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Critical Risk Factors of Design-Build Projects in Vietnam

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Abstract

Nowadays, many owners have been using different contract approaches to carry out their investment projects. The design-build system is also a relatively common method of implementing projects because it helped domestic construction enterprises, and consultants have access to a new form of project management with high professionalism because of their ownership in all aspects of consultancy and construction services. Although the design-build contract system may bring practical benefits when implementing a project, there are still many potential risks that need to be considered carefully by the project management unit when selecting it. This paper applies a fuzzy decision-making approach, namely the Fuzzy Analytical Hierarchy Process (FAHP), to evaluate critical risk factors affecting the implementation of design-build projects in Vietnam.

Keywords: *design-build (DB); critical risks, project management; construction management; Vietnam*

1. Introduction

Vietnam is a developing country with a fast-growing economy in the Asian region (Ha, 2013; Ha & Nguyen, 2014; Nguyen, 2018; Nguyen & Khoa, 2019; Nguyen, 2011; Nguyen & Khoa, 2019b; Vo et al., 2019). This has facilitated many forms of investment projects for construction and infrastructure development (Diem & Ha, 2013; Ha, Le, & Trung-Kien, 2019; Ha & Tam, 2015; Nguyen & Khoa, 2019a; To et al., 2019). The design-bid-build (DBB) method is a commonly used model because it is popular in different countries and applied in many different types of engineering and construction projects (Hale et al., 2009; Nguyen & Nguyen, 2020). However, that approach has a large amount of project management workload and potential uncertainties and risks. Meanwhile, design-build (DB) method is another optional solution. Design-Build is a new project implementation method that is widely used in the world (Bastias & Molenaar, 2011). It helps owners to shorten the process of project management because the contractor is more active in all stages of the implementation process. For owners, the selection of project distribution systems in the past is mainly based on their own experience. In fact, 80% of project managers still depend on their subjective views or personal experience to weigh risks without evaluating risk strategies systematically and effectively, and this is still an available option for project distribution systems (Ramakrishnan et al., 2020; K. D. Vo et al., 2019).

For complex and high-risk construction projects, the owners often minimize risks by applying a number of strategies, such as using a project transfer system to transfer or share risks with other

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project stakeholders (Do et al., 2017; Do et al., 2016; Nguyen, Likhitruangsilp, & Onishi, 2017). Risks can be strategically controlled to a certain extent, thus, by means that allow risks to be transferred or shared with other parties of the project (Nguyen & Nguyen, 2020). The project transfer system is a bidding method by which customers transfer or share risks to other project stakeholders. These stakeholders are usually design units in charge of the design and contractors in charge of construction (Liu, Xie, Xia, & Bridge, 2017; Öztaş & Ökmen, 2004). Although the design-build contract may bring practical benefits when implementing a project, there are still many potential risks that need to be considered carefully by the project management unit when selecting it. Therefore, this paper presents critical risk factors affecting the implementation of design-build projects in Vietnam.

2. Literature Review

Öztaş and Ökmen (2004) showed that the design-build form has certain advantages because the contractors are not only responsible for design but also directly implement the construction. However, the form also brings certain risks to the owners and contractors if the risks are not identified, analyzed, and strictly managed during project implementation. By using a Monte Carlo simulation and Microsoft Project, the risks of the project's progress and costs of a design-build form from Turkey were analyzed. Ling (2004) has identified four groups of factors that improve the management and control of design-build project performance. These four groups include 11 evaluation criteria. The four groups are (i) costs (unit price, inflation, and unit price over time), (ii) time (construction period, average construction period, and implementation progress), (iii) quality (revenue, quality management system, and management of equipment quality), and (iv) owners (financial burdens of owners and their satisfaction). The author also pointed out the important determinants influencing the evaluation criteria and proposed measures to better manage the projects to improve the chances of a project's success.

Shen, Wu, and Ng (2001) identified 58 risk factors affecting joint venture projects in the Chinese construction industry. They were categorized into six groups as follows: finance, legality, management, market, policy, and technology. Among the ten most influential risk factors, five factors belonged to the management group, two belonged to the market, two belong to the policy, and one referenced technology. The authors identified the three most important risk factors as (i) cost increases due to policy changes, (ii) inaccurate pre-feasibility studies, and (iii) delays. Then, the authors proposed several risk management strategies such as improving cooperation with local governments, hiring contractors to control risks completely, and controlling risks using technical factors.

Using the perspective of the owner, Tsai and Yang (2010) used fuzzy numbers to simulate changes in rankings and assess the level of project risks. Such risks include natural phenomena, the financial situation, socio-political regimes, domestic industry characteristics, contractual difficulties, construction implementation difficulties, safety, and environmental sanitation issues, and the difficulties caused by owners, design contractors, and construction contractors. They also identified risk factors in risk management that depends on the attitude of the decision-makers (optimistic, neutral, or pessimistic). Therefore, for our research information, each different decision-making environment must be identified.

By presenting a risk distribution chart from a risk management perspective, Powell (1996) showed project distribution systems that are thought to be the most effective strategy allowing risks to be transferred and shared. Several previous studies have been conducted to assist project managers in selecting project transfer systems. Gordon (1994) used the project distribution

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system selection evaluation index to eliminate inappropriate project distribution systems and retain appropriate systems for the projects. Spink (1997) categorized considerations for selecting project distribution systems. The first was composed of the considerations for available conditions to customers, project distribution system evaluation index as reference for the owners in the selection of project distribution systems. Al Khalil (2002) applied AHP to calculate the weight of the project distribution system evaluation index as a reference for the owners in the selection of project distribution systems. Konchar and Sanvido (1998) applied a multivariate regression analysis method to compare the advantages of DBB and DB models according to the indicators of cost, transfer, and quality. In addition, Ling, Chan, Chong, and Ee (2004) compared the advantages and disadvantages of DB and DBB models according to the construction schedule and project completion schedule.

3. Research Methodology

The fuzzy set theory deals with uncertainty due to inaccuracy, unclearness, and ambiguity (Phong, Phuc, & Quyen, 2017). The following steps present the evaluation process of the weights of critical risk factors (Gad-Elrab, Alzohairy, & Alsharkawy, 2015; Gulzar et al., 2018a; Gulzar et al., 2018b; Nguyen et al., 2018; Nguyen & Quyen, 2017; Quyen, Nguyen, & Huynh, 2017; Nguyen et al., 2016):

Step 1. The pairwise comparison matrices to evaluate critical risk factors can be obtained by using expert input.

Step 2. We calculated the components of the synthetic pairwise comparison matrix by using the geometric mean method suggested by Buckley:

$$\tilde{a}_{ij} = (\tilde{a}_{ij}^1 \otimes \tilde{a}_{ij}^2 \otimes \tilde{a}_{ij}^3 \otimes ... \otimes \tilde{a}_{ij}^n) \quad (1)$$

where $\tilde{a}_{ij}$ is the fuzzy comparison value.

Step 3. To calculate the fuzzy weights of critical risk factors, we need to calculate (Buckley, 1985; Hsieh, Lu, & Tzeng, 2004):

$$\tilde{r}_i = (\tilde{a}_{i1} \otimes \tilde{a}_{i2} \otimes \tilde{a}_{i3} \otimes ... \otimes \tilde{a}_{in})^{1/n} \quad (2)$$

Moreover, for the weight of each factor:

$$\tilde{w}_i = \tilde{r}_i \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \tilde{r}_3 ... \oplus \tilde{r}_n)^{-1} \quad (3)$$

where $\tilde{w}_i$ is the geometric mean of the fuzzy comparison of the i[th] factor, which is indicated by a triangular fuzzy number $\tilde{w}_i = (Lw_i, Mw_i, Uw_i)$.

Step 4. For defuzzified the fuzzy weights, in this research, we applied the following CoA method (Vahdat, Smith, & Amiri, 2014):

$$BNP_{w_i} = [(U_{w_i} - L_{w_i}) + (M_{w_i} - L_{w_i})] / 3 + L_{w_i} \quad (4)$$

where BNP_{w_i} is the Best Nonfuzzy Performance (BNP) value of the fuzzy weights of the i[th] factor.

4. Results and Discussion

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The unsuitable responsibilities and risks allocation were the crucial elements in design-build projects. The owners often claim that they are rarely free to determine the execution or results of the final product. Through a project management unit, an owner can participate in the project consultancy in order to meet requirements and their technical guides (Likhitruangsilp, Malvar, & Handayani, 2016; Quyen, Phong, & Vy, 2017; Sy et al., 2017). Therefore, the design-build contractors need to be careful about ensuring their rights by notifying the owner of the compensation requirements if progress is delayed, or there are damages because the requirements and instructions of the owner are changed too quickly and too much. In fact, the owners may not recognize that their introduction of so many detailed instructions actually means that they have done the part of the work which they had paid the contractor for. In other words, they are damaging their contractual position while intervening too intensively in the design department, especially when the design has already been delivered completely to the contractors for execution.

Besides, in the design and construction phases in a design-build contract, the purpose is to shorten the project execution duration, so only passing through a responsible major focal point is the contractors. The contractors are entitled to control all the issues, but there may be an interruption of responsibilities by the supervision consultants of the client about the design revisions, construction method, and specifications (Tsai & Yang, 2010). Although the contractors always try their best be to meet these requirements, the client's consultancy often causes conflicts. In order to solve this problem, the contractors need to hold a discussion with the owner to agree about one solution, for example, extension. Another remedy is to ensure that the main contractors can freely carry out the project tasks and do not have to work too much with the stakeholders, because this can put great pressure on the project executors. All the stakeholders in the project are also required to acquire knowledge, sympathy, experience, and to establish their duties and responsibilities in deploying the design-build contracts.

In fact, many contractors in Vietnam only focus on developing one of the fields such as consulting, installation, or supply of equipment, so the experience in executing the design-build projects is quite restricted (Huynh et al., 2019). In particular, their capacity to design and construct, organize, and manage them is not professional, since they do not have general knowledge. The contractors' capacity and experience are also shown in the accurate, reasonable, and economical coordination between the design alternatives and the construction methods that the contractors recommend (Nguyen, Nguyen, Nguyen, & Huynh, 2018). The design-build contractors may carry out some tasks of coordination and project management on behalf of the owner. The contractors are responsible for chaining the processes, the components in the series of project tasks including procurement, fabrication, and supply of technological equipment that meet requirements and progress points of a contract, selecting the subcontractors (if any), etc. (Haseeb et al., 2019; Nguyen et al., 2018; Nguyen et al., 2019; Phong et al., 2017). Therefore, using the design-build method, the contractors may promote their creativity as well as seize the opportunities to develop in their business sector. However, a lot of privileges and significant duties are assigned to an incompetent contractor, and unclear allocation of duties by the owner is a considerable risk to the owner as well as to the project. Because of this, the bidding process for contractor selection must emphasize that a low bid does not mean a qualified contractor and that the contractor selected must be fully vetted (Rizkan et al., 2019; Vina et al., 2019).

Next, because the form of design-build is still quite new in Vietnam, the operation and management mechanism has not been completed. The owner and the project management unit have been not fully promoted to their roles, and the coordination with the contractors has not

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been good. In principle, A design-build contractor is responsible before the law and the owner for the quality and schedule of the work under the contract signed, including the work done by the subcontractors. Owners take the main responsibilities before the law for the implementation of the regulations in the management of investment and construction projects, for the quality, schedule, costs of implementation as well as the efficiency of investment capital use, not the contractors (Ling & Hoang, 2009; Luong, Tran, & Nguyen, 2018). Therefore, the owner must actively play its role in the management and decision-making, seek solutions and handle variations in the course of organizing and managing the project implementation. Thus, an owner must be experienced, professional, knowledgeable in many fields and have a comprehensive overview. However, the current situation in Vietnam shows that many domestic owners are only familiar with the management of each individual bidding package but do not have experience in overall management, especially for new high-tech and advanced projects. Another problem is that the promotion of construction managers by owners is not reasonable, so they have made many errors in construction procedures. Even leaders of units are not aware of their authority and responsibility in construction investment.

On the other hand, the project management unit must play its role in supporting the owners' management and operation of the project, and inspect, supervise, assess quality, implementation schedule, and regularly coordinate with the owner, and the contractor to ensure the quality and progress of the project (Linda et al., 2019; Nguyen et al., 2016; Nguyen et al., 2018). In addition, due to lack of experience among consultants and supervisors, the capacity of the project consultant team is weak and untrained, and when put into practice, projects often face difficulties in the on-site treatment. The proposals are not appropriate, fail to meet the requirements, and the project objectives. The organizational structure and decentralization in the consultation and use of resources are unreasonable, causing waste and delays in implementation, increasing investment costs for the project. In particular, it affects the quality of the work, fails to ensure timely completion, but also greatly affects the overall goals of a project.

Contractors using inferior or substitute materials is an issue of contractor ethics (Bowen, Akintoye, Pearl, & Edwards, 2007). The contract of design-build projects is usually a fixed-price contract, so when the contractor is awarded the bidding package by the owner thanks to the competitive price (by offering bidding price less than the package value), one of the common violations of the contractors is to lower the quality of materials or use alternative materials to gain profit from fixed-price contracts. During the design process, the contractors deliberately use available materials or special types of supplies that are difficult to find the suppliers in the market (Nguyen et al., 2018). This is, in fact, very difficult to control when the owner does not have effective quality management and monitoring models. Because there is no assessment on the price of materials, contractors can provide high-quality criteria and low prices to win the bid. However, during construction and installation, contractors will reduce the quality, categories and origin to bring inferior quality equipment and materials to the works to offset costs and gain part of the profits. Others are less interested in overall quality, which can lead to the risk that the project fails to meet the standards and quality required by the owner. The Quang Ninh thermal power plant project in Vietnam is an example. In the bidding documents, the owner has specified the size of the pile foundation for the plant, but the Chinese contractor conducted a smaller size.

Furthermore, Chinese contractors brought wires with a cross-section smaller than specified in the contract (Huynh et al., 2017). After being detected by owners and supervisors and not allowed to install, they temporarily put it outside, but when the owner left, they still used these materials for installation in Na Duong power project, owner designed the plant foundation plan as a reinforced

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concrete bored pile for excellent durability, but the contractor constructed raft foundation for both being cheap and fast. This will really greatly affect the quality of the whole project and the reputation of the contractor as well as the trust of the owners.

Besides, in the design-build form for international contractors, they are entitled to take initiative to reduce the use of domestically produced goods and materials as well as domestic hiring from the domestic labor force, unless otherwise specified in the contract terms. Thus, some of the socio-economic objectives that were to be achieved such as increasing employment, improving domestic industrial production-consumption, and developing the qualifications and experience of officials and workers in Vietnam are not achieved (Haseeb et al., 2019; Huynh et al., 2018; Huynh Phuc et al., 2017; Nguyen, et al., 2017). Many foreign general contractors prepare designs and cost estimates at a high level, add in more non-contractual volumes to adjust contract prices, and make it difficult for owners to control costs. Moreover, there are cases where the supervision consultant colludes with the contractor to reduce the quality of the project due to a lack of capacity and responsibility. The owner must then pay an additional cost to repair the works during the operation and the value of the project is also reduced.

5. Conclusion

The design-build contract provides a single standard interface in projects for both design and construction, especially in projects with clearly defined goals before construction. Although this approach helps owners to simplify management interface throughout the project life cycle, it still has certain risks in real practice. So this paper presents critical risk factors affecting the implementation of design-build projects in Vietnam based on the evaluation of experienced experts via a fuzzy decision-making approach. Recognizing these risks will help the owner and the contractors devise effective risk response strategies.

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