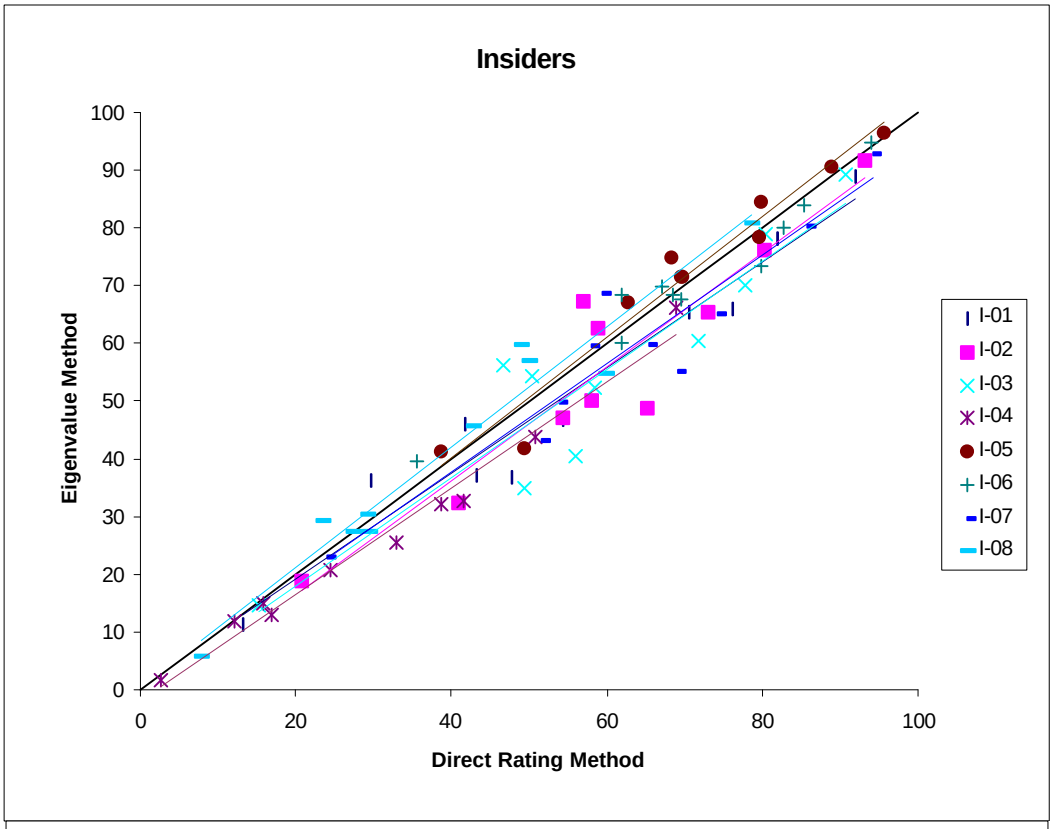


Figure 5-22: Correlation Between the Results Obtained from the Decomposed Evaluations of Company Profiles Using DRM and EM Weights



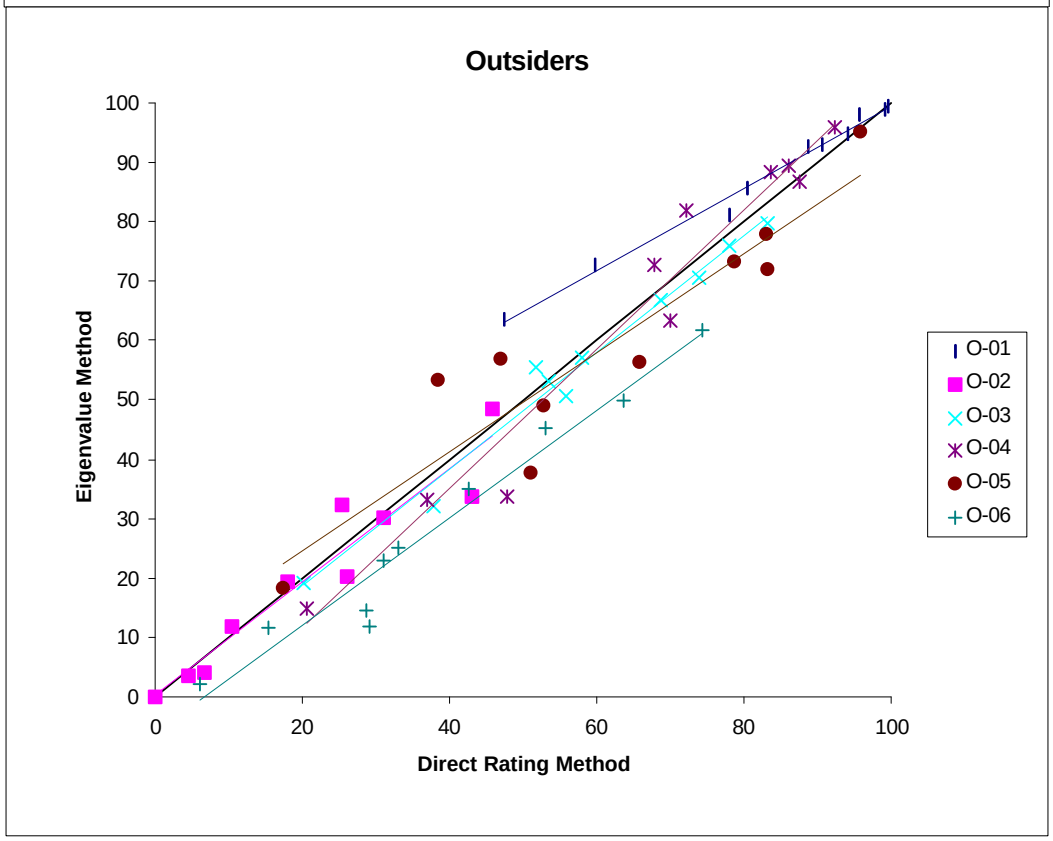


Figure 5-23: Correlation Between the Results Obtained from the Decomposed Evaluations of Project Profiles Using DRM and EM Weights

	Correlations taken across Company Profiles		Correlations taken across Project Profiles	
	Pearson's coeficient.	Spearman's rank coeficient	Pearson's coeficient.	Spearman's rank coeficient
Insiders				
I-01	0.956	0.983	0.974	0.952
I-02	0.911	0.950	0.938	0.842
I-03	0.988	0.983	0.932	0.842
I-04	0.925	0.867	0.990	0.988
I-05	0.981	0.967	0.978	0.964
I-06	0.953	0.983	0.976	0.855
I-07	0.929	0.833	0.945	0.879
I-08	0.975	0.950	0.976	0.891
Outsiders				
O-01	0.922	0.926	0.994	1.000
O-02	0.974	0.983	0.959	0.964
O-03	0.966	0.983	0.990	0.952
O-04	0.966	0.950	0.980	0.952
O-05	0.953	0.950	0.929	0.830
O-06	0.957	0.950	0.978	0.988

Table 5-27: Correlations Between the Results of Decomposed Evaluations Obtained Through the Use of the Eigenvalue and the Direct-Rating Weighting Procedures (Taken Across Company and Project Profiles)

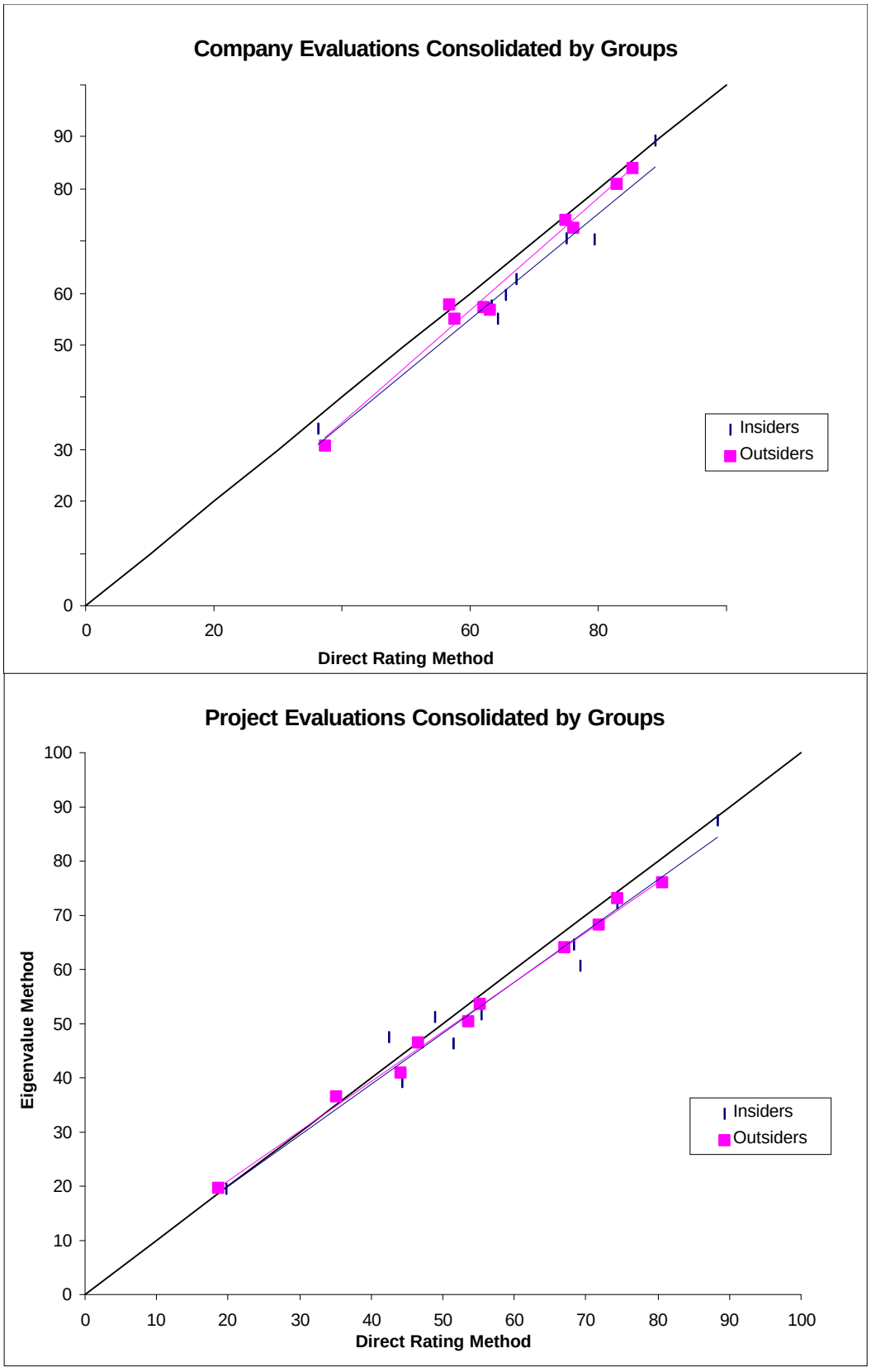


Figure 5-24: Correlation Between the GROUP Results Obtained from the Decomposed Evaluations Using DRM and EM Weights

judgments were equal to zero.[82] All seventy-six tests had their hypotheses accepted. These results plus the strength of the individual and group correlation coefficients between the holistic and decomposed evaluations suggest that the Desirability Model indeed captures the respondents' intuitive judgments.

Figures 5-25 and 5-26 display the plots of the values of the company and project profiles given by the groups holistic approach versus the outcomes provided by the decomposed evaluations. The regression lines on Figure 5-25 appear to indicate that the decomposed evaluations of the insiders tend to overrate the holistic judgments for company profiles below a certain index value and to underrate profiles above this value. The evaluation bias seems to be the source of the divergence, that is, a good performance level for some attributes might lead the insiders to assign an abnormally high value to one profile while bad performance levels might lead them to assign a low value to the profile. For the outsiders, the regression lines show similar values for company profiles being evaluated holistically and by a decomposed evaluation. The lines on Figure 5-26 appear to indicate that both groups rate project profiles higher when using a direct assessment.

All in all, the Desirability Model proves to be a good tool to capture the decision makers preferences. There is however a natural question to be asked: since holistic judgments are always easier to perform than any decomposed evaluations, why should one bother using these more troublesome procedures? Two arguments appear to answer this question. One argument is that the correlations between the holistic judgments and the decomposed evaluation, though high enough to be encouraging, are by no means 1.0. It is the author's believe and understanding that a multiattribute decomposed approach, by structuring and separating the important problem dimensions, provides a better representation of the underlying values than do holistic judgments. The other argument is that the information generated by the decomposition of the overall evaluation into more manageable parameters serves many purposes other than simply providing an index value. For example, the use of the Desirability Model provides information on the actual performance levels of the attributes and allows the decision maker to perform sensitivity analysis to verify how strategies increase or decrease the attractiveness of a project. Such analysis might suggest a possible negotiation agenda between the different project participants so that the quality of the project and its likelihood of success can be improved.

Differences and Similarities Between Insiders and Outsiders

Respondents were divided into two groups to verify if they see the promotion of projects or the involvement of companies from similar or different points of view. The comparison of the weights showed a tendency of insiders to place more attention on the

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82 Thirty-eight tests were used to compare the outcomes of decomposed evaluations using the DRM with the holistic judgments. Another thirty-eight tests were used to compare the EM outcomes with the holistic judgments.

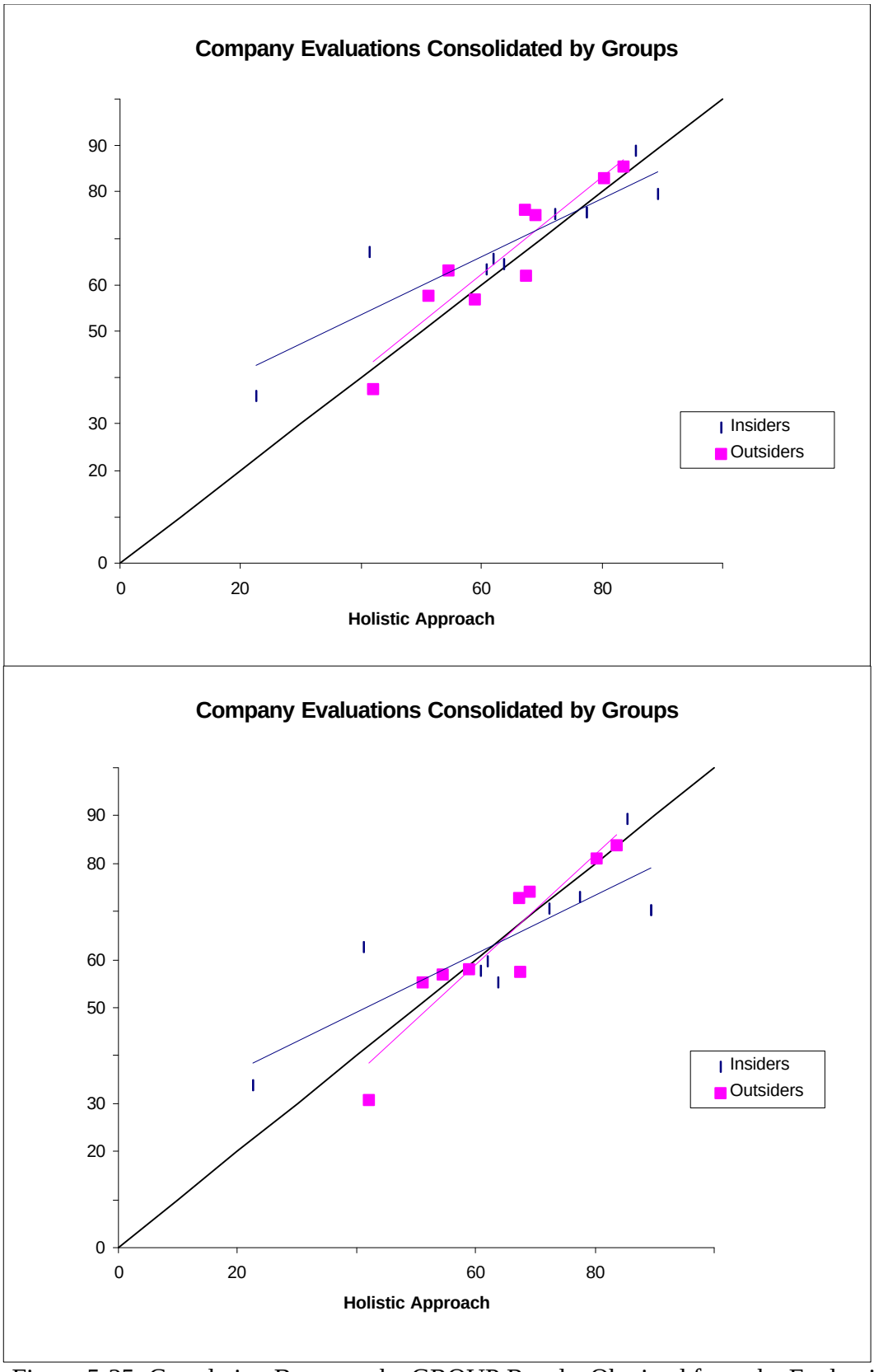

Figure 5-25: Correlation Between the GROUP Results Obtained from the Evaluation of Company Profiles Using the Holistic and the Decomposed Approaches

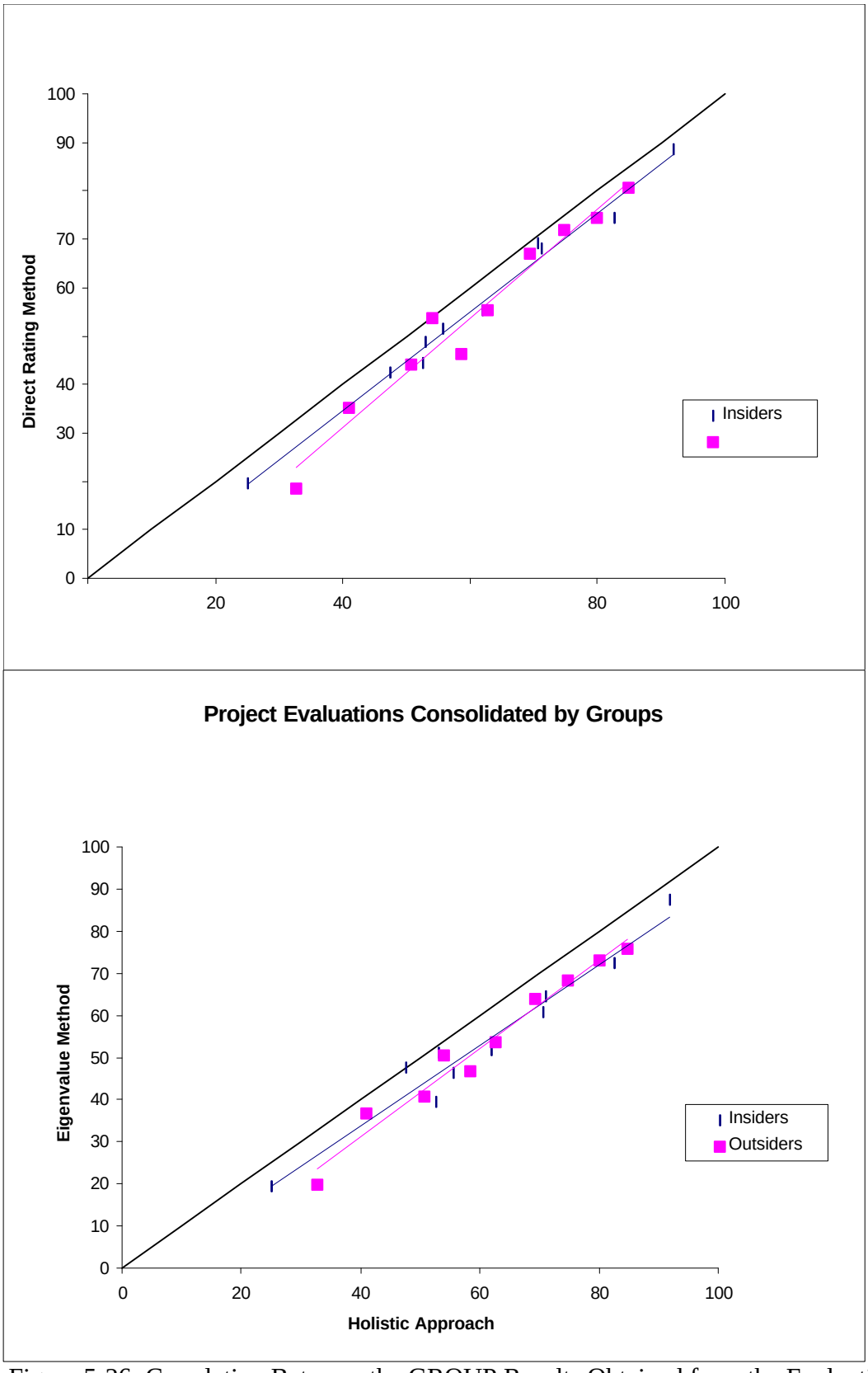

Figure 5-26: Correlation Between the GROUP Results Obtained from the Evaluation of Project Profiles Using the Holistic and the Decomposed Approaches

financial related attributes while outsiders focused more on the management part. These differences however were not statistically significant.

Figures 5-27 and 5-28 plot, for each evaluation procedure, the outcomes provided by the group of insiders and the group of outsiders about the different company and project profiles. They show that both groups provide responses that follow a similar trend and are closely related. The correlation coefficients between both groups are shown in Table 5-28. Two-tailed Student's t-tests were performed on every profile to verify if the evaluations given by the insiders had an average that was similar to the average calculated from the evaluations of the outsiders. All fifty-seven tests accepted the hypotheses.

Figure 5-29 shows the regression lines between the group of insiders and the group of outsiders. The regression line on the holistic approach of company profiles (top chart) suggests that the group of insiders tend to provide a lower assessment than the group of outsiders for companies that fall below a CC index of around 65 and a higher assessment for companies above this value.[83] The other regression lines seem to indicate that the group of insiders and the group of outsiders provide very similar indices for company and project profiles.

The information above leads to the conclusion that insiders and outsiders provide similar evaluations when they agree on the attribute performance levels of the companies and projects being analyzed. However, it does not provide any insight about possible disagreements and their consequences.[84] In order to superficially explore possible differences between insiders and outsiders when evaluating the attributes of a project and the consequences of such disagreements the fourth questionnaire included a section where the most publicized privately-promoted project to date, the Eurotunnel was introduced. Respondents were asked if they would feel comfortable rating its attributes, six of the eight insiders and all of the outsiders felt they had enough knowledge about the project as to perform its evaluation.

Individual as well as group answers are displayed in Table 5-29. The outcomes suggest that there are differences between the evaluations performed by insiders and outsiders, for instance:

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83 This transitional effect can also observed on the top chart of Figure 5-21. There the group of insiders gives a lower assessment to the first three company profiles and a higher assessment to the other, "higher quality," profiles.

84 As previously mentioned, the necessity of providing extensive background information on companies and projects to enable respondents to perform a reasonable evaluation of the performance level of the attributes led to the employment of pre-determined attribute levels for all the profiles used in the validation of the Desirability Model.

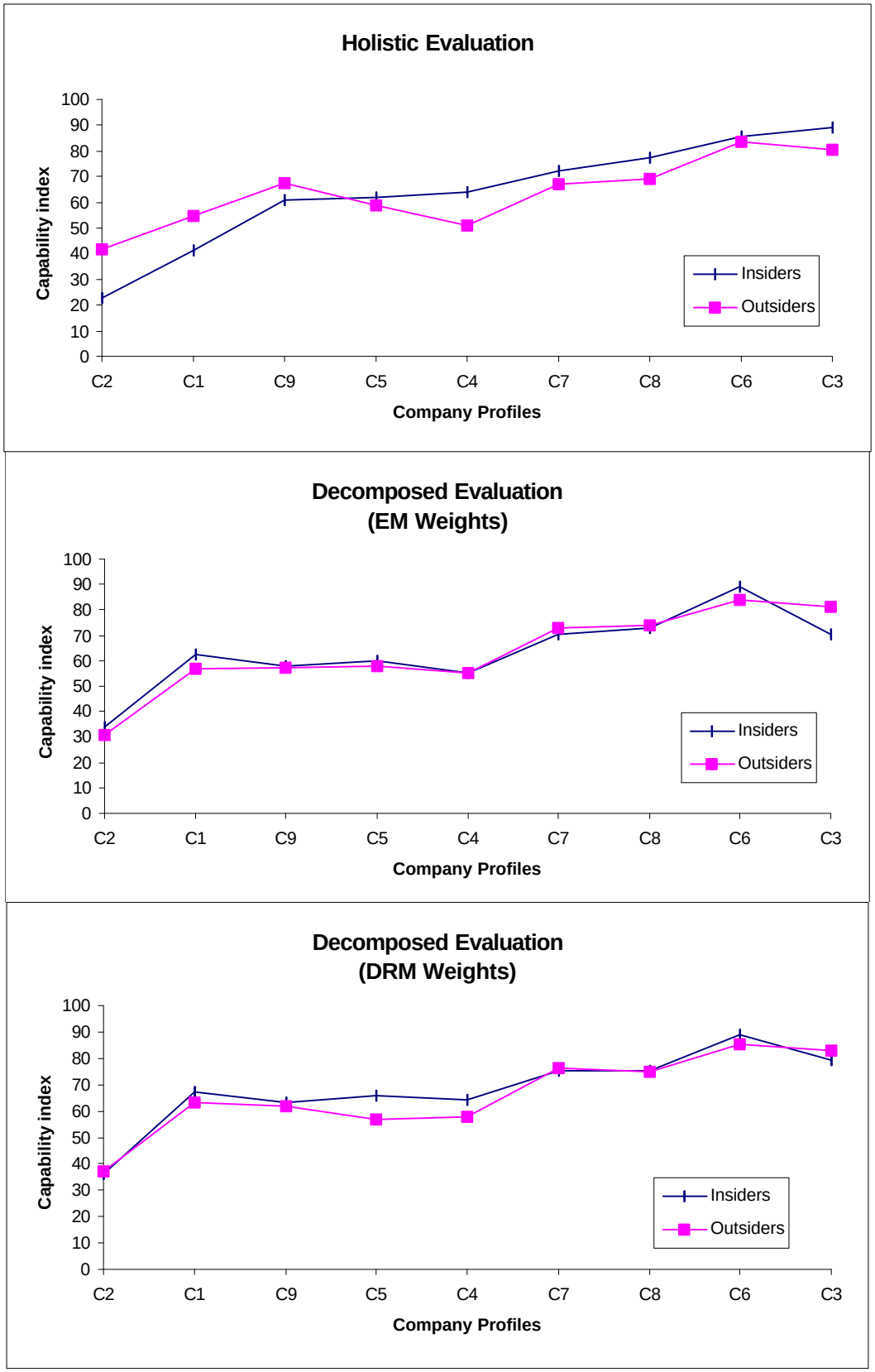

Figure 5-27: Comparison Between the Results Provided by the Group of Insiders and the Group of Outsiders on the Company Profiles

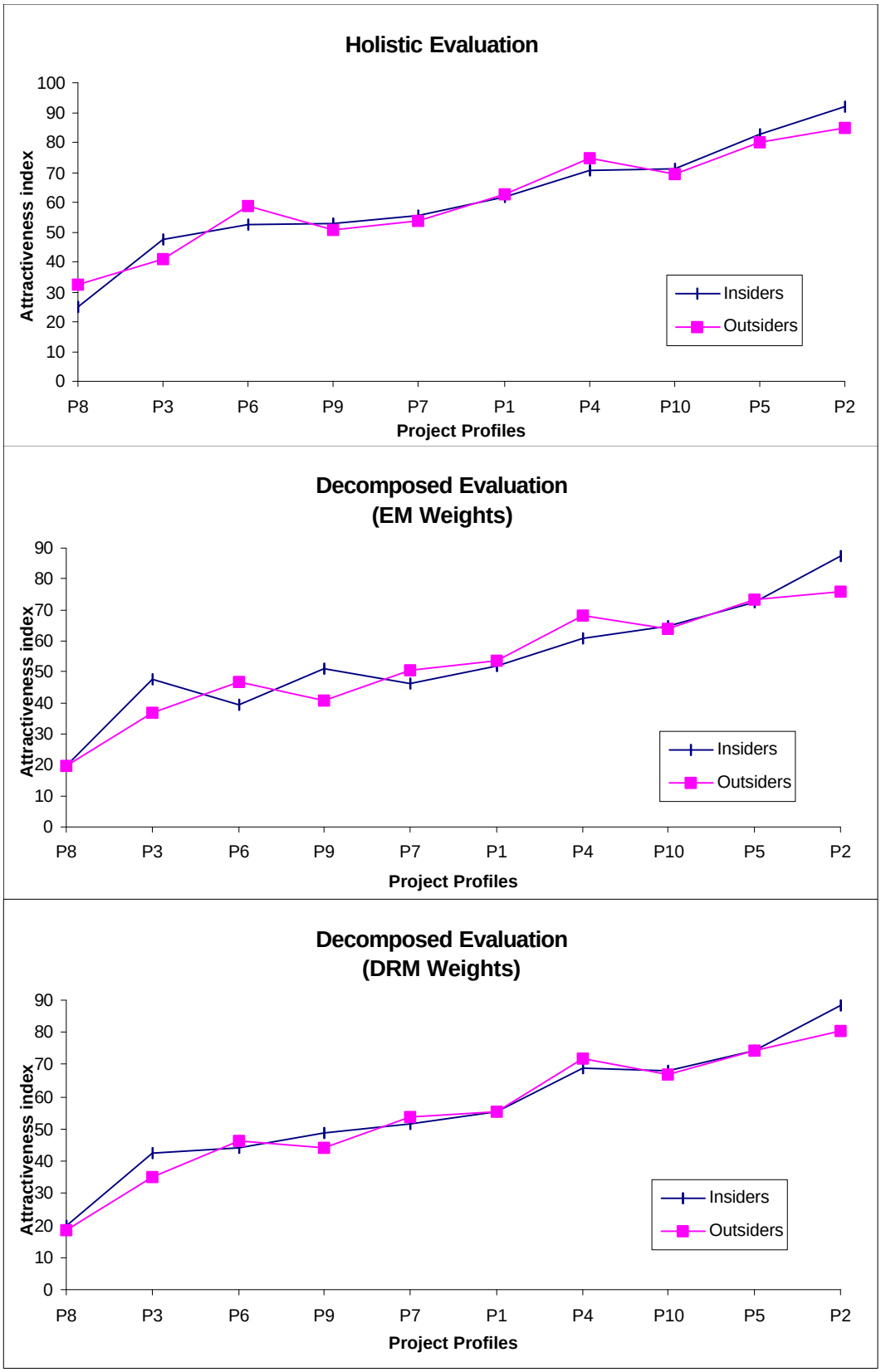

Figure 5-28: Comparison Between the Results Provided by the Group of Insiders and the Group of Ousiders on the Project Profiles

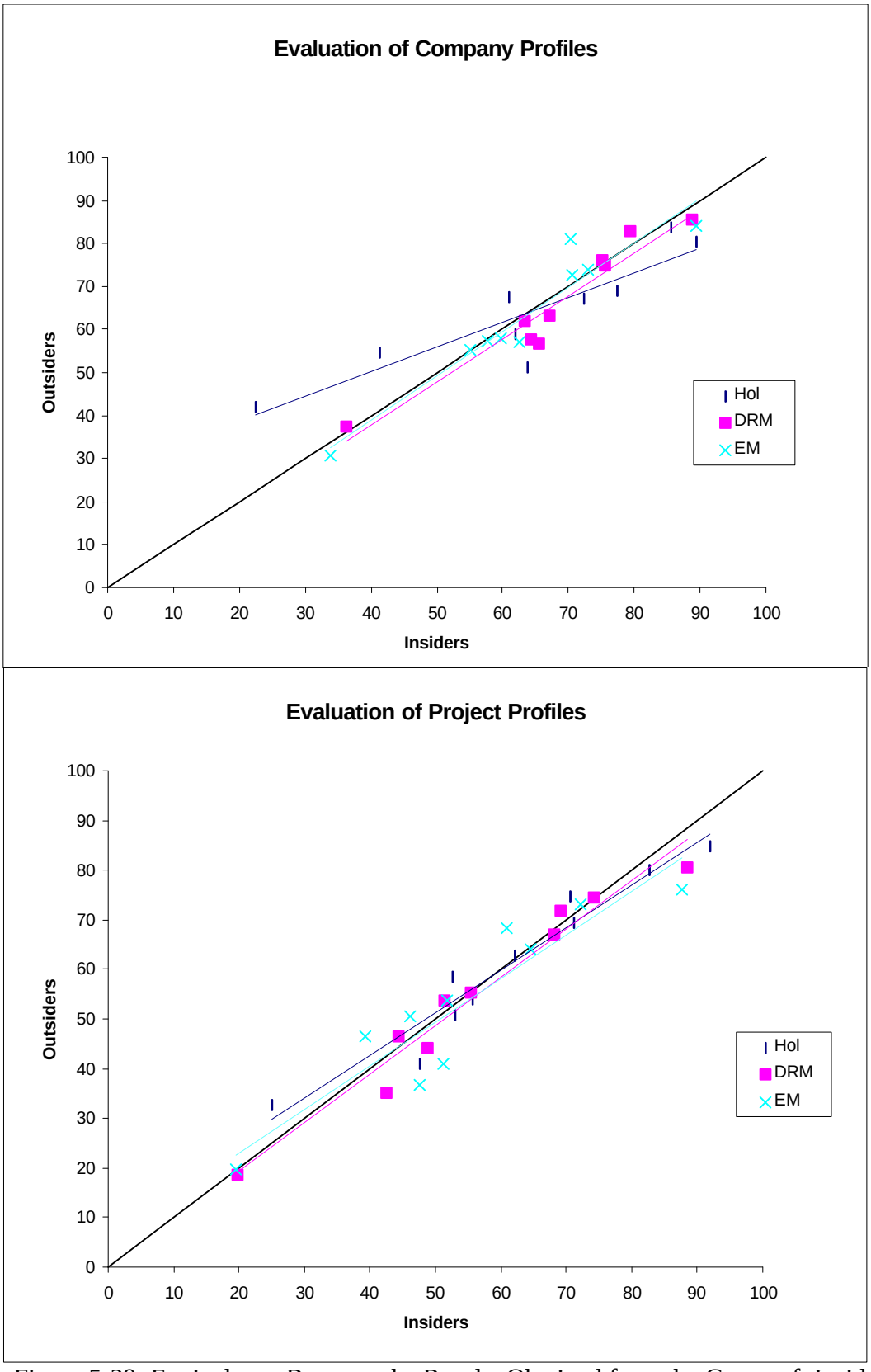

Figure 5-29: Equivalence Between the Results Obtained from the Group of Insiders and the Group of Outsiders

	Correlations taken across Company Profiles			Correlations taken across Project Profiles	
	Pearson's cor. coef.	Spearman's rank cor. coef.		Pearson's cor. coef.	Spearman's rank cor. coef.
Holistic	0.969	0.952	**Holistic**	0.897	0.817
Decomposed (EM)	0.922	0.891	**Decomposed (EM)**	0.955	0.900
Decomposed (DRM)	0.980	0.988	**Decomposed (DRM)**	0.965	0.917

Table 5-28: Correlations Between the Outcomes Provided by the Insiders and the Outsiders (Taken Across Company and Project Profiles)

- All group attribute performance levels (i.e., the average between the performance levels assigned by each group component) given by the insiders are smaller than the ones provided by the outsiders.
- The four largest holistic evaluations were provided by the outsiders, and
- The PA index, calculated using either weighting method, is higher for outsiders than insiders (despite the fact that one of the outsiders gave very low indices).

Results from one project are obviously not sufficient to draw general conclusions, however it appears that differences do exist (i.e., the two groups evaluate the project from different points of view.) Insiders seems to assume a more conservative position than outsiders perhaps because they have more at stake than the outsiders do. The small differences between the responses given by the group decomposed evaluations and the average holistic judgments confirm the fact that the PA index captures the preferences of the decision makers.[85]

The validation results indicate that the Desirability Model appears to capture the preferences of insiders and outsiders. However, its use cannot create consensus within the members of each group. That is, when evaluating a project or company, the range of outcomes provided by the insiders' and outsiders' decomposed models does not appear to be smaller than the spread observed from their holistic evaluations. Figures 5-20 and 5-21 show the range of responses provided by the insiders and outsiders when evaluating the company and project profiles used in this study.

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85 For the group of insiders the differences between the decomposed evaluations, using the EM and the DRM, and the holistic judgments were, respectively, 1.70 and 2.55 index points. For the group of outsiders the differences were 2.70 and 4.38 index points.

	I-01	**I-02**	**I-03**	**I-05**	**I-06**	**I-07**	**O-01**	**O-02**	**O-03**	**O-04**	**O-05**	**O-06**	**Group of Insiders**	**Group of Outsiders**
4.1. Character of Promoting Team's Management	6	7	5	8	4	8	6	4	6	8	9	9	6.33	7.00
4.2. Strength of Promoting Team	5	7	6	7	4	8	8	4	6	8	9	7	6.17	7.00
4.3. Adequacy of Promoters Agreement	3	5	5	5	6	6	9	4	5	5	9	7	5.00	6.50
5.1. Ability to Provide a Quality Design	8	7	5	5	8	6	7	7	6	6	9	8	6.50	7.17
5.2. Ability to Prov. a Feasible Construction Plan	7	5	3	5	8	6	7	6	6	8	9	9	5.67	7.50
5.3. Abil. to Prov. an Adeq. Operat.-Transf. Pack.	7	7	5	6	5	6	9	6	4	7	7	8	6.00	6.83
6.1. Avail. Adeq. Fin. Source to Raise Financing	5	2	4	6	8	8	8	5	6	8	9	9	5.50	7.50
6.2. Financial Viability	5	5	2	7	8	9	9	6	6	6	9	9	6.00	7.50
6.3. Certainty of Construct. & Operational Costs	2	2	1	4	7	8	8	3	3	4	9	7	4.00	5.67
6.4. Certainty of Revenues	5	7	1	6	7	8	8	3	5	4	9	7	5.67	6.00
7.1. Overall Quality of the Principal	2	5	3	7	3	8	7	7	7	9	9	8	4.67	7.83
7.2. Level of Community Support	6	6	6	7	6	7	5	5	5	7	9	9	6.33	6.67
7.3. Legal Environment	7	7	4	7	5	7	5	7	5	9	9	9	6.17	7.33
7.4. Political Environment	8	6	3	5	6	7	5	6	6	9	9	9	5.83	7.33
Holistic Judgments	40.0	65.0	40.0	60.0	70.0	60.0	50.0	50.0	75.0	75.0	90.0	80.0	55.83	70.00
Decomposed Evaluations														
EM	39.4	43.8	7.4	78.1	81.7	94.8	89.5	1.6	43.2	76.6	99.6	93.3	57.53	67.30
DRM	43.0	50.3	14.7	73.7	76.5	92.1	83.0	2.9	42.8	74.6	99.2	91.2	58.38	65.62

Table 5-29: Attribute Performance Levels and Holistic and Decomposed Evaluations for the Eurotunnel

What Drives the Action in the Desirability Model, Importance Weights or Worth Scores?

In order to determine the driving force in the Desirability Model let us consider the evaluation of the Eurotunnel. Table 5-30 shows the PA index values of the Eurotunnel for every respondent. The indices were computed based on three different alternatives: (1) individual attribute importance weights (using the DRM) , individual P1 and P2 assessments, individual attribute performance levels; (2) group importance weights, individual P1 and P2 assessments, individual attribute performance levels; and (3) individual importance weights, group average P1 and P2 assessments, group average attribute performance levels.[86]

	Alternatives				Alternatives		
	A	**B**	**C**		**A**	**B**	**C**
I-01	43.0	34.3	44.8	**O-01**	83.0	85.2	77.1
I-02	50.3	51.2	45.9	**O-02**	2.9	3.4	81.3
I-03	14.7	16.9	44.4	**O-03**	42.8	45.9	77.9
I-05	73.7	65.7	45.2	**O-05**	74.6	70.4	85.8
I-06	76.5	70.2	39.7	**O-06**	99.2	98.9	80.8
I-07	92.1	89.6	37.0	**O-07**	91.2	90.7	78.8
Average	58.4	54.6	42.9	**Average**	65.6	65.7	80.3
Std. Dev.	28.0	26.2	3.6	**Std. Dev.**	36.4	35.8	3.2
Cof. Var.	0.48	0.48	0.08	**Cof. Var.**	0.55	0.54	0.04

Note: Alternative A — individual attribute importance weights (using the DRM) , individual P1 and P2 assessments, individual attribute performance levels

Alternative B — group importance weights, individual P1 and P2 assessments, individual attribute performance levels

Alternative C — individual importance weights, group average P1 and P2 assessments, group average attribute performance levels

Table 5-30: PA indexes for the Eurotunnel

An examination of the results obtained by using alternative C shows that the PA indices do not present much variability when the attribute worth scores (i.e., P1 and P2 assessments and attribute performance levels) are held constant and the attribute importance weights are allowed to vary. For the insiders, the coefficient of variation is

[86] This third option should never be applied in the computation of a PA or CC index as it is wrong to average the assessments of P1 and P2 and the performance levels of the attributes to calculate group results. This alternative is shown here only to illustrate the sensibility of the Desirability Model to different attribute importance weights.

0.08 and for the outsiders, it is 0.04. In contrast, results from alternative B (variable worth scores and constant attribute importance weights) present almost the same variability of the results from alternative A (where both worth scores and importance weights are allowed to change) and a much higher variability than alternative C. For the insiders, the coefficient of variation is 0.48 for alternative B and 0.48 for alternative A. For outsiders, the coefficients of variation are, respectively, 0.54 and 0.55.

These results indicate that the "action" on the Desirability Model may be more in the single-attribute ratings than in the importance weights. Stillwell, von Winterfeldt, and John (1981) obtained similar evidence on their analysis about alternative sources of energy.

At What Level is the CC or PA Index Good Enough For Company Involvement or Project Promotion?

The purpose of calculating the CC (PA) index for a company (project) is not to simply verify if it surpasses a certain threshold where a company is considered capable to participate in the promotion of an infrastructure project (a project is considered feasible to be privately promoted.) There are no simple answers to the question "How much is good enough?" This sub-section provides some basic index values to signal the quality levels of companies and projects. The decision to go forward should not be based solely on these values as they have been developed from hypothetical company and project profiles.

In questionnaire four, respondents were asked to place each company and project profile in one of four quality intervals: high, medium-high, medium-low, and low. Points were assigned to the profiles according to the interval they had been placed by the respondents (i.e., a profile placed on "high" got 4 points, on "medium-high" 3 points, on "medium-low" 2 points, and on "low" 1 point.) Next, the profiles were averaged across insiders and outsiders and were reclassified into the quality intervals. Then, profiles within the same intervals had their "quality points," group holistic and decomposed evaluations averaged. Table 5-31 shows the averages obtained at each interval. Finally, two "thresholds" were calculated by linearly interpolating the averaged profile evaluations. Profiles with indices above the "3.50" threshold may be considered as of having high quality, profiles with indices between the "3.50" and the "2.50" thresholds may be considered as medium-high quality, and profiles with indices below the "2.50" threshold may be considered as low quality. For example, the Eurotunnel, according to the information contained on Tables 5-29 and 5-31, is considered by both the insiders and the outsiders as a "medium-high" quality project. The thresholds displayed on Table 5-31 are very crude estimates and should be used only as reference points.

	Quality Intervals				Thresholds	
	High	Med-high	Med-low	Low	"2.50"	"3.50"
Insiders						
Company Profiles	C3, C6	C4, C5,C7, C8, C9	C1	C2		
Quality Interval Average	3.88	2.81	1.81	1.13		
Evaluation Averages						
Holistic	87.44	67.23	41.25	22.50	59.1	80.3
EM	79.81	63.20	62.59	33.88	63.0	73.9
DRM	84.10	68.80	67.18	36.20	68.3	78.7
Project Profiles	P2, P5	P1, P4, P10	P3, P6, P7, P9	P8		
Quality Interval Average	3.88	3.00	2.08	1.13		
Evaluation Averages						
Holistic	87.25	67.92	52.19	25.00	59.4	79.0
EM	79.94	59.05	46.07	19.51	52.0	71.0
DRM	81.36	64.23	46.76	19.72	54.7	74.0
Outsiders						
Company Profiles	C3, C6	C5, C7, C8, C9	C1, C2, C4			
Quality Interval Average	3.90	2.93	2.03	0.00		
Evaluation Averages						
Holistic	82.00	65.63	49.22	0.00	57.8	75.3
EM	82.46	65.52	47.62	0.00	57.0	75.5
DRM	84.18	67.45	52.69	0.00	60.4	77.3
Project Profiles	P2, P5	P1, P4, P6, P10	P3, P7, P9	P8		
Quality Interval Average	3.90	3.00	2.07	1.40		
Evaluation Averages						
Holistic	82.42	66.33	48.56	32.67	56.8	75.3
EM	74.56	58.14	42.66	19.71	49.8	67.3
DRM	77.48	60.12	44.25	18.64	51.6	69.8

Table 5-31: Crude Estimates for PA Index Thresholds

5.6 Using the Information Provided by the Desirability Model

The first step on using the Desirability Model consists of developing the attribute importance weights, creating the attribute value curves, and determining the dominant attributes. Once the model parameters have been defined, one needs to evaluate the performance level of all the model attributes, to verify if any dominant attribute has a performance level below point "P1," and to compute the PA index. If, a project presents a delta parameter smaller than zero (i.e., one or several dominant attributes have very low performance levels), one should seek strategies that boost the performance of these attributes and should not proceed until the delta parameter is set to zero. Using, for instance, the information provided by "I-06" and the performance levels given by profile "P6" results in a PA index of 62.0. A graphical illustration of the actual and maximum attribute contributions to the index, as shown in Figure 5-28, helps to clarify the information contained in the index value. The shaded part of a column represents the actual contribution of the attribute to the index. The attributes can be identified by its initials placed just below the columns. Each box on top of a shaded column (shown with a dotted-line border) represents the extra contribution provided by that particular attribute if its performance level increases by 0.5. The numbers on the top of an attribute column represent the incremental contribution an attribute can provide to the index (i.e., the height of each dotted-border box) and its maximum "extra" contribution (i.e., its contribution if the performance level goes from the actual level and reaches point "P2").

Sensitivity analysis can be performed to verify how different incentives and risk mitigation strategies influence the model attributes. The use of the model improves the understanding of the weaknesses and strengths of the project and hence, allows for better decision making. For instance, an inspection on Figure 5-30 reveals the attributes that would contribute most to the improvement of the index, they are: financial viability, certainty of revenues, availability of adequate financial sources to raise the financing, level of community support, and certainty of construction and operation costs. Therefore, efforts to improve the quality of the project should aim at increasing the performance level of these attributes. Some of the strategies that can enhance the performance of these attributes include: provision of a minimum-revenue guarantee, supply of long-term financing by the World Bank, utilization of local companies (in order to build some rapport between the local community and the project owning company), and use of lump-sum construction contracts.

Is the analysis of PA attributes sufficient for a company to decide about participating in the promotion of a project? The answer to this question is "no." Concomitantly with the analysis of the project parameters, the company should analyze its on own capability for promotion. For instance, suppose the company interested in a high-quality project is represented by profile "C2." An analysis of its attributes (see Figure 5-31) quickly points out the company's deficiencies, mainly in the availability to supply capital for the project

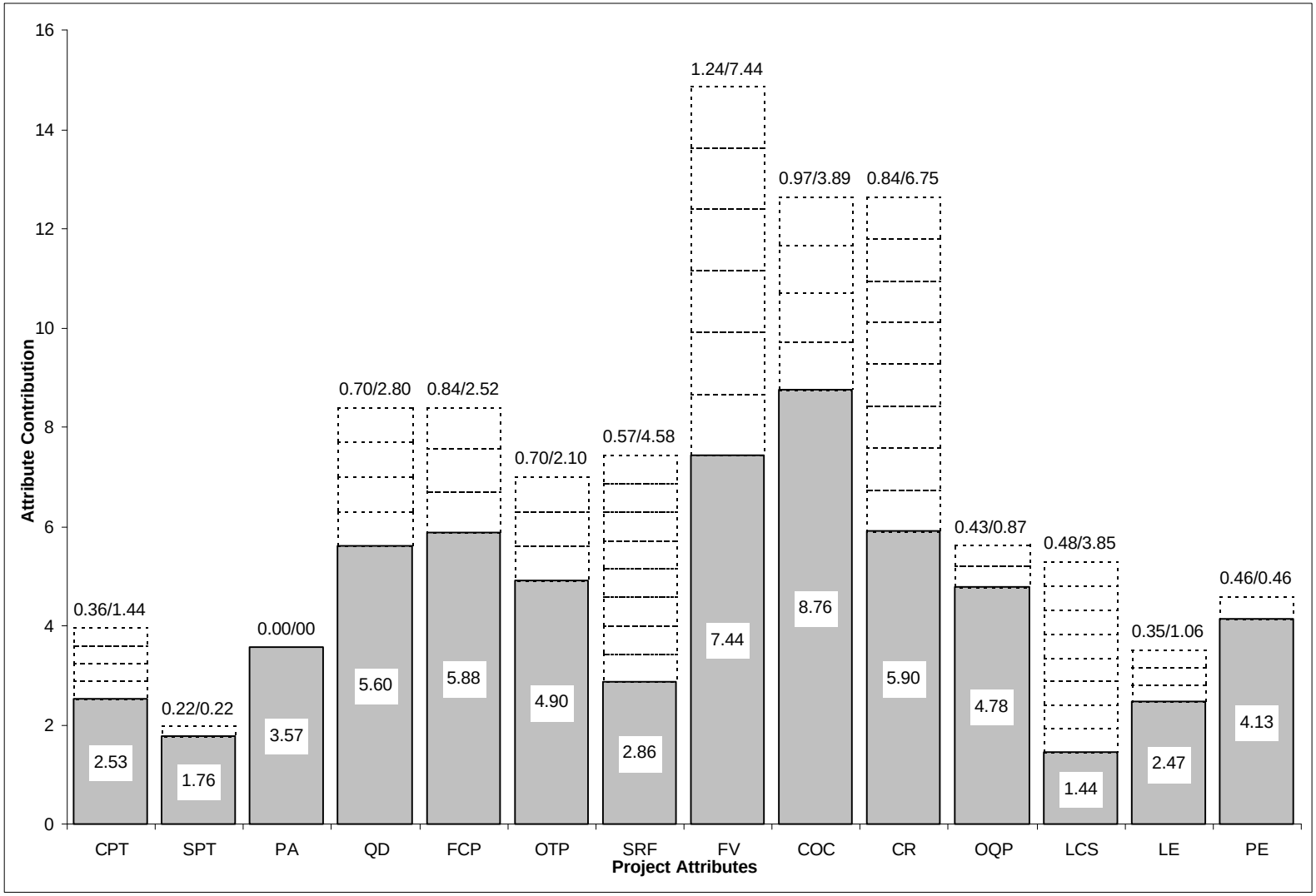

Figure 5-30: Illustration of Attribute Contributions to the PA index of "P6"

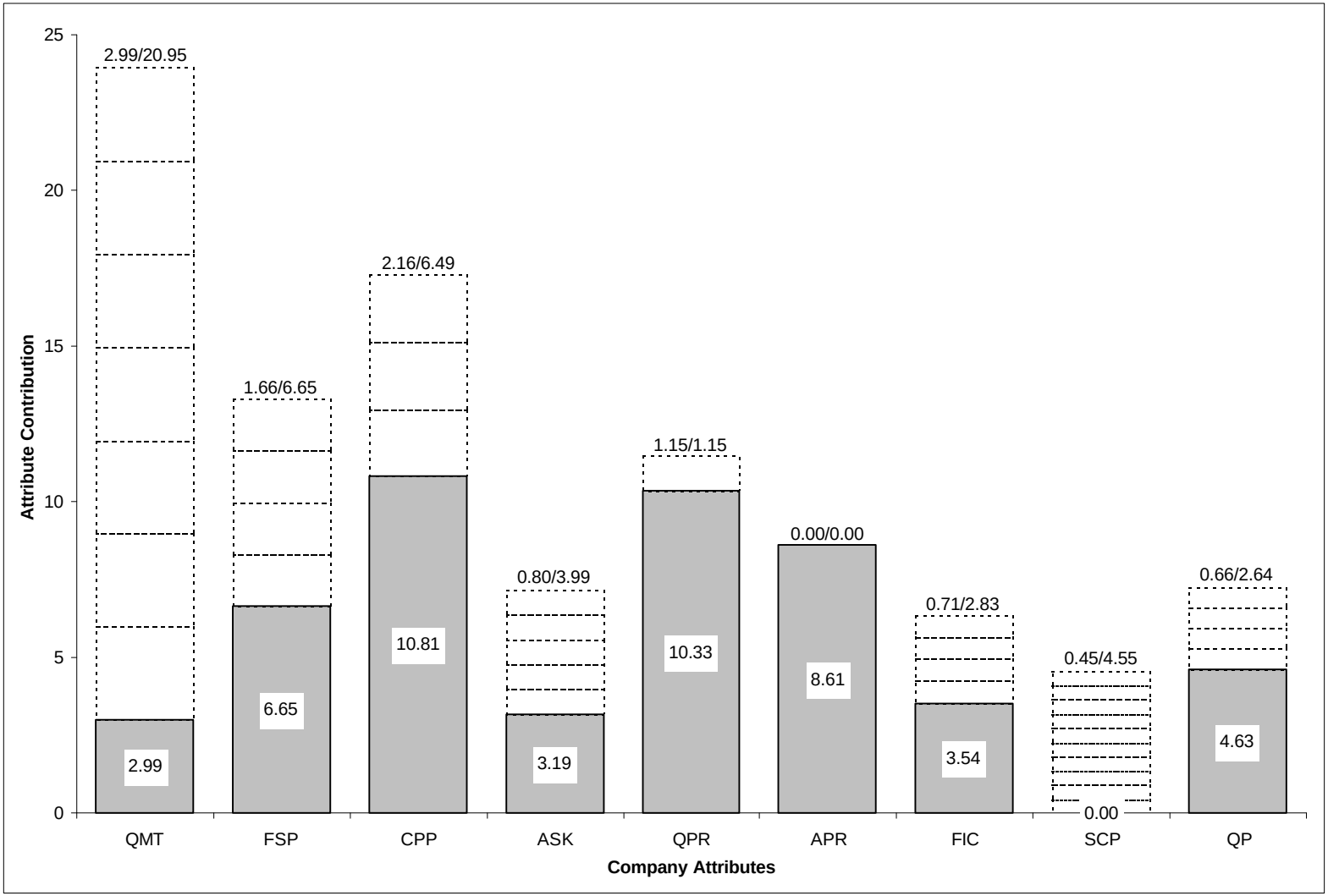

Figure 5-31: Illustration of Attribute Contributions to the CC index of "C2"

and the quality of the management team, and demonstrates its inadequacy to promote the project. Therefore, there has to be a good match between the characteristics of companies and projects. A good company will not make a potential unsuccessful project into a successful one, and a good project will not be successful if it is not developed and implemented by quality companies.

5.7 Summary

This chapter presented the outcomes provided by the experts that participated in the development of the Desirability Model. The analysis of the data gathered led to the following results: (1) the outcomes of the model correlate well with the direct assessment performed by experts, (2) the model is able to capture the disagreements between the different individuals (and groups) performing the evaluations, (3) both weighting procedures yield comparable importance weights, and also between different groups of individuals and (4) the outcomes of the model are more sensitive to attribute ratings than to their importance weights.

As a guideline to the use of the model, the author suggests that the decision maker uses one of the four group composite weights reported in Table 5-16 and develops the value curves for each attribute so that it reflects his/her own considerations for the different levels of attribute performance (quality).

Undoubtedly, the most important result presented herein was the unveiling of the attributes that best characterize the quality level of companies and projects. The identification and formalization of the model attributes allows analysts and decision makers to:

- Decompose the entity being evaluated into structured and more manageable parts,
- Gain insights about the performance levels of each of the company (project) attributes,
- Investigate how different strategies influence these attributes,
- Suggest courses of action to enhance the quality of the company (project) being evaluated,
- Develop a negotiation agenda with the other parties involved in the process,
- Facilitate group decision making (i.e., the model provides an efficient medium of communication, a focus for evaluation. It allows relevant issues to be identified and clearly discussed either by one person and his superior, the various members of the promoting team, or the many parties involved in the promotion process), and
- Decide about their participation on privately-financed infrastructure projects not based on an single number but rather on a better understanding of the process and of the quality of all the elements involved.

6 Conclusions

"In the end, we will conserve only what we love, we will love only what we understand, we will understand only what we are taught."

Baba Dioum

6.1 Private-Promotion Fundamentals

There are questions in today's economy about the government's ability to operate, maintain and finance infrastructure, as facilities have been inefficiently operated and inadequately maintained, social needs have been neglected, and governments have been bearing more of the burden of infrastructure expenditure than they can reasonably be expected to manage. The private promotion of infrastructure projects is a key mechanism for providing new facilities with advantages for the public and private sectors. From the government's perspective, private promotion provides new sources of project finance, has the potential to improve the quality and efficiency of infrastructure services and facilities, encourages better risk sharing between the public and private sectors, and provides access to technology, management expertise and financial skills that would not be available otherwise. For the private sector it provides new business with the possibility of high returns.

The procurement processes for privately-promoted projects have been complex, costly, and long, leaving many promoters apprehensive about the benefits of pursuing these type of projects. The results of this study suggest that these procurement processes

can indeed be enhanced. For example, in order to decrease the costs of procuring infrastructure projects, the government may: (a) utilize a pre-qualification procedure where it invites organizations to prepare and to submit pre-qualification documentation, analyzes the each of the prospects, and only invites the best 3 or 4 potential promoters to bid for the project; (b) promote a cost sharing policy where it pays for certain studies (e.g., geological investigations, traffic volume on existing facilities) that are required for all bidders, and (c) promote a reimbursement policy where the successful bidder's costs may be used as a benchmark for what may be considered as "reasonable" procurement expenditure and award part of this amount (e.g., 50%) to each of the unsuccessful bidders.

From a list of twenty-four possible factors (six financial and eighteen managerial) that lead private-sector companies to pursue the promotion of infrastructure projects, respondents picked financial factors as the foremost important for their decision to promote projects. They placed great importance on the possibility of having a long and healthy stream of project income.

The suitability of infrastructure projects for private promotion depends on several sectoral characteristics (e.g., potential for competition, potential for efficiency gains, cost recovery from user charges, certainty of revenues, and level of initial investment). Telecommunications, power generation, garages, industrial plants, hotel and resorts, and public buildings have been suggested in this study as projects that are particularly suited to "privatization" agreements. These projects generally offer highly marketable services with direct measures of production or consumption (e.g., power generation), potential cost reductions due to efficiency gains (e.g., power generation) and competitive environment (e.g., telecommunications), and high potential for cost recovery from user charges without the need for government guarantees (e.g., telecommunications). In contrast, bridges, tunnels, airports, roads, water treatment facilities, waste treatment facilities, power plants, and sewage treatment facilities have been identified as particularly suited to "concession" agreements. These projects usually do not promote "direct service competition" (e.g., sewage treatment facilities), do need government guarantees to cover some of their costs (e.g., roads), and are generally unsuitable for full privatization as they are part of the basic country infrastructure.

6.2 The Desirability Model

In the development of the importance weights for the categories that constitute the company-competency index, all experts (insiders and outsiders) indicate the financial category as the most important, with the management and production categories coming as second and third. These results seem to suggest that an owning company's ability to fund the procurement process and to provide its own resources to finance part of the project coupled with the quality of the investment in terms of potential return is of vital importance for the promoter in its decision to pursue infrastructure projects. The relatively low importance given to the production-related category appears to indicate that

potential promoters are not as concerned with the availability of their own resources and/or the adequacy of their technical expertise as they can rely on third parties to bring the necessary resources and expertise to have the project developed and implemented.

Among the categories that compose the project-attractiveness index, insiders and outsiders indicate that the financial category is the most important. Thus, a favorable project financial assessment is essential to attract private promoters. According to these experts, the second most important category is the ability of governments to provide the necessary conditions for the project to materialize and to be operated. Although both insiders and outsiders agree with these rankings, there is a notable difference in their weights for the managerial, technical, and financial categories. Insiders input money in the process and are liable to lose their investment if the project fails. They appear to be confident about their ability to manage and to provide technical solutions to the project. Therefore, they place a high importance on the project's ability to provide an adequate return on their investment and a relatively low importance to the categories that they have more control over. Outsiders provide services, mainly management and legal expertise to principals and promoters, and thus put less emphasis on the financial assessment (although it is still the most important category), and assign more importance on the management and technical categories perhaps indicating their concerns that some promoting companies have in the past performed poorly in this respect.

The holistic evaluations performed by respondents on several company and project profiles are highly correlated with the outcomes obtained from the additive decomposed models. This suggests that the Desirability Model captures the preferences of insiders and outsiders and can be used as a substitute for the direct assessment of individuals and groups in the evaluation of (a) the capability of companies to participate in the promotion of projects and (b) the feasibility of projects to be pursued through a private-sector promotion procedure.

The indices obtained from the group evaluations of insiders and outsiders on companies/projects are comparable. There is no evidence that they would produce different indices when the performance (quality) levels of the attributes that characterize these companies/projects are the same. In contrast, the individual evaluations of either insiders or outsiders provide different indices primarily because their subjective assessment of the performance (quality) levels of the attributes differ. In this case, it appears that, as a group, insiders are more conservative than outsiders as they tend to rate projects lower.

Study results also suggest that (a) both weighting procedures, the eigenvalue method and the direct rating method, yield comparable importance weights, and that (b) the indices produced by the Desirability Model may be more sensitive to the worth scores (i.e., the non-dimensional numbers that measure the values of attributes in a specific company/project) than to the importance weights of the attributes. Therefore, special attention should be placed in the creation of the value curves for each model attribute.

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