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QUALITATIVE DEVELOPMENT OF DEBT/EQUITY MODEL FOR BOT INFRASTRUCTURE PROJECTS

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Abstract
This paper is concerned with determinants of equity investment in build, operate and transfer (BOT) infrastructure project. The determinants such as revenue risks, availability of guarantees or security, loan tenor, location of project and novelty of proposal had being identified in Woodward et al (1996). The results from surveys on the factors are studied in conjunction with actual BOT projects. Finally, a qualitative model which provides a systematic approach in the determination of optimum equity level is presented in this paper.

Keywords: Build-Operate-Transfer (BOT), Equity Investment, Financing, Infrastructure

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INTRODUCTION

Equity finance of BOT infrastructure projects represents the injection of risk capital by the project promoter and investors into the concession company. Given the uncertain nature of the revenue stream associated with BOT infrastructure projects, investors' risk can be high. Since the servicing of debt has priority over dividend payment, dividends can only be paid after the debt claims have been met. However, equity investment is inevitable in certain BOT projects especially those in the developing countries. It is necessary for the promoters to raise the non-recourse financing or even to win the concession. How much then is the optimum equity? All parties have to negotiate for the best allocation of risks and the returns on their investments.

Woodward, et al (1996) have identified ten factors which constitute the main elements that determine the debt-equity ratio for most BOT projects. The common factors are identified from analysis of several major infrastructure projects developed using BOT principles. They have also recommended further investigations into the optimum level of debt/equity for BOT projects. These factors are Long Concession Period, High Commercial/Revenue Risks, Availability of Guarantees, Location of Project, Dispersion of Ownership, Size of Project, Real Interest Rate, Speculative Vs Invited Bid, Novelty of Proposal and Consolidation. The objectives of this paper are to further analyze the key determinants so as to establish those factors that would encourage high equity participation. It will propose a qualitative model that will incorporate those factors and provide a systematic approach in determining the optimum level of equity investment in infrastructure projects.

RESEARCH METHODOLOGIES

The methodologies of this research study are literature review, interviews and survey questionnaire with the findings supported by data of BOT projects from Loh et al (1992), Mohd (1991), Tiong et al (1996), Tiong (1995), Woodward et al (1993) and Yeoh (1995).

Two sets of mail questionnaires were sent out and the targeted respondents were the major BOT project promoters in Malaysia and the BOT financial advisors and lenders in Singapore. Structured interviews were also conducted in depth with the respondents of the first survey. The first set of questionnaire was sent to the respondents by hand during the interviews which were conducted in Malaysia in December 1996. The authors interviewed senior executives of 5 BOT project promoters.

For the first survey, three project promoters and one financial advisor, responded out of a total of 6 questionnaires submitted. In the second survey, sent in February 1997 to financial advisors in Singapore, a total of 8 bankers responded out of a total of 16 questionnaires submitted. In addition, 2 promoters replied to the second survey also.

There are ten factors listed in the questionnaire for the respondents to evaluate their importance. Table 1 shows the summary of the results.

ANALYSIS OF DETERMINANTS OF EQUITY INVESTMENT

F1 - Revenue Risks and Sectors

Risks such as construction risks, technological risks, environmental risks, feedstock risks and political risks can cause uncertainty in future revenues of projects and lead to high equity requirement. Projects with a high degree of certainty in revenue generation may also have a relatively high proportion of equity. The reason for this is the attractiveness of the project to the investor looking for a high equity return. The lenders

on their part will find it easier to get credit committee approval and to syndicate a deal of this nature if the certainty of revenue is high.

Table 1. Ranking of Key Determinants from Survey

Factors		Rank	Average Score
F1	Revenue Risk and Sectors	1	5.00
F2	Availability of Guarantees	2	3.86
F3	Loan Repayment Period	3	3.42
F4	Real Interest Rate	4	3.14
F5	Location of Project	5	2.85
F6	Concession Period	6	2.57
F7	Novelty of Proposal	7.5	2.28
F8	Size of Project	7.5	2.28
F9	Speculative Vs Invited Bid	9	2.00
F10	Dispersion of Ownership	10	1.71

[a] *Score: 5 = most important, 4 = very important, 3 = important, 2 = fairly important and 1 = not important.*
[b] *Average score = ∑ (frequency x score) / ∑ (frequency).*
[c] *Rank = 1 as the most important and so on*

The lenders are willing to lend if the project has attractive economic fundamentals, attractive internal rate of return (IRR), positive net present value (NPV), consistent Debt Service Cover Ratio (DSCR) and Loan Life Cover Ratio (LLCR). The above must be maintained even in a worst case scenario.

From the interviews and the surveys, the DSCR of the project must be more than the minimum range of 1.10 to 1.25 in order for the project to be bankable. The satisfactory or comfortable range of DSCR is 1.30 to 1.50 and any DSCR above this range is preferable.

Table 2 shows the ranges of equity that were used in BOT projects in the infrastructure sectors, with toll roads exhibiting the lowest average equity participation of 15% as compared to 26% for the water supply project.

Table 2. Revenue Risks and Sectors

F1: Revenue Risk And Sectors	Tolls	Power	Water	Others
No. of Projects - developed country	15	0	0	0
- developing country	6	7	3	2
Range of Equity (%)	0 - 28	3 - 25	23 - 30	24
Mean Equity (%)	15.0	16.5	26.0	24.0

F2 - Availability of Guarantees and Securities

a) Guarantees by host government

Guarantees provided by the host government will encourage participation of the lenders and equity investors. The credit standing of the government agency, its track record and the strength of the off-take contract by the government agency are also crucial.

The incentives and guarantees that have been given include: 1) Guaranteed Minimum Income; 2) Government Support Loan; 3) Transfer of Existing Infrastructure for Operation; 4) No Second Similar Infrastructure to be Built; 5) Tax Incentives; 6) Longer Concession Period.

b) Security package

Taking security over the project assets and contracts gives the lenders the ability to control the project's cash flows and even step in and operate in adverse situations. The most common securities are mortgage charge over the physical assets, assignments of project contracts, contract undertakings, shareholder undertakings, insurances and bonds.

Table 3 shows the comparison of mean equity level between projects which were granted with guarantees and those without guarantees or security. It shows that those projects without guarantee would require a high equity level by the project promoters.

Table 3. Availability of Guarantees and Securities

F2: Availability Of Guarantees & Securities	None	Yes
No. of Projects - developed country	10	5
- developing country	13	5
Range of Equity (%)	0 - 30	0 - 21
Mean Equity (%)	20.3	9.8

F3 - Loan Repayment Period/ Loan Tenor

It is the natural preference for lenders to see that their debt is repaid as quickly as possible so that their loans are exposed in the shortest period of time to the project risks. However, project promoters typically want longer tenors to ease their cash flow. But if the loan tenor is stretched to a longer period, the total interest charges payable will be higher. Loan repayment periods of 1 to 5 years are considered short but lenders would be reluctant to consider a period exceeding 15 years. Lenders would question whether the project is able to service the debt as the DSCR may fall below the comfort zone.

F4 - Real Interest Rate

Economic theory suggests that the nominal cost of borrowing is largely irrelevant, since the inflation in revenues will automatically compensate for it (Woodward, et al, 1996). The higher the interest charged, the higher could be the debt level provided by lenders provided that lenders are satisfied with the risk security structure.

In certain conditions, this may not be true because the debt servicing will increase due to the heavy interest charges. The DSCR of higher interest rate is of course lower compared to the lower interest rate when all other factors are equal.

Therefore, high interest rate will not compensate for poorly structured project. Furthermore, it is the interest margin that determines lenders appetite, not the absolute level of interest. This margin will reflect a combination of many risk determinants in loan tenor, industry demand, sponsor quality, country risk, quality of off takers and fuel supplier, project economics and other factors like security structures.

F5 - Location Of Project

Favorable location of the project is viewed as important. Factors that should be considered include political and economical stability, and depth of local financial market and even geological parameters. The current financial turmoil in some Asian countries has caused a flight of capital and suspension of many mega infrastructure projects. Due to the crisis, lenders will only be comfortable if there is a higher equity investment for projects in developing countries. Up to this point of time, there is no BOT project financing in developing countries which has a 100% debt financing as shown in Table 4.

Table 4. Location of Project

F5 : Location of Project	Developed Countries	Developing Countries
Number of Projects	15	18
Range of equity (%)	0 - 28	3 - 30
Mean Equity (%)	13.8	19.9

The scenario is different in developed countries where the equity requirement for BOT project could be low and 100% debt financing had been attained in UK. The range of equity level in developed countries is 0% to 28% which is comparable to the developing countries' 'pre-crisis' equity of 3% to 30%.

F6 - Concession Period

A project with a short-term equity pay back is more attractive than one with a longer term pay back. If the economics of the concession are such that a long concession is needed to recoup the investment, then a high equity ratio will be necessary to allow repayment of debt within normal market tenors. Lenders have maximum tenors for various industries and countries.

Concession period has to be longer than the loan tenor. After that, the equity will be the main consideration. This means that DSCR is only important for the loan tenor period and not relevant to lender beyond the specified period of repayment.

Figure 1 shows the correlation between equity and concession period based on the data from BOT projects. The hypothetical equation for developed countries is $E = 1.64 \times n^{1.17}$ and for developing countries is $E = 0.05 \times n^{2.5}$ where E equal to calculated equity and n is the concession period of the projects.

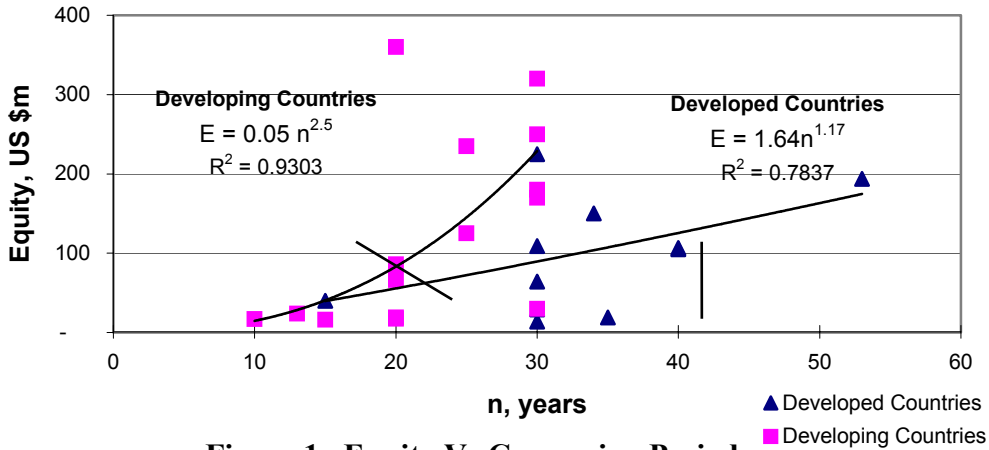


Figure 1. Equity Vs Concession Period

F7 - Novelty of Proposal

When the construction technique is complicated, the lenders will consider the project inherently more risky. Thus, higher equity level is required. There is evidence that lenders are more comfortable with those proposals that are similar to ones they have previously financed and in areas of activity in which they are familiar (Woodward, et al, 1996). New and unproven technology is unlikely to be financed in the absence of a guarantee from a strong and credible promoter. Table 5 provides the suggested equity level for three different levels of construction novelty from the second survey.

Table 5. Novelty of Construction and Equity Level

Novelty Level of Construction	Range of Recommended Equity Level (%)
Level 1: Proven Conventional Method *(e.g. road construction)*	20 - 30
Level 2: Difficult Construction & Operation *(e.g. tunnels and dams)*	30 - 60
Level 3: Radical Construction Techniques *(technology not proven)*	40 - 100

** exclude the technology of operational equipment*

The recommended equity level ranges from 20 to 30% for the proven conventional construction method (novelty level 1). For example in road construction, the equity investment is lower as compared to other. For BOT projects such as tunnels and dams where construction and operations are difficult, the equity commitment will be higher (30% to 60%). The above guidelines should be used with discretion. Each project needs to be carefully studied and to be categorized into correct level of novelty.

F8 - Size of Project

Availability of equity investment is possibly constrained by the risk capital available in the economy at any one time (Woodward, et al, 1996). Therefore, the equity investment by BOT developers will also be affected by the size of project. Generally, the lenders are not attracted by small project size, say below US$10 million, though in an emerging market, lenders may be interested to deal on a full recourse basis for small projects.

A relationship between the project size and the amount of equity in absolute dollar for the BOT cases is as shown in Figure 2: the bigger the project size, the bigger amount of equity is required. Due to the wide range of project sizes which are covered (US$38m to US$9200m of size and US$9m to US$1720m of equity), the log graph is plotted to illustrate the relationship of the two parameters. Logarithms are suitable for improving resolution where data go through many powers of 10. The equation is Equity = 0.3476 x Size $^{0.9187}$, Equity and Size are in terms of absolute amount (US$ millions).

The relationship between the debt-equity ratio and the project size is shown in Figure 3 also. The relationship can be represented by the equation Debt-Equity ratio = (Size + 31867) x 10^{-4}, where size of project is in terms of absolute amount (US$ million). From this equation, for a project size is of US$500m, debt-equity ratio can be estimated as 3.24 [from (500+31867) x 10^{-4}], or 76.4% of debt and 23.6% of equity.

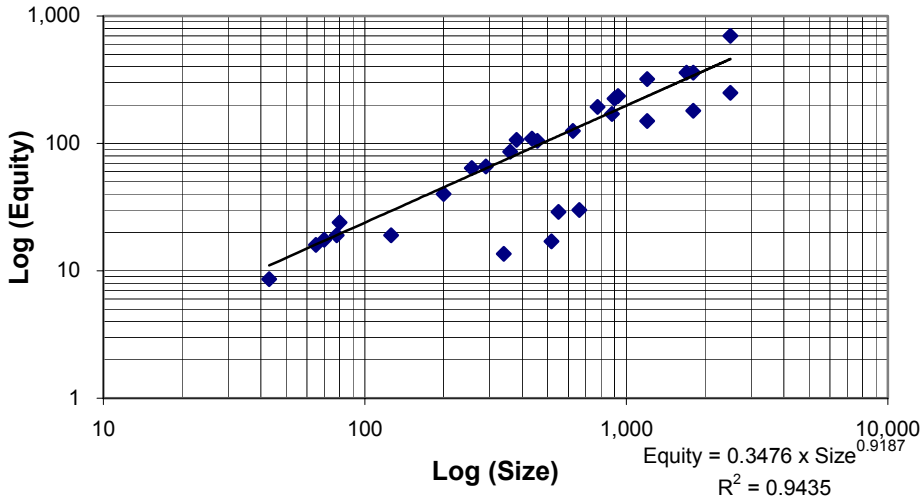


Figure 2. Log (Equity) Vs Log (Size)

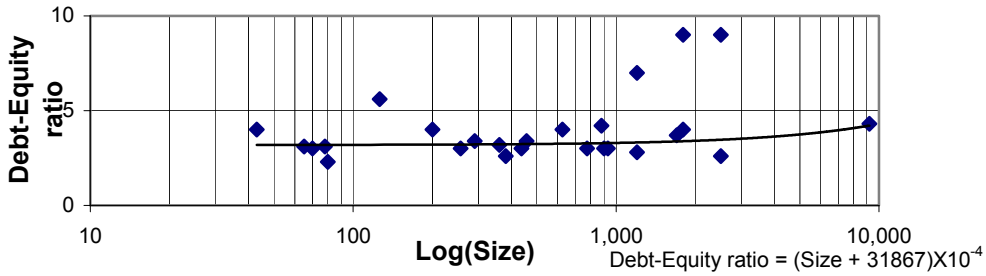


Figure 3. Debt-Equity ratio Vs Log(Size)

F9 - Speculative Vs Invited Bid

An unsolicited proposal or speculative bid is a proposal which is prepared and submitted solely at the initiative of a private promoter and is not in response to an official Request For Proposal (RFP). BOT projects need government support and political will. A speculative proposal is therefore assumed inherently more risky to invest since it is difficult to determine its validity and the commitment of the host government. The associated risks also depend on the off-take contracts and other forms of guarantees. Therefore high equity may be required by the lenders.

If the bid is not accepted, there will be no risks taken by the lenders. If the speculative bid is accepted and all normal agreements are in place, then it does not differ from other projects approved based on RFP route. This factor is important to be considered only at the conceptual development stage of the BOT project. This is shown in Table 6 which shows the distribution of speculative and invited bids in developed countries and developing countries. The mean equity is about 17% for both cases.

Table 6. Speculative Vs Invited Bid

F9: Speculative vs Invited Bid	Speculative	Invited
No. of Projects - developed country	2	13
No. of Projects - developing country	7	11
Range of Equity (%)	3 - 30	0 - 28
Mean Equity (%)	17.7	17.0

F10 - Dispersion of Ownership

The issue of wide dispersion of the ownership (equity) of a project will not affect the equity participation. The control over the project is left to the major shareholder and the voting right of the rest of the shareholders. The greater the equity, the greater the likelihood of an increase in the number of the owners of the project because one single project promoter may not be able to raise the equity. For many large projects (US$1000m above) several promoters are required and funds may have to be raised through public share issues or bonds.

DEVELOPING THE EQUITY MODEL

The qualitative modeling of determinants of the optimum debt-equity ratio is developed from the above factors: those factors that will affect the debt-equity ratio are listed in accordance to the phases in a BOT project which are conceptual development stage, project development and implementation stage and transfer. The factors or determinants of equity investment in BOT projects are modeled in groups of sub-factors

As shown in Figure 4, there are five columns in the model with the sixth column providing the estimation of equity level for each small group such as E_1, E_2, E_3 and so on. The final optimum level of equity is E_0.

CONCEPTUAL DEVELOPMENT STAGE

The commercial viability of the proposal is determined to confirm the level of equity investment at the early stage of conceptual development. This stage involves the application of different strategies in BOT tender. Factors F5 (Location of Project), F7 (Novelty of Proposal), F8 (Size of Project), F9 (Speculative or Invited Bid) and F10 (Dispersion of Ownership) are identified as important factors.

PROJECT DEVELOPMENT AND IMPLEMENTATION

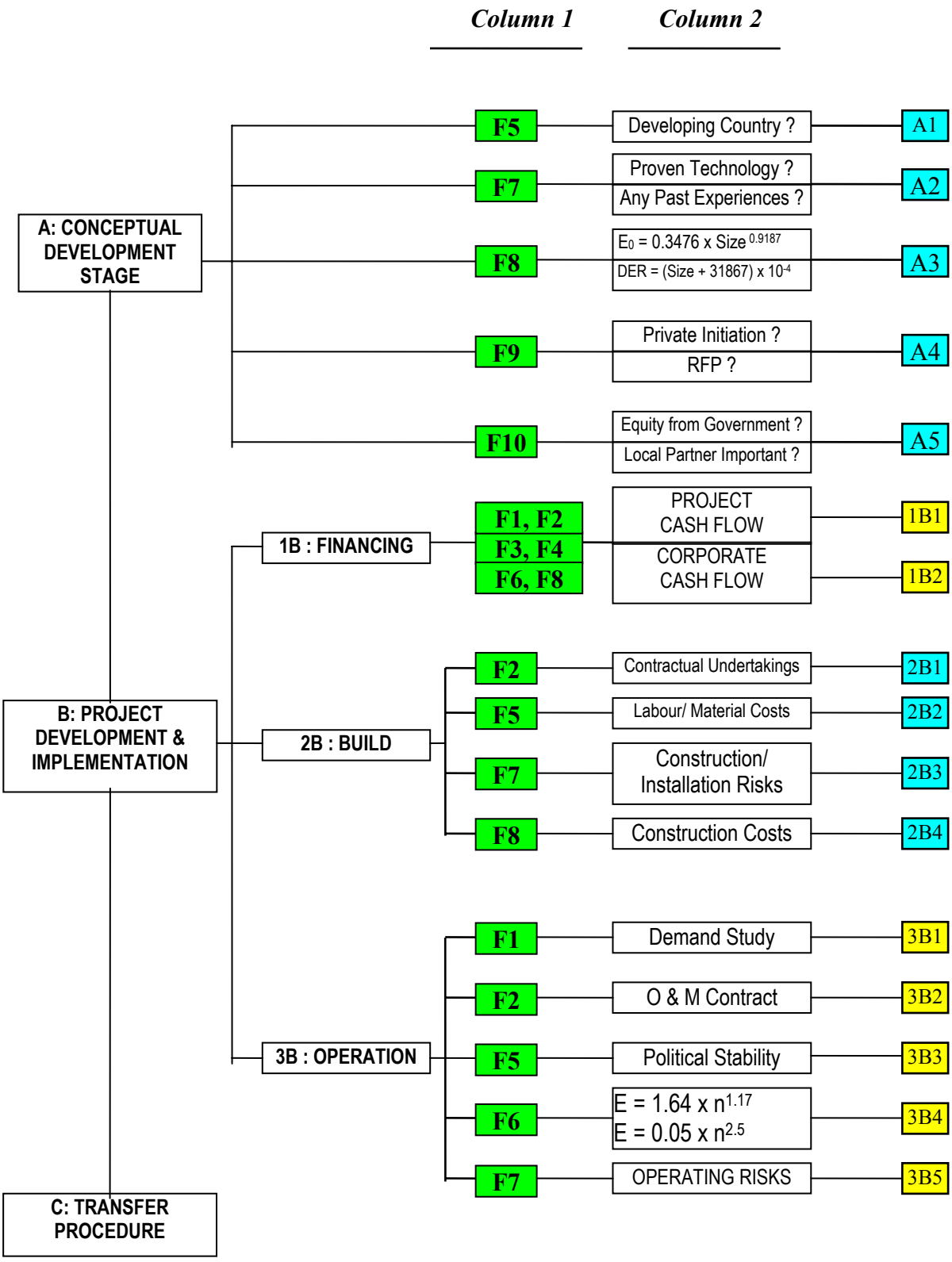
Project Development - Financing

The important factors at this stage are F1 (Revenue Risks and Sectors), F2 (Availability of Guarantees and Securities), F3 (Loan Repayment Period/Loan Tenor), F4 (Real Interest Rate), F6 (Concession Period) and F8 (Size of Project). The challenge of structuring the project finance is to establish a mixture of debt, equity and mezzanine financing that optimizes the use of financial sources. The sources of equity and the availability of debt would play a part in deciding the debt-equity ratio. The financial indicators need to be calculated with a high certainty to prove their validity in this application.

Figure 5 is extracted from Figure 4 to illustrate the financing stage in Column 4 and Column 5. The range of DSCR and attractiveness of the investment return are determined in Column 4 and then the desirable equity levels, E_7 and E_8, are determined in the subsequent steps.

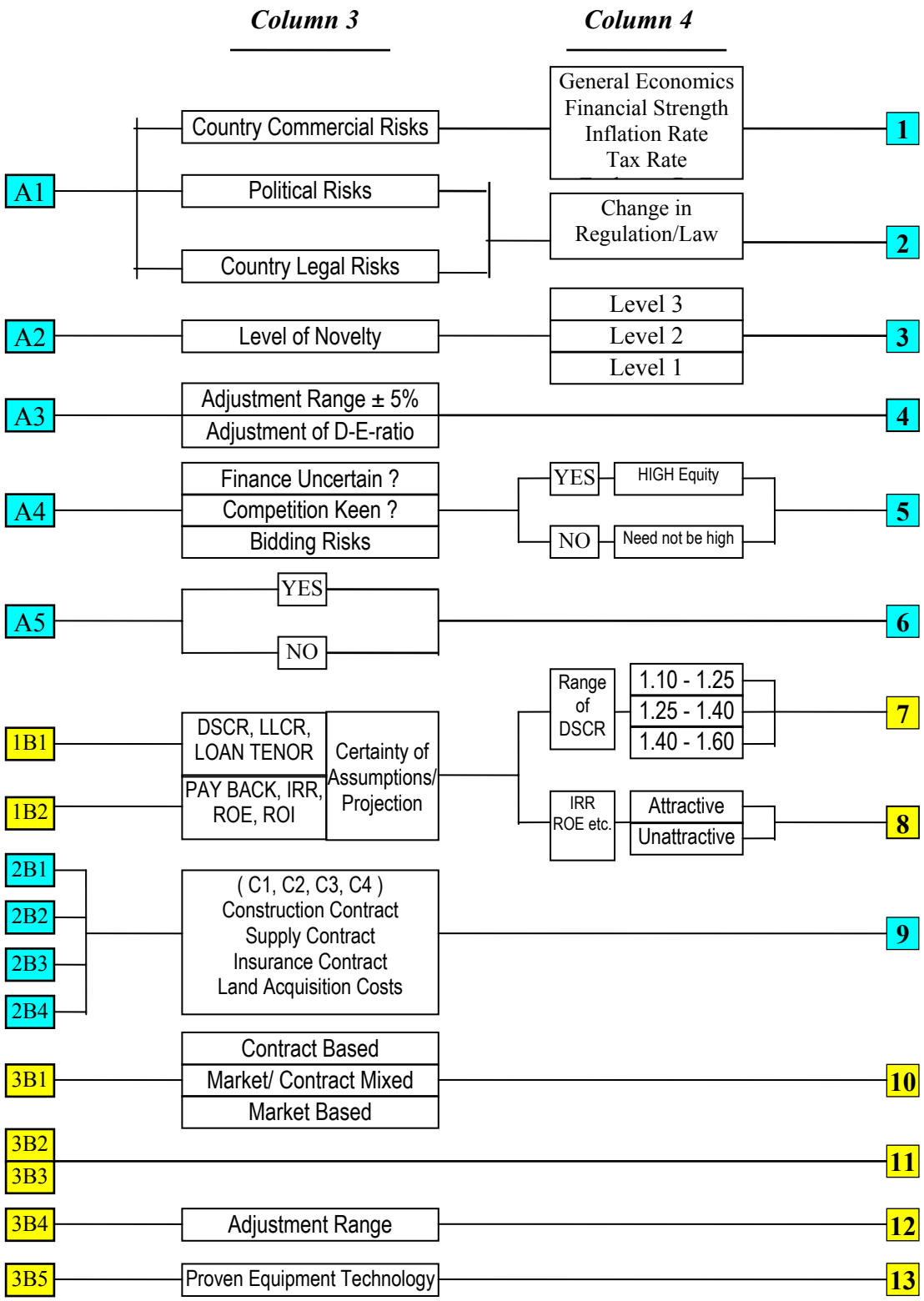
Project Implementation - Build

The factors associated with project implementation that would differences the debt/equity ratio are F2 (Availability of Guarantees and Securities), F5 (Location of Project), F7 (Novelty of Proposal) and F8 (Size of Project):



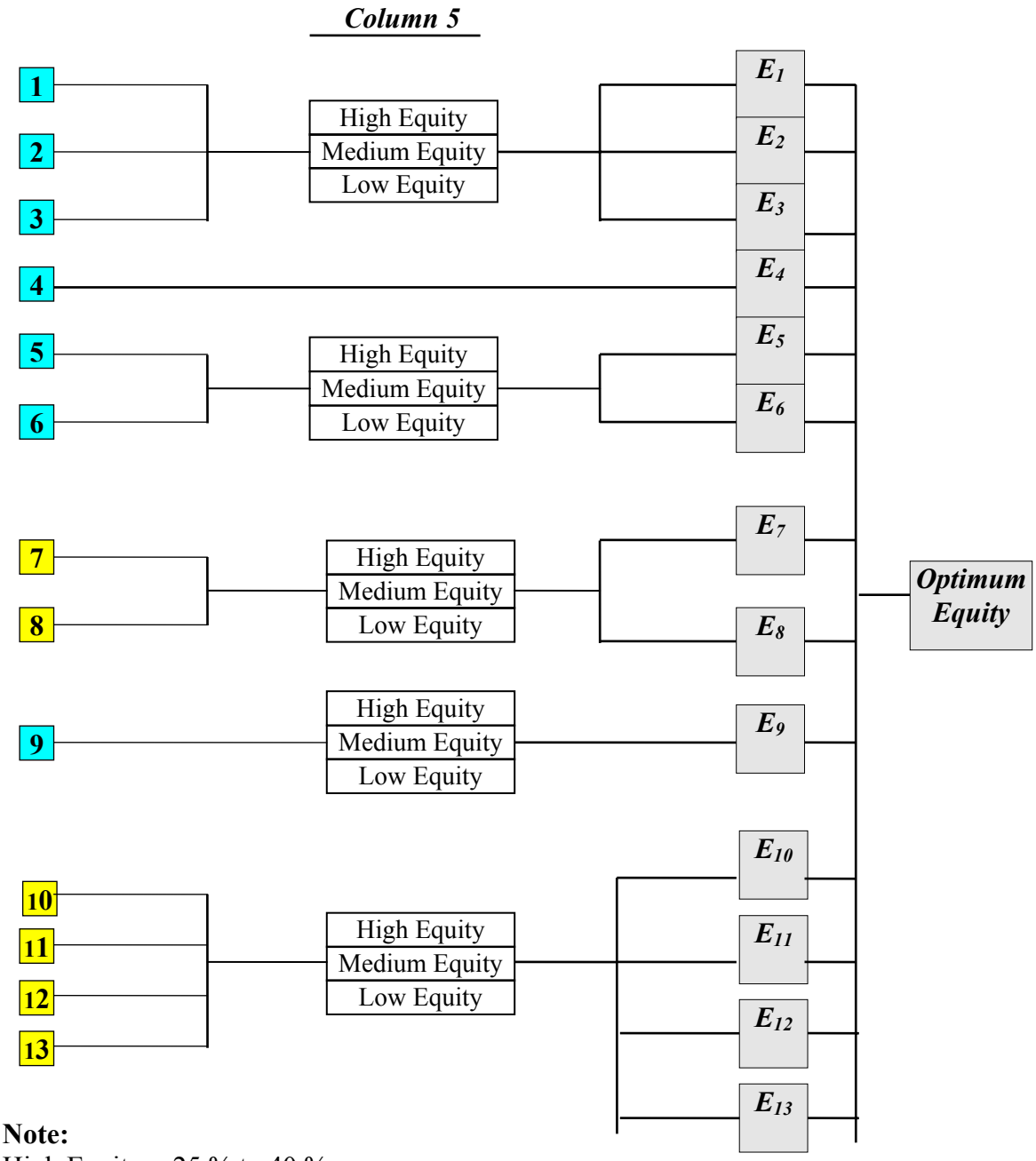
Note: ■ *denotes key factor/determinant;* ■ *&* ■ *denote connector to column 3 in next page*

Figure 4. Flow Chart for Equity Model (Continued Next Page)



Note: ■ & ■ *denote connector to column 5 in next page*

Figure 4. Flow Chart for Equity Model (Continued Next Page)



Note:
High Equity = 25 % to 40 %
Medium Equity = 15 % to 25 %
Low Equity = 10 % to 15 %

Figure 4. Flow Chart for Equity Model

Project Implementation - Operation

The factors that need to be considered at this stage are F1 (Revenue Risks and Sectors), F2 (Availability of Guarantees and Securities), F5 (Location of Project), F6 (Concession Period) and F7 (Novelty of Proposal):

TRANSFER PROCEDURE

The possibility of early or timely transfer, the extension of concession period, new O&M contract and the transfer of technology are the main factors identified.

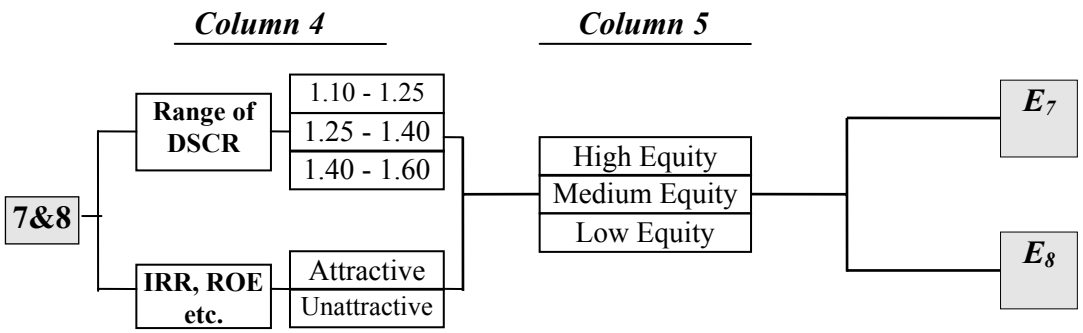


Figure 5. Columns 4 and 5 of Financing in Equity Model

CONCLUSIONS

The qualitative equity model is developed to determine the optimum equity level from the view point of a project promoter. The 10 key determinants of equity are classified into three broad categories depending on the stage of BOT development.

The ability to identify the determinants in each particular infrastructure project is the first step to obtain the optimum equity level. There must exist the ability to measure or evaluate all these identified determinants and subsequently control them.

From the survey analysis, F1 (Revenue Risks and Sectors) and F2 (Availability of Guarantees and Securities) seemed to be the main concerns of most project promoters. The importance of government support and guarantees must not be neglected especially for the developing countries.

Typically equity of more than 30% is considered as high equity participation. Basically the equity level can be classified into low, medium and high risks and the respective equity level is being recommended at the range of 10-15, 15-25 and 25-40%.

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