AN INTEGRATED PROJECT EVALUATION TOOL FOR PFI SEAPORT PROJECTS

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The evaluation of the financial viability for seaport projects is a critical activity for bidders and governments under traditional procurement or through private finance initiative (PFI). The aim of this research is to assist government agencies in evaluating bids and making decision efficiently for seaport development projects through the use of an integrated project evaluation tool. The proposed tool is expected to integrate the results of the financial model and the risk sharing strategy. The integrated project evaluation tool can be mutually used by the government agency and the sponsor(s). This paper discusses the proposed tool to be tested in future study. The research strategy uses literature review, questionnaire surveys, interviews, and document analyses in order to develop the proposed tool. The tool will be tested through case studies and experts' opinion to validate its applicability and effectiveness. The main conclusion of this paper is that the knowledge gap between the sponsor(s) and the government agency can be improved if the government agency is provided with efficient tools that consider both the financial and the risk factors affecting a new project.

Keywords: bidding, estimating, risk, procurement, decision analysis.

INTRODUCTION

Traditionally, infrastructure projects are usually owned and managed by the government. In any type of contract strategy, both the public and private sectors usually hire consultant firms to help them with different tasks such as legal, technical, financial and management consultancies (Kaka and Alsharif 2009). Under traditional procurement, government agencies rely on consultant firm from the project initiation to construction phase without much problem. However, the introduction of PFI system has enabled the involvement of the private sector in project finance. PFI as a type of public-private partnership (PPP) project scheme has become a major procurement method worldwide that generates more risks to both the government and the private parties due to the complexity of the project financing arrangement (Zhang 2005b). In the history of PFI development, the policy initiatives undertaken by the government agency do not always favour the investors (Bing *et al.* 2005, Schaufelberger and Wipadapisut 2003, and Wang *et al.* 2000). The development of favourable policies should be intended to allocate the expected risks in PFI projects. Since project financing arrangements involve many participants with complex transactions and diverse interests, negotiations among them are time consuming. Therefore, risk

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Kurniawan, F, Ogunlana, S and Motawa, I (2010) An integrated project evaluation tool for PFI seaport projects. *In:* Egbu, C. (Ed) *Procs 26th Annual ARCOM Conference,* 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, 1317-1327.

sharing between government and the sponsor(s) should be carefully examined within reasonable time. The problems in evaluating a large infrastructure project should also be considered when using project evaluation tools. This paper addresses the need for developing the tool that is expected to shorten the evaluation and negotiation processes, and presents the methodology adopted to undertake this research. The discussions about the evaluation of seaport projects and the project evaluation tool to be tested in future study are also presented within this paper.

EVALUATING LARGE INFRASTRUCTURE PROJECTS

Seaport projects as large infrastructure projects need to be extensively evaluated during the bidding or preliminary stage of the project life-cycle. Since the implementation of a large infrastructure project needs strong financial support, sound financial evaluation is perhaps the most important part among other project evaluations. In this respect, Angelides and Xenidis (2009) summarized the critical issues with regard to financing successful PFI projects as follows: (1) lack of strong domestic capital markets; (2) limited raising of institutional funds; (3) non-dependable project revenue streams; and (4) Improper assessment of the value of government guarantees.

The evaluation of the financial viability of a large infrastructure project is usually a very long and complex process. Generally, project finance assessment requires banks or other financial institutions to conduct full risk analysis, including technical/ engineering assessment of the project. Thus, the entire financing process is prone to take a long time before reaching financial closure. On the other hand, pre-transaction or contingent exposure during the preliminary project stage can be dangerous to the bidder or the company which proposes a new project to the government agency. According to the African Development Bank (2008), this exposure results from change in prices or rates before the bidder knows the exact nature of the commitment (size and timing). Long bidding process and uncertain economic conditions could lead to the bid either being uncompetitive or unprofitable because the bidder sets a price for a new contract and makes certain assumptions in terms of exchange and interest rates and commodity prices. Meanwhile, the bidder may or may not be successful with the bid which makes the bidding process time consuming and very costly. Considering the aforementioned risks, financial evaluation should be made to minimize the effect of these risks by incorporating risk analysis in the management process (RAMP 2005). Sound financial evaluation can only be achieved if all important financial aspects have been analyzed adequately. Meanwhile, not all project participants indentify important financial aspects properly due to the knowledge gap between bidder and government agency.

Problems in evaluating a large infrastructure project

The knowledge gap between bidder and government agency, sometimes, leads to misconception in the result of financial evaluation (Chiang and Cheng 2009). This is because government agencies usually employ consultants to help in making decisions without having sufficient expertise to use the results of financial evaluation effectively. Financial evaluation process and results usually lack transparency in explaining the output of the analysis. Wrong interpretation of given information leads to a bad decision. In order to minimize misjudgement, sufficient explanation should be given along with output data. Whitelaw-Jones (2010) introduced FAST modelling standard for financial models in order to keep models flexible, accurate, structured, and transparent. Project evaluation tools should be able to reveal the hidden risks and assist project participants in choosing appropriate risk mitigation strategies (Ozdogan and Birgonul 2000). A project evaluation tool can be used to help in making decision faster and effectively. Alberdi *et al.* (2009) suggested that a decision should not merely rely on the result of an evaluation tool due to the possibility of tool errors. In the context of general financial model, Panko (2008) stated that 88% of 113 financial model spreadsheet audited since 1995 contains errors due to formula inconsistency. The possibility of "garbage in garbage out" error can be minimized by giving more attention to the input data and the analysis process.

PROJECT EVALUATION TOOLS

Researchers have proposed numerous project evaluation tools and techniques to help companies or government agencies in making decisions. Project evaluation tools used for risk management can be classified into three evaluation stages: (1) risk identification; (2) risk analysis; and (3) risk mitigation or risk response. A summary of various risk analysis tools and techniques for PFI projects have been made by Dey and Ogunlana (2004). Zhang (2004) also identified competitive tender evaluation methods that are commonly used in PFI projects as Net present value method, Simple scoring method, Multi-attribute analysis, and Kepner-Tregoe decision analysis technique. The identification of tools and techniques are important. However, knowing how and when to use them properly is more important.

Research works in financial implications of PFI projects can be categorized into three major groupings: (1) Financial model analysis group, (2) Financial risk analysis group, and (3) Financial mitigation analysis group. The financial modelling group [e.g. Chang and Chen (2001) and Zhang (2005b)] is only concerned with financial feasibility of projects and addresses some risks in its financial parameters but they do not consider risk mitigation issues. The financial risk analysis group [e.g. Chee and Yeo (1995); Javid and Seneviratne (2000); Kakimoto and Seneviratne (2000); Seneviratne and Ranasinghe (1997); and Han, *et al.* (2004)] emphasized on assessing the types and levels of financial risks from financial planning through to the operation stage without introducing any mitigation measures. In the financial mitigation analysis group [e.g. Bing *et al.* (2005); Schaufelberger and Wipadapisut (2003); and Wang *et al.* (2000)] recommended financial strategies to the specific type and level of risk but they do not evaluate the financial viability of a project.

For seaport projects, it is important to understand how a port investment project is evaluated in respect of port-investment decisions and processes. The evaluation should consider the increasing flexibility and speed in investment decisions with comprehensive analyses, in response to the rapid transformations of the market. The position of a seaport in the competitive market is also an important issue to be evaluated by using techniques such as: Data Envelopment Analysis (DEA) technique (Cullinane and Wang, 2007). DEA model is a project evaluation tool for evaluating the efficiency of a seaport among the other seaports in the world. The results of DEA model provide important information for port managers or policy makers to decide on the scale of production and estimate the efficiency of a container port at the beginning of any analysis.

Among all researches into project evaluation tools, only Ozdogan and Birgonul (2000) developed a decision support framework (DSF) as a comprehensive project evaluation tool to help the project company in the planning stage of a hydropower plant. DSF model evaluates project viability against several predefined critical success factors within risk management perspective. DSF also defines the risk sharing scenarios under which a project becomes viable, by incorporating risks into cash flow analysis and risk mitigation strategies. The proposed tool will adopt and modify the previous methods including DSF into an integrated project evaluation tool for the government agency to evaluate a PFI seaport project during the bidding process. The next section will introduce the methodology adopted to develop this tool.

RESEARCH METHOD

In order to assist government agencies in evaluating bids and making decision efficiently, an integrated project evaluation tool will be developed for PFI seaport projects by considering critical success factors (CSFs), key performance indicators (KPIs), financial risks, and mitigation measures with the following modules: (1) Financial feasibility module; (2) Financial risk analysis module; (3) Financial risk mitigation module and; (4) Scenario simulation module. The framework for the development of the proposed tool is illustrated in Figure 1.

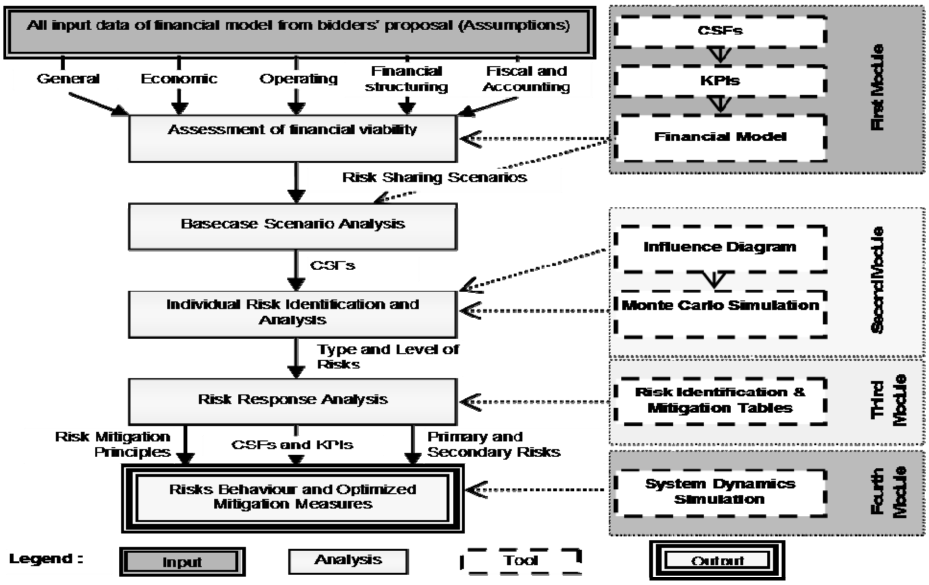

Figure 1: Integrated Project Evaluation Tool Framework

Two case studies are to be conducted. First is PFI seaport project in India and the other case study is for seaport development project in Indonesia to test the applicability and reliability of the proposed tool. The second case study will be used to calibrate the proposed tool into a project specific evaluation tool for use in Indonesia.

Financial feasibility module

In the first module, financial data from the bidders' proposal including the DEA results (e.g. general, economic, and operating assumptions) are to be prepared. The data will be used to find the optimum financial viability of the project by using several parameters such as self-financing ratio, % of private investment, debt coverage ratio, payback period, etc. This will identify the best case scenario for the second module.

The measurement ratios of financial model are selected to assess the important aspects of organization's objectives, which are based on pre-identified CSFs with their associated KPIs. Since project evaluation should be based on the objectives of the organization, key performance indicators are often used to measure the important aspects of organization's objectives.

Critical Success Factors and Key Performance Indicators

Critical success factors (CSFs) and key performance indicators (KPIs) are often used to help decision makers in evaluating projects and making an appropriate decision. CSFs have been defined by Rockart (1979) within business perspective as the few key areas where "things must go right" for the business to be successful. CSFs are several aspects of both the internal and external environment of an organization that have major influences on attaining the organization's aims. Thus, CSFs are identified based on the objective of the organization. The identification of specific CSFs for evaluating project viability should be properly categorized for better evaluation of projects.

Belassi and Tukel (1996) introduced a framework for critical success/failure factors in projects. The factors are grouped into four areas: (1) factors related to the project; (2) factors related to the project manager and the team members; (3) factors related to the organization, and (4) factors related to the external environment. Moreover, the effects of CSFs, which lead to project success or failure, should be clearly defined for better understanding of project performance before making any decision. As supported by Toor and Ogunlana (2009), KPIs are quantifiable measurement that an organization employs to measure each CSF. KPI can be financial or non-financial indicators. There are also many studies which have been conducted to identify CSFs in the construction industry (Lu *et al.* 2008, Zhang 2005a, Ozdogan and Birgonul 2000, Gupta and Narasimham 1998, Belassi and Tukel 1996). However, they did not explain clearly how to measure project performance strategy by way of CSFs linking with the measurement of performance through KPIs. Most of the studies use CSFs as checklist to measure the performance of a project.

Fernie *et al.* (2006) argued that monitoring performance using measures and KPIs falls short of entirely reliable explanation for the relationship between practice and performance. It is because not all aspects of organizational performance can be codified and structured to generate measureable outcomes. Therefore, benchmarking method by using measures and KPIs should be notably considered only for all important aspects that are measurable. The relationship between practice and performance can be partly understood and only possible explained via the use of measurement and KPIs. An overemphasis on performance measurement and the reliance on a quantitative approach to benchmarking should be avoided and shifted towards dialogue, reflection and learning.

The findings of literature are to be further explored to correlate CSFs and KPIs which affect financial viability of a PFI seaport development project. The financial viability of the new project can be tested by using KPIs to measure each CSF. Once CSFs are determined within financial implications, the measurement indicators or KPIs can be appropriately selected for structuring a financial model. Then all assumptions such as estimation costs, revenues and financial arrangements can be made before determining the economic, legal and socio-political conditions under which the project will be viable (Ozdogan and Birgonul 2000).

Financial Modelling of PFI Projects

Khan and Parra (2003) described financial model as a tool employed by lenders to conduct negotiations with the sponsor(s) and prepare project appraisal report. In PFI projects, the sponsor(s) generally organize a special purpose vehicle (SPV) or a concessionaire company to deal with the lenders, investors, insurance providers, contractor and other parties especially government agency. Generally, a successful PFI project has mutual agreement and balance of risk sharing between government agency and the sponsor(s) prior to financial close. Therefore, a financial model can also be used as a tool of risk sharing negotiation between the government agency and the sponsor(s). According to Chang and Chen (2001), a financial model through financial analysis can be used to determine the best strategy among proposed options. Therefore, the best strategy will be selected based on the financial parameters and evaluation results. The selection of financial parameters should be based on what is needed for the project to succeed. Teixeira (2010) observed that changes to financial model are driven by external and internal forces. The external forces are: (1) development of new funding structures; (2) additional market players; (3) higher risk of changes to financing structures; and (4) new risk factors. The internal factors are (1) detailed analysis from risk departments; (2) more severe downsides; and (3) development of clear guidelines regarding financial models. CSFs and KPIs can also be used to determine the structure and financial parameters of a financial model. Although Orjela (2010) argued that financial model can be used as a tool to identify, quantify and mitigate risks, the possible risks that may happen and how to mitigate those risks from the best strategy still remain a mystery. As such, risk management tools need to be embedded into a financial model. The proposed research will develop a financial model which integrates risk management tools in order to help government agencies understand the results of financial model analyses. Furthermore, financial model of PFI seaport development projects will be evaluated through comparison and verification from three samples of financial model (Kulkarni and Prusty 2007, Khan and Parra 2003, World Bank 2001), FAST modelling standard (Whitelaw-Jones 2010) and consultation with experts.

Financial risk analysis module
The second module will use influence diagram technique to identify the potential risks that affect the best scenario. The financial risks will be selected from the risk database to identify the level of risk (e.g. combining risks such as inflation fluctuation risk, traffic volume risk, investment cost risk to calculate the level of risk by using Monte-Carlo simulation). According to Chee and Yeo (1995), performing Monte-Carlo simulation up to 500 iterations is sufficient to make the sampling bias insignificant. Therefore, it is intended to limit the simulation to 500 iterations.

Financial risk mitigation module
For the third module, the risk response strategy will be selected from the risk identification and mitigation tables based on the risk level and condition (i.e. low risk has different financing strategies compared to high financial risk, or high market risk, or high political risk). Risks and mitigation measures in PFI projects will be categorized through identification and evaluation from relevant documents, publications and interviews.

In this proposed research, the significance of CSFs, KPIs, Risks, and Mitigation Measures in PFI seaport projects will be verified through two steps: (1) A structured questionnaire survey will be sent to gather international opinions of experts, practitioners, and researchers from public, private, and academic sectors; (2) Systematic statistical analyses of the survey responses. These include: (a) Kaizer-Meyer-Olkin (KMO) test to examine the sampling adequacy of the questionnaire survey, (b) Factor analysis to derive the CSFs, KPIs, Risks and to identify their respective measurement criteria, (c) Validity analysis (Pearson bivariate correlations) and reliability analysis (Cronbach alpha) to examine the quality of the questionnaire survey and the soundness of the factor analysis, (d) Mann Whitney U test and comparison of mean significance indexes as rated by each sector to determine the agreement level in the rating of the significances of the CSFs, KPIs, Risks, and Mitigation Measures across the public, private, and academic sectors, (e) Analysis of the significances of the CSFs and KPIs to identify the most important ones in different dimensions of a financial viability assessment.

Scenario simulation module

Finally for the fourth module, the selected mitigation measures for each level and condition of risks will be evaluated to find any potential or secondary risk. The secondary risk resulting from the selected strategies and different scenario needs to be addressed in the risk database. Each scenario of financial model has different range of variable data that can affect the level of risk although the financial indicators show an acceptable result (e.g. IRR is higher than weighted average interest rate, but duration of concession period is extended by the authority as part of government support because of low revenue). The optimization of the risk mitigation measures for each risk will be an iteration process by using system dynamics simulation.

System Dynamics

System dynamics is a simulation tool to support decision making process by understanding the relationship of important aspects governing project behaviour. If benchmarking (KPIs) and system dynamics simulation methods are combined together, it is expected that reliable explanation for the relationship between practice and performance can be achieved. System dynamics simulation can be used as a risk management tool in the construction industry and effectively can help in understanding the relationship of important financial aspects.

System dynamic simulation can provide an overall picture of a PFI seaport if compared through a case study. Since system dynamics simulation will be integrated with the proposed project evaluation tool, the simulation model will be tested for its consistency between the simulated behaviour of the model and the actual behaviour of the system (Sterman 2000). The evaluation results will also be compared with the literature on project evaluation tools and risk management, and tested by systematic statistical analyses and experts' opinion.

The proposed research intends to evaluate project's financial viability combined with three risk management evaluations (risk identification, risk analysis, and risk response). The simulation of various scenarios with different KPIs' level for possible events is anticipated also to optimize the risk responses before making decision. The selection of the optimum risk mitigation measures can be exercised by using system dynamics simulation. However, not all involved parties have the same attitude on risk in PFI projects.

RISK MANAGEMENT IN PFI PROJECTS

Dey and Ogunlana (2004) recognized that PFI projects are prone to risk. PFI projects require effective management of the risks associated with the complex financial, legal, organizational and socio-political structure of the model. They require adequate allocation of risks between government agency and members of Concessionaire Company who have different perceptions and objectives (Ozdogan and Birgonul, 2000). The perception of risks in a PFI scheme is different from traditional method of contracting. In a PFI project almost all the technical and financial risks are borne by the private promoter. Thus, the risk attitude in PFI projects is influenced by the perception of main participants. Dey and Ogunlana (2004) described the risk attitude in PFI projects from the perspectives of government, contractor or Concession Company, and bankers (as summarized in Table 1).

Table 1: Risk attitude in PFI projects

PFI Participants	Risk Attitude	Issue to be concerned
Government	Expecting the private sectors to take as many risks as possible	Additional cost of risk transfer
Contractor or Concession company	Achieving higher levels or return, a quick pay-back or achieving other spin-off benefits (development gains or business for other companies within their organization)	Government willingness to take a positive stance on the subject.
Bankers	Maintaining a proactive role to the contractors or concession company not to be as the prime movers.	Availability of risk capital

Source: Adapted from Dey and Ogunlana (2004)

In connection with evaluating a project package proposal, the risk management process should be carefully understood in order to make a good decision. Zou *et al.* (2008) developed a life-cycle risk management framework for PFI infrastructure projects comprising of three stages: (1) Preliminary risk allocation stage at feasibility study; (2) Detail risk allocation stage at bidding and negotiation; (3) Risk monitoring and reallocation stage at construction, operation and transfer. Thus, by adopting a life-cycle risk management framework into an integrated project evaluation tool, the organization's objectives and the logical flow of risk management process can be integrated.

THE POTENTIAL IMPLICATIONS OF THE RESEARCH FINDINGS

Financial models are not only used as tools to win bids but also to support risk sharing negotiation. Kulkarni and Prusty (2007) suggested that sophisticated financial model and sensitivity analysis need to be developed incorporating all external post-bid factors as inputs, and support mutual revenue-sharing. In addition, a successful bidder's strategy must be able to convince the financial institutions on the financial viability of the project and the ability to generate cash flow to serve the debt. According to the World Bank, all scenarios of financial model must also be commensurate with the risk factors involved in port sector projects such as: construction risks, hand-over risks, operating risks, procurement risks, financial risks, and social risks. Thus, it is expected that the proposed tool can help government agencies to measure the financial viability of projects by identifying the best bidder's strategy, facilitating the risk sharing negotiation process, monitoring the project performance and controlling the operational risks during concession period. Nevertheless, there are some limitations and barriers to its applicability. The proposed tool will only reflect key business assumptions directly and realistically without being over-built or cluttered with unnecessary detail (FAST, 2010). A data accuracy and data availability problem is two greatest barriers that should be concerned as well. In this regard, the integrated project evaluation tool is fragmented into four individual modules in order to minimize the possibilities of error. Each module will also be designed as simple as possible to allow users to run scenarios and sensitivity analyses with possibility of making modifications.

CONCLUSIONS

This research being reported is intended to assist government agencies in evaluating bids of PFI seaport projects. The underlying premise in discussion is that the knowledge gap between the sponsor(s) and the government agency can be bridged if the government agency is provided with efficient tools that consider both the financial and the risk factors affecting a new project. There is also a gap between financial evaluation and risk management that needs to be considered when using financial model as a means of estimating strategy to win the bid and as a risk sharing negotiation tool. Once the government agency could spot on the balance of financial viability and project risk level, the appropriate mitigation measures could be addressed and performed effectively during the concession period.

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