DECISION SUPPORT SYSTEM FOR THE EVALUATION AND COMPARISON OF CONCESSION PROJECT INVESTMENTS

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by

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DECLARATION

This work has not been previously submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

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Alison Kate McCowan

January 2004

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ABSTRACT

Governments of developed and developing countries alike are unable to fund the construction and maintenance of vital physical infrastructure such as roads, railways, water and wastewater treatment plants, and power plants. Thus, they are more and more turning to the private sector as a source of finance through procurement methods such as concession contracts. The most common form of concession contract is the Build-Operate-Transfer (BOT) contract, where a government (Principal) grants a private sector company (Promoter) a concession to build, finance, operate and maintain a facility and collect revenue over the concession period before finally transferring the facility, at no cost to the Principal, as a fully operational facility. Theoretically speaking, these projects present a win-win-win solution for the community as well as both private and public sector participants.

However, with the opportunity for private sector companies to earn higher returns comes greater risk. This is despite the fact that concession projects theoretically present a win-win-win solution to the problem of infrastructure provision. Unfortunately, this has not been the case in a number of countries including Australia. Private sector participants have admitted that there are problems that must be addressed to improve the process. Indeed they have attributed the underperformance of concession projects to the inability of both project Principals and Promoters to predict the impact of all financial and non-financial (risk) factors associated with concession project investments (CPIs) and to negotiate contracts to allow for these factors.

Non-financial project aspects, such as social, environmental, political, legal and market share factors, are deemed to be important; but these aspects would usually be considered to lie outside the normal appraisal process. To allow for the effects of such qualitative aspects, the majority of Principal or promoting organisations resort to estimating the necessary money contingencies without an appropriate quantification of the combined effects of financial and non-financial (risks and opportunities) factors.

In extreme cases, neglect of non-financial aspects can cause the failure of a project despite very favourable financial components; or can even cause the failure to go-ahead with a project that may have been of great non-financial benefit due to its projected

ordinary returns. Hence, non-financial aspects need careful analysis and understanding so that they can be assessed and properly managed. It is imperative that feasibility studies allow the promoting organisation to include a combination of financial factors and non-financial factors related to the economic environment, project complexity, innovation, market share, competition, and the national significance of the project investment. While much research has already focused on the classification of CPI non-financial (risk) factors, and the identification of interdependencies between risk factors on international projects, no attempt has yet been made to quantify these risk interdependencies. Building upon the literature, this thesis proposes a generic CPI risk factor framework (RFF) including important interdependencies, which were verified and quantified using input provided by practitioners and researchers conversant with risk profiles of international and/or concession construction projects. Decision Support Systems (DSSs) are systems designed to assist in the decision making process by providing all necessary information to the analyst. There are a number of DSSs that have been developed over recent years for the evaluation of high-risk construction project investments, such as CPIs, which incorporate the analysis of both financial and non-financial (risk) aspects of the investment. However, although these DSSs have been useful to practitioners and researchers alike, they have not offered a satisfactory solution to the modelling problem and are all limited in their practical application for various reasons. Thus, the construction industry lacks a DSS that is capable of evaluating and comparing several CPI options, taking into consideration both financial and non-financial aspects of an investment, as well as including the uncertainties commonly encountered at the feasibility stage of a project, in an efficient and effective manner. These two criteria, efficiency and effectiveness, are integral to the usefulness and overall acceptance of the developed DSS in industry.

This thesis develops an effective and efficient DSS to evaluate and compare CPI opportunities at the feasibility stage. The novel DSS design is based upon a combination of: (1) the mathematical modelling technique and financial analysis model that captures the true degree of certainty surrounding the project; and (2) the decision making technique and RFF that most closely reproduces the complexity of CPI decisions. Overall, this thesis outlines the methodology followed in the development of the DSS – produced as a stand-alone software product – and demonstrates its capabilities through a verification and validation process using real-life CPI case studies.

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ACRONYMS

AHP	Analytical Hierarchy Process
ANP	Analytic Network Process
B/C	Benefit/Cost
B/CR	Benefit/(Cost x Risk)
BO/CR	(Benefit x Opportunity)/(Cost x Risk)
BOLT	Build-Own-Lease-Transfer
BOO	Build-Own-Operate
BOOST	Build-Own-Operate-Subsidize-Transfer
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate-Transfer
BTHSR	Bureau of Taiwan High Speed Rail
BTO	Build-Transfer-Operate
CASPAR	Computer Aided Simulation for Project Appraisal and Review
CIA	Cross Impact Analysis
COMFAR	COmputer Model for Feasibility Analysis and Reporting
CPI	Concession Project Investment
CSF	Critical Success Factor
DBFO	Design-Build-Finance-Operate
DBOT	Design-Build-Operate-Transfer
DSCR	Debt Service Coverage Ratio
DSS	Decision Support System
ECCO	Evaluate and Compare Concession Options
EMC	Electromechanical Cost
FBOOT	Finance-Build-Own-Operate-Transfer
HEPP	Hydroelectric Power Plant
HSR	High Speed Rail
ICRAM-1	International Risk Assessment Model
IRR	Internal Rate of Return
ISTEA	Intermodal Surface Transportation Efficiency Act
MCC	Modified Coefficient of Consensus
MCDM	Multi Criteria Decision Making
NN	Neural Networks
NPV	Net Present Value
NSW	New South Wales
NZ	New Zealand
O&M	Operations and Maintenance
O/R	Opportunity/Risk
PFI	Private Finance Initiative
PNG	Papua New Guinea
PPP	Public-Private Partnership
RFF	Risk Factor Framework
RIM	Risk Influence Matrix
THSRC	Taiwan High Speed Rail Corporation
UAE	United Arab Emirates
UK	United Kingdom
UNIDO	United Nations Industrial Development Organisation
US	United States
VaR	Value at Risk

VBA	Visual Basic for Applications
VCC	Ventana Coefficient of Consensus
VFM	Value For Money
WACC	Weighted Average Cost of Capital