



RISK ASSESSMENT ON DESIGN AND BUILD PROJECTS – A COMPARISON OF CONTRACTORS, CONSULTANTS AND OWNERS PERCEPTIONS

SABIHAH SAAIDIN¹, INTAN ROHANI ENDUT¹, SITI AKMAR ABU SAMAH², AHMAD
RUSLAN MOHD RIZDUAN¹, and NUR NABIHAH ABD RAZAK¹

¹*Faculty of Civil Engineering, Universiti Teknologi MARA, Shah Alam, Selangor*

²*Academy of Language Studies, Universiti Teknologi MARA, Shah Alam, Selangor*

Design and Build (DB) has been classified as the most risky project due to the complexities and uniqueness of the project itself. Appropriate identification, analyzing, controlling and monitoring for the project risk are required to minimize the risk in DB projects. It is essential that all parties play an important role in minimizing risk inherent in design and build projects. Therefore, this study has been carried out to conduct risk assessment on design and build projects by the comparison of contractors, consultants and owners perceptions. To achieve the objective, the survey questionnaire was distributed among contractor, consultant and owner, that were directly involved in design and build projects. A total of 128 useable questionnaires were received and analyzed using mean ranking, Kruskal-Wallis and Mann-Whitney Test. The result of these analyses shows that the contractors, consultants and owners have the same insight in risk factors presented namely: “client financial capability” and “inadequate cash flow by contractor”. There are no significant differences in between all parties except “bureaucracy in government agencies” and “inflation”. This study helps to increase understanding of contractors and owners on the importance of implementing risk management process at early stage of the projects.

Keywords: Construction, Procurement, Project risk, Stakeholder perceptions, Risk factors.

1 INTRODUCTION

Design and Build (DB) contract is an innovative procurement method whereby a single contractor is responsible for the design and construction to deliver a construction project to a client’s satisfaction (Akintoye and Fitzgerald 1995). Although the DB’s are expected to be faster and cheaper project delivery as compared to the others, not all the projects involved in DB procurement are accomplished on time (Oztas and Okmen 2004). Design and build projects are also exposed to the risks due to the unique features and complexity of the construction activities. In addition, this type of contract transfers more risk to the contractor than any other construction contract (Seng and Yusof 2006).

Literally, quite often the construction projects have failed to achieve the objectives of cost, time and quality due to the occurrence of unexpected events which the contractor has failed to identify, analyze and manage risk properly (Akintoye and Macleod 1997). Likewise, risk is being less concerned and almost non-existing in construction projects (Seng and Yusof 2006). However, it is essential that all parties play an important role in minimizing risk in DB project

(Akintoye and Macleod 1997). Therefore, this study has been carried out to conduct risk assessment on design and build projects with regard to contractors, consultants and owners perceptions.

2 RISK IN DESIGN AND BUILD PROJECTS

Design and build procurement method is a risky system of project delivery for both owners and contractors. It is due to the combination of design activity, on site supervision and participation in the actual construction project by different parties. Design and build procurement method is prone to several risks either borne by the contractor, owner or shared by both parties. Several empirical studies relevant to the risk factors influencing DB project were reviewed.

Banik and Hannan (2003) state that the allocation of risk comes from the owner and contractor or shared by both parties. A total of eight DB construction project risks was allocated to the owner of which site access/right of way, differing site condition, delayed payment on contract, unidentified utilities, permits and ordinances, change in work, Government Acts and Regulation and tax rate change and Acts of God. Furthermore, nine risks were identified among the twenty six risks that were allocated to the DB contractors. These were namely defective materials, quality of work, safety and accidents, contractor competence, defective design, labor disputes, establishment of a project cost, actual quantities of work and defensive engineering. Meanwhile, the risk factors shared by both the owner and contractor is contract delay resolution, indemnification and hold harmless, financial failure any party, change order negotiations and third party delay. Further research by Kartam and Kartam, (2001) supported the results apportionment of construction risk that also comes from owner and contractor or shared by both parties.

Financial capability is consider most important to an owner and contractor in DB projects. However, insufficient of financial capability will contribute to project risky. That is only the big scale companies can afford the financial cost and gain competitiveness at the bidding stage (Cheng 1995).

Oztas and Okmen (2004) have also indicated that the lack of experience and knowledge of owners and contractors contributed to risk in DB project. Therefore, the owner has a large role to play when deciding to use DB procurement method in minimizing the risk during construction project.

3 RESEARCH METHODOLOGY

Extensive literature review was undertaken to identify sources and types of risks in DB projects. Based on the literature, a research questionnaire was designed to elicit information from respondents such as owner, consultant, and contractor who have been involved in DB projects in Malaysia. A comprehensive list of 64 risks was identified and used in the questionnaire that was designed to get the perception of the construction practice in DB projects and only 10 risky factors were selected. The first section of the questionnaire solicited demographic information about the respondents. The second section consists of three parts of 64 risk factors. The two parts were related to the probability and impact of each risk factor in design and build project on a five-point Likert scale. The scale for risk probability ranged from 1 (low) to 5 (high). Meanwhile, the scale for risk impact ranged from 1 (insignificant) to 5 (catastrophic). A total of one hundred twenty eight (128) questionnaires were received from the owners, consultants and contractors. The results were analyzed by using Mean Ranking, Kruskal Wallis and Mann-Whitney Test.

4 DATA ANALYSIS AND DISCUSSION

4.1 Rank and Comparison of Risk Factors on Owner, Consultant and Contractor Perceptions

Based on the overall results, the risk factors in design and build project were shown in Table 1, all 64 numbers of risk factors analyzed and ranked accordingly to fulfill the objective of this study. The results only show the most ten risky factors on owner, consultant and contractor perceptions as indicated below.

Inadequate cash flow by contractor and client financial capability was given the first and second ranking on owner and consultant on their perceptions, instead of contractor's perceptions which has given client financial capability as the first ranking and followed by inadequate cash flow by contractor as the second ranking. It should be noted that financial capability is the most important in construction project as considered either by owner or contractor. Failure to that will affect the cost and time overruns. For example, Dada and Jagboro (2007) identified in their study, finance as one of the main risk factors that contributed to the construction project. These results opined by Kartam and Kartam (2001) financial capability was also at a higher rank of the survey risk in Kuwaiti. Enshassi *et al.* (2006) affirms the opinion further by agreeing that contractors could fail financially due to the following reasons: dependence on banks and paying high rates, lack of capital, and lack of experience in the line of work, cash flow management, low margin of profit due to competition, lack of experience in contracts and award contracts to the lowest price.

Insufficient time for completion date was given third ranking on the owner perception, while consultant and contractor perception was ranked seventh and eighth, which means the least ranked. Insufficient time for completion date may result from inadequate program scheduling planning, innovative design or contractors' lack of knowledge in planning construction programs. To minimize this risk, an informative program schedule should be worked out during the design stage together with the owner and contractors or project manager who is skillful in program coordination. The ability to manage construction programs may lead to the key criteria in appointing DB contractors (Ahmed *et al.* 1999).

Lack of payment (delayed progress payment by owner to the contractor) was ranked fourth and fifth on owner, consultant and contractor perceptions, respectively. This finding is consistent with literature in developing countries where the construction industry has always been closely related to the national economy (Frimpong *et al.* 2003). Adams (2008) reveals that lack of payment is the most important factor that brings to the project risks. Frimpong *et al.* (2003) have identified bureaucracy in Ghanaian government department as a contributory factor, coupled with the nature of the funding of projects which could either be through domestic savings or foreign funding. Unfortunately, for most construction organizations, the government is the main owner of the construction industry. There is so much bureaucracy in the government agencies that it takes ages for certificates to be issued for payments. Tuuli *et al.* (2007) observe that there is no form of compensation to contractors due to lack of payment.

Incompetent sub-contractors were fifth, third and tenth ranked on owner, consultant and contractor perceptions. This means that on consultant perspective the sub-contractor is one of the most important parties that will contribute to the risk in DB project. Meanwhile, for the contractor perspective it is the least risky. Responsibilities of sub-contractors normally allocate their manpower and resources to the project and supervise by contractor. Therefore, the competency and knowledge should be regarded as one of the key criteria for appointing sub-contractors to meet owner and contractor expectation (Ahmed *et al.* 1999).

Lack of design/build knowledge/experience/competency was ranked sixth by owner and consultant and contractor was ranked third. Meanwhile, contractor’s lack of staffs knowledge/experience was ranked eight by owner and consultant and ranked fifth by the contractor. Lack of project manager competency and authority was ranked ninth, tenth and seventh by owner, consultant and contractor perceptions. Lack of design/build knowledge / experience / competency was ranked third by contractor. It is important to note that the contractors should have sufficient knowledge, experience and competency because the contractor is a single entity taking the total responsibility of DB project.

Mistake during construction was ranked seventh by the owner and ninth and sixth by the consultant and contractor, respectively. Responsibility and experience of designer to determine the design correctly can help to illuminate the black box and minimize the mistake during construction to the contractors/subcontractors involved in the project. Inadequate or insufficient drawings information should be avoided by establishing an efficient communication scheme among the owner, consultant and contractor (Saaidin *et al.* 2016b).

Lack of payment (delayed progress payment by contractor to the sub-contractor) was ranked tenth by the owner and fourth and ninth by the consultant and contractor, respectively. Financial risks have an important impact on the firms and on the economy as a whole. Lack of payment can create a difficult situation to the subcontractor to carry out projects smoothly. Akintoye and Macleod (1997) have also acknowledged financial risk as having the most adverse consequences on the successful completion of the construction projects.

Table 1. Comparison of risk factors on owners, consultants, and contractors perceptions.

Risk Factors in Design and Build	Mean					
	Owner	Rank	Consultant	Rank	Contractor	Rank
Inadequate cash flow by contractor	4.000	1	4.200	1	4.260	2
Client financial capability	4.000	2	4.175	2	4.320	1
Insufficient time for completion date	4.000	3	3.950	7	4.020	8
Lack of payment (delayed progress payment by owner to the contractor)	3.895	4	4.025	5	4.120	4
Incompetent sub-contractors	3.895	5	4.100	3	3.920	10
Lack of design/build knowledge / experience / competency	3.868	6	4.025	6	4.200	3
Mistake during construction	3.868	7	3.925	9	4.080	6
Contractors lack of staffs knowledge/experience	3.816	8	3.950	8	4.120	5
Lack of project manager competency and authority	3.789	9	3.775	10	4.060	7
Lack of payment (delayed progress payment by contractor to the sub-contractor)	3.763	10	4.075	4	3.940	9

A number of discrepancies were observed between the ranking of three groups involved in the survey as discussed above. This necessitated investigating whether the overall ranking is applicable to the general population. This necessitated identifying the differences in the dataset that are statistically significant among three different parties. Therefore, Kruskal-Wallis H test was conducted to determine whether or several independent items come from the same population. The results of the test are illustrated in Table 2 on the perception of all three groups. Bureaucracy in government agencies ($p=.036<.05$) and inflation ($p=.027<.05$) were found with significant difference from each other on their perceptions. Kruskal-Wallis H test is a

compilation test statistic and based on the results it cannot tell which specific groups independent variables are statistically different from each other.

Table 2. Kruskal-Wallis Test on owner, consultant, and contractor perceptions.

Risk Factors	Mean			Kruskal-Wallis Test	
	Owner	Consultant	Contractor	Chi-square	p-Value
Bureaucracy in government agencies	3.026	3.550	3.400	6.624	0.036*
Inflation	2.974	3.450	3.460	7.239	0.027*

*Indicates that the p-value is less than 0.05

Furthermore, there were follow-up pair-wise comparisons using Mann-Whitney U test as in Table 3. The results show that the pair consultant-contractor has no significant difference on their perceptions with regard to bureaucracy in government agencies ($U = 901, z = -.843, p > .05, r = .399$) and inflation ($U = 991, z = -.078, p > .05, r = .938$); so the assumption is satisfied. However, the pair owner-contractor has significant difference when it comes to their perceptions with regard to inflation ($U = 678, z = -2.408, p < .05, r = .016$) and for bureaucracy in government agencies ($U = 745, z = -1.845, p > .05, r = .065$) have not shown significant difference in their perceptions. This means that the inflation has higher risk factor on contractor perceptions to DB project than owner perceptions. As this inflation risk is usually unavoidable, the price of construction materials is always changing in response to the inflation and the relation between supply and demand in the construction material market. According to Ahmed *et al.* (1999), inflation should best be shared among the parties between the owner and contractor by including in contract clauses which provide a clause to pay for fluctuation in labor wages. One fair way to deal with inflation is client should add the price fluctuation to the contingency premium in the contract document (Saaidin *et al.* 2016a).

The result of the pair owner-consultant has also shown a significant difference on their perception with regard to bureaucracy in government agencies ($U = 522, z = -2.497, p < .05, r = .013$) and inflation ($U = 544, z = -2.278, p < .05, r = .023$). Bureaucracy in government agencies and inflation risk has higher risk factor on consultant perceptions to DB project than owner perceptions. This risk is normally out of control of the project stakeholders. Bureaucracy in government agencies are always being complained by owner, consultant and contractor. To minimize the risk in bureaucracy, the stakeholders should create a friendly environment by communicating with each other as much as possible and to always adopt the strategies of maintaining close relationship with local government officers.

Table 3. Mann-Whitney Test on owner, consultant, and contractor perceptions.

Risk Factors	Perceptions					
	Owner	Consultant	Owner	Contractor	Consultant	Contractor
Bureaucracy in government agencies	Significant difference		No Significant difference		No Significant difference	
Inflation	Significant difference		Significant difference		No Significant difference	

5 CONCLUSION

This paper has presented the perception of owners, consultants and contractors on risk assessment in Malaysian DB project. The most top 10 risk factors were summarized in Table 1 and should be considered among the owners, consultants and contractors. Namely, the owners should possess the ability to clearly define the project scope to prevent insufficient time, have sufficient

financial capability, adequate competent and experience staff for the projects, and manage the contract and communication effectively. Meanwhile, for the contractors, they are required to have sufficient financial resources and DB project experience and corporate management capability. As key stakeholders in DB project, both owners and contractors should possess certain competencies to ensure the success of DB projects. The stakeholder's should work cooperatively to address the potential risk effectively from the feasibility phase onwards.

References

- Adams, F. K., Risk perception and Bayesian Analysis of International Construction Contract Risks: The case of Payment Delays in a Developing Economy. *International Journal of Project Management*, 26, 138-48, 2008.
- Ahmed, S. M., Ahmad, R. and Saram, D. D., Risk Management Trends in the Hong Kong Construction Industry: A comparison of Contractor and Owners Perception, *Engineering, Construction and Architectural Management*, 6(3), 225-234, 1999.
- Akintoye, A. S., and Macleod M. J., Risk Analysis and Management Construction, *International Journal of Project Management*, 15(1), 31-38, 1997.
- Akintoye, A., and Fitzgerald, E., Design and Build: A Survey of Architects' Views, *Engineering, Construction and Architectural Management*, 1, 27-44, 1995.
- Banik, G. C. and Hannan, F., Specialty Contractors' Perspectives on Risk Importance and Allocation of Design-Build Contracts. *Journal of Construction*, 2003.
- Cheng, R. T. L., Design & Build – Contractor's Role. *Design and Build Project – International Experiences International Congress on Construction, Singapore*, 1995.
- Dada, J. O. and Jagboro, G. O., An Evaluation of the Impact of Risk on Project Cost Overrun in the Nigerian Construction Industry. *Journal of Financial Management of Property and Construction*, 12(1), 37-44, 2007.
- Enshassi, A., Hallaq, K. and Mohamed, S., Causes of Contractors' Business Failure in Developing Countries: The Case of Palestine, *Journal of Construction in Developing Countries*, 11(2), 1-14, 2006.
- Frimpong, Y. Oluwoye, J. and Crawford, L., Causes of Delay and Cost Overruns in Construction of Groundwater Projects in Developing Countries: Ghana as A Case Study. *International Journal of Project Management*, 21, 321-26, 2003.
- Kartam, N. A., and Kartam, S. A., Risk and its Management in the Kuwaiti Construction Industry: A contractors' Perspective, *International Journal of Project Management*, 19, 325-335, 2001.
- Oztas, J. O. and Okmen. O., Risk analysis in fixed price design build construction projects. *Building and Environment*. 39,229-237, 2004.
- Saaidin, S., Endut, I. R., Abu Samah, S. A., M. Ridzuan, A. R. and Abd Razak, N. N., Risk Variable on Contractor's Tender Figure in Malaysia. *Journal Teknologi*, 78(5-2), 85-89, 2016a.
- Saaidin, S., Endut, I. R., Abu Samah, S. A. and M. Ridzuan, A. R., The Current Practice of Design and Build Procurement Process in Malaysia. *Social and Management Research Journal*, 13(2), 1-10, 2016b.
- Seng. N. W. & Md. Yusof. A., The success factors of design and build procurement method: A literature visit. *Proceedings of the 6th Asia Pacific Structural Engineering and Construction Conference. APSEC*. Kuala Lumpur, Malaysia, 2006.
- Tuuli, M. M, Baiden, B. K. and Badu, E., Assessment and Enforcement of Liquidated damages in Construction Contracts in Ghana. *Structural Survey*, 25(3/4), 204-19, 2007.