

Risk Factors Influencing Contractor's Cost Estimating in Design and Build Project in Malaysia

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Abstract: Cost estimating is a crucial part in Design and Build (DB) projects. The impact of inaccurate cost estimating could lead to several complications. Hence, it is very important at early stage to determine the project objectives. By applying risk analysis strategies it will help contractor to make a correct decision in cost estimating. Therefore, the objective of this study is to gain an understanding of the risk factors influencing contractor's cost estimating on project performance in DB projects. To achieve the objective of this study, the survey questionnaire was distributed among contractor, consultant and client, that were directly involved in design and build projects. A total of 170 useable questionnaires were received and analyzed. An exploratory factor analysis was used to investigate the relationship between DB project selection and the 64 risk factors influencing contractor's cost estimating. The results indicate that 8 group selection risk factors have the most influence contractor's cost estimating in DB project: management risk; political risk; construction risk; system risk; variable risk; uncertainty risk; design risk and project information risk. This study help contractors more in understanding the important of allocation risk in DB project at early stage of the project begins and also creates awareness between professional bodies and stakeholders on risk impact to the project objectives.

Key words: Cost estimating, design and build, questionnaire survey, factor analysis, risk factors influencing contractor's cost, awareness

INTRODUCTION

Cost Estimating is a critical and vital task in Design and Build (DB) projects. The success level of cost estimating depends on how much level of parties concern on risk management implication. The impact of inaccurate cost estimating will lead to the project objectives. If the contractor overestimates costs the results are higher tender price being submitted to the contractor and the tender could not be acceptable by the client. On the other hand, underestimated costs could lead to a situation where contractor incurs losses on the contracts awarded by the clients. The projects facing with cost overrun due to insufficient costs of resources and indirectly time overrun and lack of quality performance can also occur (Akintoye, 2000). Thus contractor suffers from low profitability in the contract awarded.

Identification of risk factor at an early stage of the project will help to reduce risk impact to the project (Vidivelli and Jayasudha, 2016). The contractor should have good insight with previous project handling by

providing all information related to risks. Risk cannot be eliminated but it can be shared or mitigated among parties. Risk occurs either during design or construction stage (Tran and Molenaar, 2014). Uncertainty risks make a situation where a contractor or client justifies the risk by estimation with added provisional sum value to the contract for safe side (Saaidin *et al.*, 2016; Saaidina *et al.*, 2016).

Selection of contract method specifies the degree of risk that depends on the size, value and complexity of the project itself. DB project is also exposed to the risk due to the unique features and complexity of the construction activities. Quite often using this type of contract has failed to achieve the objective of the project. It is because contractor has failed to identify, analyze and manage risk properly during design phase. However, it is important that all parties play an important role to tackle this situation at the beginning stage. Therefore, this study has been carried out to gain an understanding of the risk factors influencing cost estimating of contractor on project performance in DB project.

Risk factors influencing cost estimating in design and build projects:

Risk is defined as a matter of change from positive to negative situation. Understandings of risk management process will help contractors or cost estimator to reduce the negative impact on the project objective in DB project.

Yap reported that risk factors on design change have been classified as a critical risk to the project. Design change is related to the rework in construction project. Normally, design change occurs due to several factors from client modification of original design, addition of new scope of work, unclear of initial design brief, client lack of experience and design not suitable with functionality of the project. Palaneeswaran supports in his study that there are several causes of design change due to lack of experience and knowledge of design and construction, lack of funding allocated for site investigation, lack of client involvement in the project, inadequate briefing, poor communication with design consultants, inadequacies in contract documentation and experience financial problems (Bates *et al.*, 1984).

Qazi *et al.* (2016) have highlighted that project complexity is one of the risk factors contributed to affecting the project objectives. Project complexity consists of structural, uncertainty, dynamics, pace and socio-political. Lessard *et al.* (2014) state in their study the “House of Project Complexity” encompassing both technical and institutional elements, that project with no staff experience contributed to major problem because uncertainty and complexity of the projects (Koppenjan *et al.*, 2011).

MATERIALS AND METHODS

Based on the literature a research questionnaire was designed to elicit information from respondents such as client, consultant and contractor who have been involved in DB project in Malaysia. A comprehensive list of 64 risks was identified in previous literature and used in the questionnaire that was designed to get perception of the construction practice in DB project and only 47 risks were selected for factor analysis extraction. The first section of the questionnaire solicited demographic information about the respondents. The second section consists of 64 risks probability in DB project on a 5 point Likert scale. The scale for risk probability ranged from 1 (low) to 5 (high). These Likert scales were produced by Rensis Likert in 1932. A total of 170 questionnaires were received from the clients, consultants and contractors. The results were analyzed by using principal component analysis for factor extraction.

RESULTS AND DISCUSSION

Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) test was carried out to check the data suitability for factor analysis. According to Field (2009), the value of KMO varies according to range such as value above 0.9 is excellent, values between 0.9 and 0.8 are great, values between 0.8 and 0.7 are good and values between 0.7 and 0.5 are mediocre. Meanwhile, for Bartlett’s test of sphericity the value must be <0.05. Table 1 indicates the value of both KMO is 0.913 and Bartlett’s test of sphericity is satisfactory for factor analysis. The result of scree plot and eigenvalues produced with 8 factors in Fig. 1. This is from linearity coinciding with 8 factors.

The result for factor analysis indicated that only 47 of the 64 generic risk factors influencing the contractor’s cost estimating in DB projects and these 47 of risk factors are grouped in to eight factors. These eight factors accounted for 65.477% of the total variance in responses which is above the 60.0% of variation (Hair *et al.*, 2009) recommended for terminating the factor extraction process. Table 2 presents the eight factor components of principal factors extraction.

Factor 1; Management risk: In this principal it consists of 13 components which is lack of project manager competency and authority, contractor lack of staff knowledge/experience, lack of teamwork, lack of design/build knowledge/experience/competency, lack of payment (delayed progress payment by owner to the contractor), inadequate cash flow by contractor, insufficient time for completion date, client financial capability, scope of work is uncertainty, lack of training on safety at site, lack of payment (delay progress payment by contractor to the sub-contractor), lack of information on safety at site and lack of coordination with sub-contractor. Management risk accounted for 14% of variance on risk factors influencing contractor’s cost estimating in the DB project. Management risk is the most important issues that need to take care on risk factors influencing contractor’s cost estimating in DB projects. It is essential to estimate that the department’s responsibility is to gather all the information from the contract department to establish the resources of finance, staff and labour required for a project, plus the availability of material and plant.

Table 1: KMO and Bartlett’s test

Bartlett’s test of sphericity			
Kaiser-Meyer-Olkin measure of sampling adequacy	Approx. χ^2	df	Sig.
0.913	10047.423	2016	0.000

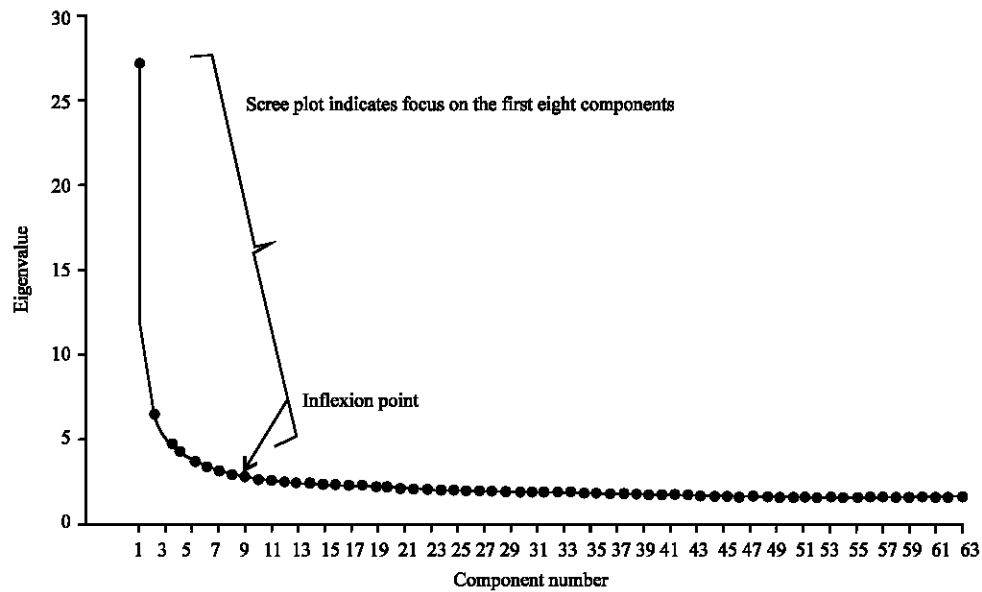


Fig. 1: The scree plot shows 8 factors >1.0

Table 2: Risk Factor influencing cost estimating in DB project

Risk factors	Factor loading	Variance (%)	Cumulative (%)
Factor 1: Management risk	-	14.184	14.184
Lack of project manager competency and authority	0.801		
Contractors lack of staffs knowledge/experience	0.774		
Lack of teamwork	0.719		
Lack of design/build knowledge/experience/competency	0.694		
Lack of payment (delayed progress payment by owner to the contractor)	0.621		
Inadequate cash flow by contractor	0.618		
Insufficient time for completion date	0.612		
Client financial capability	0.605		
Scope of work is uncertainty	0.556		
Lack of training on safety at site	0.549		
Lack of payment (delayed progress payment by contractor to the sub-contractor)	0.545		
Lack of information on safety at site	0.529		
Lack of coordination with sub-contractor	0.513		
Factor 2: Political risk		11.971	26.155
Slow approval permit by local authorities	0.878		
Slow approval permit by town planning department	0.866		
Slow approval permit by public work department	0.863		
Slow approval permit by BOMBA department	0.814		
Change in government policy	0.795		
Change in government regulations and law	0.756		
Political uncertainty	0.692		
Bureaucracy in government agencies	0.667		
Factor 3: Construction risk		10.517	36.672
Lack in availability of equipment	0.752		
Supplies of defective materials	0.742		
Late deliveries of materials	0.731		
Difficulties in availability of materials	0.727		

Table 2: Continue

Risk factor	Factor loading	Variance (%)	Cumulative (%)
Lack in availability of skilled labour	0.674		
Incompetent sub-contractors	0.600		
Lack on supervision of labour and works	0.542		
Factor 4: System risk		7.972	44.644
Insufficient time to evaluate tenders from sub-contractor	0.866		
Insufficient time in preparing tender documents to sub-contractor	0.831		
Insufficient time during request for proposal to sub-contractor	0.830		
Lack of information in drafting request for proposals to sub-contractor	0.625		
Lack in preparing method statement or shop drawings by contractor	0.584		
Lack of standardized systems during tender evaluation	0.511		
Factor 5: Variable risk		7.310	51.954
Tax rate exchange	0.751		
Inflation	0.740		
Catastrophes (act of God)	0.624		
Exchange rate fluctuation/devaluation	0.577		
Factor 6: Uncertainty risk		4.914	56.868
Unidentified utilities	0.764		
Unforeseen site condition	0.705		
Insufficient information of site access/right of way	0.521		
Factor 7: Design risk		4.389	61.257
Change of original design from client	0.718		
Insufficient of original design	0.689		
Errors of original design	0.645		
Factor 8: Project information risk		4.220	65.477
Rigid specifications in contract document	0.790		
Inadequate specification in contract document	0.610		
Insufficient information in contract document	0.517		

The competency of project manager is important to determine the level of efficiency achieved at construction site and the profitability of the project. Knowledge/experience of staff must complement with project type and quality expectation. It must be decided, as part of the cost estimating either to involve with new recruitment of new experience staff to suit with the type of project or just re-organization of the existing staff.

Client financial capability and inadequate cash flow by contractor is a serious issue on risk factor influencing contractor's cost estimating in DB project. Oyewobi *et al.* (2012) carried out their study that inadequate cash flow by contractor is the major risk and has significant impact on contractor's cost estimating. Enshassi *et al.* (2006) supported the assertion that contractors fail on financial due to the several reasons: depending on bank loan with high paying of interest rate, lack of experience in construction work, lack of capital, low profit margin due to compete of competition, award contract with lowest price and a few others.

Factor 2; Political risk: The second factor consists of 8 components that influence contractor's cost estimating in DB project, namely, slow approval permit by local authorities, slow approval permit by town planning department, slow approval permit by public work department, slow approval permit by BOMBA Department, change in government policy, change in government regulations and law, political uncertainty and bureaucracy in government agencies. Political risk accounted nearly 12% of variance on risk factors influencing contractor's cost estimating in the DB project. Slow approval of permit from government department will make a difficult situation to the contractor to start construction work. This should be noted that the permit acquisition process typically takes time and effort from all parties. It is because of design and construction is concurrent in DB projects. Obtaining approval of permit is a long-lead item that can affect the project objectives from the preliminary design to construction stage. Furthermore, some permit must be reissued before construction starts and this happens when the design diverges from the original plan. These issues occur before awarding the contract to a contractor and it continues after being awarded the contract. In this case a contractor must take full responsibility for any circumstances related to political risk and indirectly it can lead to project delay and cost overrun. Gransberg and Molenaar (2004) recommend that the clients must delineate both design and construction quality clearly in the RFP.

Factor 3; Construction risk: The third factor consists of seven components. These seven variables are lack in availability of equipment, supplies of defective materials, late deliveries of materials, difficulties in availability of materials, lack in availability of skilled labour, incompetent sub-contractors and lack on supervision of labour and works. Construction risk accounted nearly 11% of variance on risk factors influencing contractor's cost estimating in the DB project. The availability of equipment and material deliveries depends on how much effort and relationship of main-contractor to take care of sub-contractor and supplier. Good relationship with sub-contractor or supplier will avoid complication of situation of construction risk. Most of the projects face with lack of skilled labour availability. This happens as nowadays Malaysia faces currency drop therefore, the skilled labour shift to other countries. Meanwhile, the remaining ones also demand for high pay.

Competent sub-contractor is essential in DB projects. Akintoye (2000) indicates that almost 50% of work-done will be carried by sub-contractor. It is important for estimators to have detailed insights and knowledge when incorporation of subcontractors and suppliers (material and equipment) prices into the main contractor's estimate.

Factor 4; System risk: The fourth factor consists of 6 components namely insufficient time to evaluate tender from sub-contractor, insufficient time in preparing tender documents to sub-contractor, insufficient time during request for proposal to sub-contractor, lack of information in drafting request for proposal to sub-contractor, lack in preparing method statement or shop drawing by contractor and lack of standardized systems during tender evaluation. System risk accounted nearly 8% of variance on risk factors influencing contractor's cost estimating in the DB project. These risk factors consider influencing cost estimating however, it can be tackled and must be paid attention at early stage of construction project to ensure coordination of team work is not lacking.

Factor 5; Variable risk: The fifth factor consists of four components. These four variables are tax rate exchange, inflation, catastrophes (Act of God) and exchange rate fluctuation/devaluation. Variables risk accounted 7% of variance on risk factors influencing contractor's cost estimating in the DB project. The cost estimator in the estimating process must take into account the trends of market condition and the implication on the cost of the resources for the project. This variable risk is unavoidable; the contractors are encouraged to forecast economy to minimize the impact of price inflation, fluctuation and exchange rate. The stock pile of

construction material will help contractor reduce the impact of price inflation such as steel bar and raw material (Saaidin *et al.*, 2016). Contractors are encouraged to allocate a risk price for catastrophes (Act of God) in their contract tender. Anything happen to the project cost, the contractor will pay for losses.

Factor 6; Uncertainty risk: The sixth factor consists of three components. These three variables are unidentified utilities, unforeseen site condition and insufficient information of site access/right of way. Uncertainty risk accounted nearly 5% of variance on risk factors influencing contractor's cost estimating in the DB project. A common issue in DB projects is the level of uncertainty risk occurs during design and construction stage. Insufficient and limitation of information from client that makes a contractor allocates a high contract price by putting some amount in contingency sum. As a result, the price of contract increases. This is crucial risk factor for DB project. Uncertainty risk needs to be considered also during cost estimating in Request For Proposal (RFP) in DB projects. If the uncertainty risk is not properly reviewed, it may cause a major problem during construction stage.

Factor 7; Design risk: The seventh factor consists of three components. These three variables are change of original design from client, insufficient of original design and errors of original design. Design risk accounted 4% of variance on risk factors influencing contractor's cost estimating in the DB project. Mohamad *et al.* (2012) report that design risk is a common phenomenon in DB project which leads to claims and disputes. Changes, insufficient or error of original design from owner after a contract awarded that leads adjustment to the contract price and contract time. These design risks basically lead to unexpected rework of construction work also and can degrade the project performance. Yap claim that design risk is much affected to the project performance in Malaysia of low-cost air terminal Kuala Lumpur International Airport 2 (KLIA2) which has led to cost overruns and time overrun. The cost has increased due to new design concept from the initial RM 1.7 billion to RM 4 billion. Thus, the management strategies need a proper plan in preventing design risk happening during construction stage.

Factor 8; Project information risk: Eighth factor consists of three components. These three variables are rigid specifications in contract document, inadequate specification in contract document and insufficient information in contract document. Project Information risk accounted 4% of variance on risk factors influencing contractor's cost estimating in the DB project. Akintoye (2000) suggests that project information risk is less critical

in the United Kingdom context. However, Ling and Boo (2001) suggested that information of contract document is important in completing the construction projects. Insufficient information from contract document could lead to higher risk to the project objectives (Saaidin *et al.*, 2016). Communication among parties needs to be proactive and productive (Saaidin *et al.*, 2016). This is to prevent the miscommunication occur among them. Teamwork and supervision from project manager need to be improved.

CONCLUSION

The general view of construction industry in accuracy of cost estimating risk factors is crucial to all parties especially those involved in DB construction project. This is because of the combination of design and construction activities into one party responsibility. From the result of analysis gathered by using the factor analysis technique extraction shows that the 47 risk variables grouped into 8 risk factors need to be considered in influencing contractor's cost estimating in DB project. These are namely management risk, political risk, construction risk, system risk, variable risk, uncertainty risk, design risk and project information risk.

IMPLEMENTATIONS

This study is to help increase in understanding of contractors the importance of implementation of risk management process at early stage and to recognize the contractor on eight groups of risk factors considering in their cost estimating decisions.

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