Success Factors for Project Risk Management in Construction Projects: A Vietnam Case Study

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Despite being one of the oldest industries in human history, the modern construction industry is still suffering from delays, cost overruns, and low satisfaction levels. As construction activities greatly contribute to economic growth for any nation, the study of how to achieve success in construction projects should be continuously developing and attracting scholars’ attention. The Vietnam Construction Industry (VCI) is no exception. The economy in Vietnam has been growing fast and steady with significant contributions from construction activities. The VCI also faces unique risks pertaining to the conditions of developing countries that require a separate study on project risk management strategies. This paper focuses on a survey that is adopted from 23 Critical Success Factors (CSFs) pertaining to common construction risks in the VCI. Factors were found through extensive literature reviews, and inputs were solicited from 101 VCI participants. The participants ranked those CSFs with respect to impact to project success. The study reveals the top five impactful CSFs such as all project parties clearly understand their responsibilities, more serious consideration during contractor selection stage, test contractors’ experience and competency through successful projects in the past, project team members need to be well matched to particular projects, and promote pre-qualification of tenders and selective bidding. Spearman’s rank-order correlation tests determined no significant differences between the participating groups. Factor analysis was conducted to explore the principal success factor groupings and yielded four outcomes – Improving Management Capability, Adequate Pre-Planning, Stakeholders’ Management, and Performance-based Procurement. The findings lay the foundation to understand project management in developing countries and assist project managers in planning and forming strategies to ensure high performance in their projects.

Keywords: Construction Industry Risks, Risk Management, Project Management, Developing Countries, Critical Success Factors, Relative Importance Index, Factor Analysis, Vietnam

Introduction

The construction industry is one of the most important industries to the economy of any nation. It contributes to the economic growth, delivers jobs and provides critical infrastructure (e.g. healthcare facilities and transportation network) to support the growth and development of various economic sectors. While the construction industry is one of the oldest industries in any civilization, the modern construction industry (even the ones in the developed countries) is still marred with risks that results in project schedule delays, budget overruns, and low quality (Rivera et al., 2017). Hence, the study of how to achieve success in a construction project has never stopped developing and has continuously attracted scholars.
Once regarded as an economic disaster, Vietnam is now emerging as the latest East Asian growth engine which attracts the attention of global investors. Today, Vietnam is currently among the countries with the highest gross domestic product (GDP) growth rates. In 2002, GDP growth in Vietnam hit 7% (high) and recorded the fastest economic growth in Southeast Asia. In 2007, the GDP kept growing to 8.5%, marking the third consecutive year above the 8% benchmark for this small country (Ling & Bui, 2010; Long et al., 2004). That was an all-time high record in terms of growth rate, placing Vietnam second only to China in the Asia region. In 2009, Vietnam was one of the only South East Asian emerging economies not to have gone into a recession during the 2008 U.S. financial crisis. Since 2013, GDP growth has been recovering and increasing above 6% on average until now. In comparison, the U.S. GDP growth has been 3.2% on average in the past 10 years.

The construction sector accounts for the significant economic growth in Vietnam. The Vietnam Construction Industry (VCI) has been growing at 15% annually for the past 10 years. In 2002, VCI comprised 39% of the GDP growth rate. In 2011, VCI increased its contribution to 41.1%. Thanks to the promotion of industrialization from the Vietnamese government and infusing of foreign investments through the Official Development Assistance (ODA) program, construction growth rate has been healthy and consistent over the years (Nguyen Duy et al., 2004; Khanh & Kim, 2014; Luu et al., 2008). However, despite large growth and increasing demand for construction, multiple research efforts in the past 15 years, with the most recent one conducted by Le et al. (2019), have identified that there are still risks existing in the VCI that hinder performance. It is therefore imperative to develop and conduct research on risk management solutions for common risks in Vietnam. Particular attention is given to the development of factor models for enhancing the VCI project performance, and potentially construction industries in other developing countries.

**Objectives of the Study**

The main research objective is to identify success factors that could address common risks and improve project performance in the VCI. The research first identified the success factors through extensive literature review for developing countries, and prior research in the field. After which, the research team determined how different construction stakeholders rank the success factors, and how they perceive their impacts. The analysis finally identifies and models the potential relationships between those factors. The results are simplified factors that can be used to improve project management capability in the VCI. Other countries that face similar construction risks as Vietnam may also find the results useful.

**Literature Review**

Despite different perceptions of success among project participants, construction projects are widely acknowledged as successful when it is delivered on time, within budget, in accordance with specifications and to stakeholders’ satisfaction (Sanvido et al., 1992). Critical Success Factors (CSFs) are certain conditions when achieved would lead to such success, defined by Rockart (1982) as: ‘those few key areas of activity in which favorable results are absolutely
necessary for a manager to reach his/her goals’. The CSF methodology attempts to identify the key areas that are essential for management success and has been utilized in financial services, information systems, manufacturing industry, and construction management (Li et al., 2005). Other functions of CSFs include: to guide an organization in strategic plans development, to form strategies, to identify critical issues and risks associated with a plan, and to help achieve high performance (Nguyen Duy et al., 2004).

In 2019, Le et al. revealed twenty-three common risk factors in developing countries and conducted a case study about their relative impacts in Vietnam. To develop an effective framework to manage those risks, the authors attempt to identify CSFs pertaining to them. The following CSFs have been found through extensive literature reviews and case analysis from published journals:

- **CSFs related to procurement practices:** more serious consideration during contractor selection stage (Le-Hoai et al., 2008; Koushki et al., 2007; Toor & Ogunlana, 2010), promote pre-qualification of tenders and selective bidding (Long et al., 2004), change tender selection philosophy from "lowest-price wins" to select the most responsive contractor based on preset criteria (Luu et al., 2009, Sambasivan & Soon, 2007, Lo et al., 2006), test contractors’ experience and competency through successful projects in the past (Le-Hoai et al., 2008, Sambasivan & Soon, 2007), select designer based on experience and past performance (Thuyet et al., 2007, Yakubu & Sun, 2010), simplify bidding process (Thuyet et al., 2007), save time and cost during the bidding process (Long et al., 2004), and improve contracts to equitably allocate risks between parties (Le-Hoai et al., 2008, Faridi & El-Sayegh, 2006, Sambasivan & Soon, 2007).

- **CSFs related to performance assessment:** measurable projects performance (Khanh & Kim, 2014, Frimpong et al., 2003), create practical models to assess the changes of schedule and cost (Le-Hoai et al., 2008; Lo et al., 2006; Yakubu & Sun, 2010; Toor & Ogunlana, 2010), and measurable construction company’s performance for improvement (Luu et al., 2008, Lo et al., 2006).

- **CSFs related to management:** introduce effective construction management (Long et al., 2004; Lo et al., 2006; Faridi & El-Sayegh, 2006; Frimpong et al., 2003; Yakubu & Sun, 2010), all project parties clearly understand their responsibilities (Khanh & Kim, 2014; Koushki et al., 2007; Lo et al., 2006; Faridi & El-Sayegh, 2006; Frimpong et al., 2003; Yakubu & Sun, 2010), project team members need to be well matched to particular projects (Thuyet et al., 2007), and adequate resources invested in the pre-construction phase (Lo et al., 2006, Sambasivan & Soon, 2007).

- **CSFs related to other high impact issues:** have a plan to assist inexperienced owners (Thuyet et al., 2007), effective communication between owner and designer (Thuyet et al., 2007), select high performing consultants to evaluate design works (Thuyet et al., 2007; Koushki et al., 2007), owners understand their responsibility for timely payment to contractors (Le-Hoai et al., 2008; Sambasivan & Soon, 2007), all project parties, especially contractors, understand their responsibility to provide materials on time (Le-Hoai et al., 2008; Sambasivan & Soon, 2007; Yakubu & Sun, 2010), good relationships with both central and local governments (Thuyet et al., 2007), projects are inspected by government officials (Ling & Bui, 2010, Faridi & El-Sayegh, 2006), and foreign experts are involved (Ling & Bui, 2010).
While these CSFs were identified, their relative importance to one another has yet been determined. They could all be considered important, but some could have higher impact to success than others. Hence, it is prudent to attempt ranking them in terms of impact to project performance and attention should be given to them during project development. Additionally, the interrelationships among the CSFs should be revealed so the findings of this study could be readily and consistently applied for future projects (Nguyen Duy et al., 2004).

**Research Methodology**

This research uses a field survey as its key research method to collect data pertaining to the research objectives. The survey collects data from various construction stakeholders pertaining to the application of various strategies and practices that impact construction performances, particularly, time, cost overrun and client satisfaction. The survey was designed using the 23 CSFs identified from the literature. The survey also aimed to identify the relative impact that those CSFs had on construction project performance. The five-point Likert scale of 0 to 4 measured the respondents’ perception of the impact each CSF has on project success. The numerical values assigned for the Likert Scale are as follows: ‘0 – No Impact, 1 – Mild, 2 – Moderate, 3 – Very, 4 – Extremely’. The respondents had the option to include additional CSF they personally pursued but was not included in the initial 23 CSFs.

The survey was validated before it was distributed. Four (4) construction industry experts were identified and participated in the validation exercises. The experts included a civil engineering/construction engineering professor, a practicing contractor, and two owner representatives. These experts had at least 15 years of experience in the industry at the time of the validation test. The experts were requested to critically review the structure and content of the questionnaire, and recommended changes to the originals. Their recommendations are incorporated into the final questionnaire which was then sent to the selected survey participants in Vietnam. The participants are divided into “Owners”, “Contractors” and “Consultants”, and they were either sent an email with a link connected to the survey or physical mail to their offices. The online survey was developed using Google Survey and printed copies of the survey forms were mailed out with return envelopes enclosed. Completed surveys were compiled online and physically from the returned mails. The surveys were returned within a month after they were mailed out.

The collected surveys were quantitatively analyzed using IBM SPSS Statistics v25. The research team employed the following techniques:

1. Cronbach’s alpha coefficients to test internal consistency of the results.
2. Relative Importance Indexing to rank the CSFs based on response ratings data.
3. Spearman’s rank-order correlation coefficient to determine the degree of agreement of rankings between each responded group.
4. Factor analysis to derive interrelationships among the CSFs.
Data Collection

The survey was sent to over 300 construction professionals from three stakeholder groups in Vietnam. These professionals were selected from companies that faced the highest risk factors, such as the type, complexity and size of the construction projects. These companies were involved to determine their perspectives in managing those risks. The research team avoided companies that were involved in low-risk projects, such as renovation and structural repairs where cost and budget are less volatile, and project risk management practices are standard and straightforward.

Nearly half of the surveys were returned (140). Of the 140 surveys that were returned, incomplete surveys were eliminated from the responses. Thirty-nine (39) surveys were removed from the analysis as a result. A total of 101 completed surveys remained for further analysis (described in Table 1). While the total response rate was around 47%, a total of 33.7% of the invited surveys were used for the analysis.

Table 1: Project Complexity Factors

| Demographic Characteristics | Responses | %  |
|-----------------------------|-----------|----|
| Groups                      |           |    |
| Owners                      | 44        | 43.6% |
| Contractors                  | 35        | 34.7% |
| Consultants                 | 22        | 21.8% |
| Industry Experience         |           |    |
| 0 - 5 years                 | 18        | 17.8% |
| 6 - 10 years                | 17        | 16.8% |
| 11 - 20 years               | 41        | 40.6% |
| Over 20 years               | 25        | 24.8% |
| Project Types               |           |    |
| Commercial / Residential    | 62        | 61.4% |
| Infrastructure / Heavy Civil| 21        | 20.8% |
| Industrial                  | 18        | 17.8% |
| Project Sizes               |           |    |
| < $1M                       | 22        | 21.8% |
| $1M - 5M                    | 45        | 44.6% |
| > $5M                       | 34        | 33.7% |

Among the 101 returned surveys, 44 respondents worked for owners (43.6% of the responses), 35 for contractors (34.7%), and 22 for designers and/or consultants (21.8%). The majority of participants held high level managerial positions, such as project managers, directors or associate directors. The respondents’ mean years of relevant experience in the construction industry is around 16 years. The experienced profiles and the management roles of the respondents would likely translate into reliable results and thus enhance the quality of the findings. The participants did not make any significant contributions of new CSFs to the survey and concluded that the initial 23 CSFs generally describe their risk management approach to success.
Data Analysis

The research team used the following techniques:

1. Cronbach’s alpha coefficients to test internal consistency of the results.
2. Relative Importance Indexing to rank the CSFs based on response ratings data.
3. Spearman’s rank-order correlation coefficient to determine the degree of agreement of rankings between each responded group.
4. Factor analysis to derive interrelationships among the CSFs.

These are described in the following subsections, and the analysis will follow.

*Cronbach’s Alpha Coefficients*

The Cronbach’s Alpha Coefficients of the internal consistency reliability tests for impact ratings of the survey results are 0.940. Litwin & Fink (1995) suggested that consistency is high when Cronbach’s alpha is above 0.7. This confirmed that there is high internal consistency among the answers.

*Relative Importance Indexing*

The survey results were analyzed using Relative Importance Index previously used in several studies (Kaming et al., 1997; Le-Hoai, 2008; Doloi, et al., 2012). This index measures the impact of each CSF to project performance. It is computed with the following formula:

\[ RII = \frac{\sum a_i n_i}{4N} \]

\( a = \) the weight assigned to each response (as in this research, a range of 0 for “No Impact” to 4 for “Extremely”), \( n = \) frequency of occurrence for each response, and \( N = \) total number of responses.

*Ranking and Analysis of CSFs*

The calculations of RII and the rankings of the twenty-three (23) CSFs identified in the questionnaire are presented in Table 2 which shows overall that 10 factors scored RII values higher than 0.7, 10 factors scored RII values between 0.6 and 0.5, and three factors scored RII values between 0.5 and 0.4. Each CSFs are then further investigated:

The first ranked CSF emphasizes that ‘All project parties clearly understand their responsibilities’ (Table 2: RII value 0.745; ranked first overall). This suggests that project stakeholders should be aware of what they are responsible for at all times to ensure timely actions and quality results. This applies to contracted parties such as contractors, suppliers, and consultants, as well as (but not limited to) owners for timely approvals and payments, and local government for permit approvals and inspections. The best time to achieve this CSF is before the project starts. Kashiwagi (2019) recommends a clarification period between contractor selection
and project execution for this purpose. During clarification period, contractors will present their plans from beginning to end to all stakeholders along with expected responsibilities for each party. The contractors will also estimate the time and cost deviations to projects whenever a party fails to meet their responsibilities. The stakeholders will then provide feedback to adjust and finalize the plan before it becomes part of the contract. Such practices allow all project parties to understand their roles and responsibilities at the beginning to act and cooperate accordingly as the project develops.

‘More serious consideration during contractor selection stage’ is considered the second most important CSF (Table 2: RII value 0.738; ranked second overall). Vietnam and other developing countries have been criticized for having inefficient bidding and low-bid practices. Selected contractors are often unable to deliver projects on-time and within budget. An innovative, strategic and proven tendering approach is therefore critical to ensure project success.

One way to improve tendering quality is to ‘Test contractors’ experience and competency through successful projects in the past’ (Table 2: RII value 0.735; ranked third overall). A contractor with inadequate experience is likely incapable to plan and manage projects properly, and that could lead to disastrous consequences (Sambasivan & Soon, 2007). As Vietnam is still in development, contracting and consultancy firms have been mushrooming the industry on a daily basis, but quantity does not always mean quality (Le-Hoai et al., 2008). Therefore, experience and success in past projects should be considered in selecting contractors.

Workers that will be working on projects should also be tested to confirm that ‘Project team members need to be well matched to particular projects’ (Table 2: RII value 0.735; ranked fourth overall). Competent project managers and competent project teams hold vital roles in successful projects; however, the quantity and quality of such human resources are still very scarce in Vietnam and probably other developing countries (Le-Hoai et al., 2008). In order to win a project, companies may present their best teams while bidding but assign the project to less experienced groups after receiving the contract. Owners should request profiles of project team members and their time involvement during the project as part of the bidding submission. Those documents will be compared with project requirements to ensure that team members are qualified and capable to successfully deliver projects.

‘Promote pre-qualification of tenders and selective bidding’ is another important CSF (Table 2: RII value 0.728; ranked fifth overall). In general, this term means that the owner is inviting short-listed contractors to bid on the project. This practice is an alternative to open competitive bidding and sometimes proves to save time and cost for the owner (Long et al., 2004). Since inexperienced owners do not have enough expertise to shortlist the contractors by themselves, they should consult an expert before considering selective bidding. Nevertheless, this practice has yet been taken full advantage of by Vietnamese owners (Long et al., 2004).

Similar to selecting contractors, owners should consider to ‘Select designer based on experience and past performance’ (Table 2 RII value 0.728; ranked sixth overall). Le et al. (2019) observed that domestic and foreign design firms in Vietnam had been encountering design issues that led to change orders and inaccurate estimates throughout projects. Possible causes of those design
issues are the owners’ lack of experience and uncertainty in what they want. Those risks could be minimized and mitigated by an experienced designer with proven past performance.

Other CSFs pertaining to design are ‘Select high performing consultants to evaluate design works’ (Table 2: RII value 0.703; ranked tenth overall) and ‘Effective communication between owner and designer’ (Table 2: RII value 0.662; ranked fourteenth overall). As design issues often surface much later after the design is completed and bid out, changes to design could be costly, reduce project’s profits, and increase time. Having a third party to evaluate design works to identify design flaws early on could save cost and time from design-related headache arising later (Le-Hoai et al., 2008). Having competent consultants to evaluate design works also ensure constructability, accurate translation of owner’s ideas to design parties, and effective concurrent engineering (Thuyet et al., 2007).

By nature, materials are crucial for construction success. Hence, it is essential that ‘All project parties, especially contractors, understand their responsibility to provide materials on time’ (Table 2: RII value 0.725; ranked seventh overall). Due to fast development and high demands, material prices in Vietnam and other developing countries often fluctuate (Le-Hoai et al., 2008; Sambasivan & Soon, 2007). Additionally, scarcity of specialized, long-lead items, interest and inflation rates, and inaccurate estimates are common risks that cause delay in supplying materials (Le et al., 2019). Depends on project nature and material requirements, responsible parties should consider additional planning and surveying, and development of strategies upfront to ensure timely delivery of materials (Le-Hoai et al., 2008).

It is important that ‘Owners understand their responsibility for timely payment to contractors’ (Table 2: RII value 0.718; ranked eighth overall). Money ensures construction projects run smoothly and is an obvious imperative to carry out projects (Long et al., 2004). Owners’ financial capability in Vietnam is not strong. Most private owners are mid-sized developers who often struggle with land use compensation and payments to contractors (Luu et al., 2009), while on the other hand, public owners are mandated to follow excessive bureaucratic procedures that take a long time to approve completed works for payments. Hence, additional efforts are required for owners understand and manage the risks on late payments.

‘Change tender selection philosophy from ‘lowest price wins’ to select the most responsive contractor based on preset criteria’ in the procurement process is necessary to achieve success (Table 2: RII value 0.710; ranked ninth overall). Construction projects, especially the complex ones, are not commodities that can be procured by just a cost factor. Contract awarding to the lowest bidder has been criticized in the VCI as it attracts contractors with inadequate experience that may bring unfavorable consequences such as sub-standard work, change orders, and bankruptcy that make low-bid projects end up with high overall costs (Luu et al., 2009; Sambasivan & Soon, 2007; Lo et al., 2006). Hence, the practice of selecting the lowest bidder needs to change, especially for public owners who tend to select the lowest bidders to justify with the citizens.

‘Adequate resources invested in the pre-construction phase’ (Table 2: RII value 0.693; ranked eleventh overall) is also important. The Cost of Change curve demonstrates that the longer a flaw is left unaddressed during a project, the more expensive it will be to fix (Griffiths, 2015). This
concept applies to design flaws as mentioned earlier as well as other dominant risks in the VCI such as lack of site (soil, weather, traffic) and legal information (Le et al., 2019). Those risks are important input data for project activities and could be addressed with adequate time and budget built into the master program to investigate their conditions during pre-construction phase (Ling & Bui, 2010).

‘Have a plan to assist inexperienced owners’ (Table 2: RII value 0.691; ranked twelfth overall) is important but often overlooked as shown by relatively lower rankings from all parties. Despite not directly performing the works, the owner is revealed as the party that would often cause risks and deviations in a construction project (Elawi et al., 2016). Financial difficulties, slow payments, and site clearance difficulties are among the most common owners’ risks in the VCI and other developing countries (Le et al., 2019). In order to minimize those risks, it might be appropriate for owners to seek external skills and experience from competent contractors and consultants to complement their lack of experience and create a clear and simple project plan to execute.

‘Create practical models to assess the changes of schedule and cost’ (Table 2: RII value 0.673; ranked thirteenth overall) is fundamental in achieving success in construction. Constant changes such as those initiated by designers, client requirements, weather, site conditions, late deliveries, economic conditions, etc. that effect schedule and cost are inevitable in construction projects (Yakubu & Sun, 2010). Le et al. (2019) conducted a survey with 103 construction participants in Vietnam and revealed that 94.2% of them experienced delays and 81.6% of them experienced over-budget issues in the past five years. The VCI now needs practical models to manage changes of schedule and cost that fit Vietnam’s conditions. There have been several efforts in the world pertaining to this domain such as mathematical models, artificial intelligence models, etc. However, the efforts are scattered and have not been tested widely within construction settings in Vietnam (Le-Hoai et al., 2008).

‘Improve contracts to equitably allocate risks between parties’ (Table 2: RII value 0.661; ranked fifteenth overall) is a strategic approach for risk management that is essential during project development. Generally, this practice is meant to allocate each risk to the party best able to manage it. In theory, the party in the best position to manage a risk should be able to do so at the lowest cost. For example, to manage the risk from interest and inflation rates, a fluctuation cause should be introduced to require contractor to bear risk of cost increase for the original scope, while owner to bear risk of cost increase for change orders (Ling & Hoang, 2010). This practice could potentially lower each party’s risk premiums and thus, the project’s overall cost (Li et al., 2005).

‘Measurable construction company’s performance for improvement’ (Table 2: RII value 0.653; ranked sixteenth overall) and ‘Measurable projects performance’ (Table 2: RII value 0.651; ranked eighteenth overall) are indicators of project success. This practice utilizes metrics such as key performance indicators (KPIs), performance metrics (Kashiwagi, 2019) to benchmark performance, process, and strategy for improvement. Construction practitioners in Vietnam and other developing countries could benefit from this practice. For example, owners may use metrics to select potential contractors, construction companies may judge their own performance to reveal strongpoints and weaknesses to develop strategies for improvement, and contractors to
compare their performance with competitors to learn and change from good practices of others (Luu et al., 2008).

A further CSF is ‘Introduce effective construction management’ (Table 2: RII value 0.653; ranked seventeenth overall). Project management tools and techniques play a vital role in the effective management of a project. It involves managing various resources (workers, machines, money, materials, methods used, etc.) and stakeholders (Sambasivan & Soon, 2007). Mismanaged projects often incur delay and cost overruns (Frimpong et al., 2003). Due to fast development and lack of support infrastructure, construction practitioners in development countries still lack the required knowledge and experience in project management (Le et al., 2019). There is a demand for the involvement of experienced construction managers at various levels such as corporate, process, project, and activity to enhance the overall construction industry performance in Vietnam (Long et al., 2004).

‘Good relationships between both central and local governments’ (Table 2: RII value 0.643; ranked nineteenth overall) and ‘Projects are inspected by government officials’ (Table 2: RII value 0.565; ranked twenty second overall) are two CSFs pertaining to dealing with the government. Good relationships with the government are important for the success of construction projects because they allow owners and contractors to understand, be familiar, and conversant with current approval processes, laws, and regulations. Similarly, having government officials to inspect projects helps identify and resolve existing legal issues that are common in Vietnam to avoid halts. With unresolved regulation and code issues, a project faces the risk of unexpected halt or termination even after design and construction have been well developed.

Employment of innovative strategies to ‘Simplify the bidding process’ (Table 2: RII value 0.606; ranked twentieth overall) and ‘Save time and cost during the bidding process’ (Table 2: RII value 0.597; ranked twenty first overall) are other CSFs pertaining to tendering. Tendering practice in Vietnam has been criticized as time-consuming, complex, expensive, and based on relationships (Thuyet et al., 2007). Improving the quality of tendering system proves effective in shortening completion time, improving quality, and lowering costs of construction works (Thuyet et al., 2007).

Ling & Bui (2010) suggested that as ‘Foreign experts are involved’ (Table 2: RII value 0.515; ranked twenty third overall), it would lead to better project performance in the VCI. Benefits that foreign experts bring to the table include experience, sophisticated technologies, technology transfer, ethics, and professional work attitude. However, the limited access, high cost, and cultural differences to employ foreign experts are common concerns that need to be addressed before introducing the expertise of foreign professionals into projects. Those high barriers are probably the reasons why this CSF is ranked last by all parties.
### Table 2: Relative Importance Index and Rankings

| Success Factors                                                                 | Overall | Owners | Contractors | Consultants |
|--------------------------------------------------------------------------------|---------|--------|------------|-------------|
| All project parties clearly understand their responsibilities                  | RI: 0.745 Rank: 1 | RI: 0.761 Rank: 1 | RI: 0.793 Rank: 2 | RI: 0.636 Rank: 7 |
| More serious consideration during contractor selection stage                   | RI: 0.738 Rank: 2 | RI: 0.733 Rank: 4 | RI: 0.807 Rank: 1 | RI: 0.636 Rank: 6 |
| Test contractors’ experience and competency through successful projects in the past | RI: 0.735 Rank: 3 | RI: 0.722 Rank: 8 | RI: 0.786 Rank: 3 | RI: 0.682 Rank: 2 |
| Project team members need to be well matched to particular projects            | RI: 0.735 Rank: 4 | RI: 0.756 Rank: 2 | RI: 0.786 Rank: 4 | RI: 0.614 Rank: 11 |
| Promote pre-qualification of tenders and selective bidding                    | RI: 0.728 Rank: 5 | RI: 0.721 Rank: 7 | RI: 0.764 Rank: 7 | RI: 0.682 Rank: 1 |
| Select designer based on experience and past performance                       | RI: 0.725 Rank: 6 | RI: 0.716 Rank: 9 | RI: 0.779 Rank: 6 | RI: 0.670 Rank: 5 |
| All project parties, especially contractors, understand their responsibility to provide materials on time | RI: 0.725 Rank: 7 | RI: 0.744 Rank: 3 | RI: 0.729 Rank: 11 | RI: 0.682 Rank: 3 |
| Owners understand their responsibility for timely payment to contractors       | RI: 0.718 Rank: 8 | RI: 0.705 Rank: 12 | RI: 0.757 Rank: 8 | RI: 0.679 Rank: 4 |
| Change tender selection philosophy from "lowest-price wins" to select the most responsive contractor based on preset criteria | RI: 0.710 Rank: 9 | RI: 0.699 Rank: 14 | RI: 0.779 Rank: 5 | RI: 0.625 Rank: 8 |
| Select high performing consultants to evaluate design works                    | RI: 0.703 Rank: 10 | RI: 0.727 Rank: 6 | RI: 0.721 Rank: 12 | RI: 0.625 Rank: 9 |
| Adequate resources invested in the pre-construction phase                     | RI: 0.693 Rank: 11 | RI: 0.733 Rank: 5 | RI: 0.743 Rank: 9 | RI: 0.534 Rank: 18 |
| Have a plan to assist inexperienced owners                                      | RI: 0.691 Rank: 12 | RI: 0.705 Rank: 11 | RI: 0.736 Rank: 10 | RI: 0.591 Rank: 14 |
| Create practical models to assess the changes of schedule and cost             | RI: 0.673 Rank: 13 | RI: 0.716 Rank: 10 | RI: 0.686 Rank: 16 | RI: 0.568 Rank: 16 |
| Effective communication between owner and designer                             | RI: 0.662 Rank: 14 | RI: 0.680 Rank: 15 | RI: 0.671 Rank: 18 | RI: 0.607 Rank: 12 |
| Improve contracts to equitably allocate risks between parties                  | RI: 0.661 Rank: 15 | RI: 0.659 Rank: 18 | RI: 0.693 Rank: 13 | RI: 0.614 Rank: 10 |
| Measurable construction company’s performance for improvement                 | RI: 0.653 Rank: 16 | RI: 0.670 Rank: 16 | RI: 0.693 Rank: 14 | RI: 0.523 Rank: 19 |
| Introduce effective construction management                                    | RI: 0.653 Rank: 17 | RI: 0.670 Rank: 17 | RI: 0.686 Rank: 17 | RI: 0.560 Rank: 17 |
| Measurable projects performance                                                | RI: 0.651 Rank: 18 | RI: 0.653 Rank: 19 | RI: 0.686 Rank: 15 | RI: 0.591 Rank: 13 |
| Good relationships between both central and local governments                  | RI: 0.643 Rank: 19 | RI: 0.705 Rank: 13 | RI: 0.600 Rank: 21 | RI: 0.583 Rank: 15 |
| Simplify the bidding process                                                   | RI: 0.606 Rank: 20 | RI: 0.642 Rank: 21 | RI: 0.621 Rank: 19 | RI: 0.511 Rank: 20 |
| Save time and cost during the bidding process                                  | RI: 0.597 Rank: 21 | RI: 0.648 Rank: 20 | RI: 0.600 Rank: 20 | RI: 0.489 Rank: 21 |
| Projects are inspected by government officials                                 | RI: 0.565 Rank: 22 | RI: 0.608 Rank: 22 | RI: 0.543 Rank: 22 | RI: 0.489 Rank: 22 |
| Foreign experts are involved                                                   | RI: 0.515 Rank: 23 | RI: 0.528 Rank: 23 | RI: 0.521 Rank: 23 | RI: 0.477 Rank: 23 |

**Spearman’s Rank-Order Correlation**

The Spearman’s Rank-Order Correlation (SRC) measures the implied degree of agreement on the ranking among groups of respondents. It is computed with the following formula:

\[
\rho = 1 - \frac{6 \times \sum d^2}{n(n^2 - 1)}
\]
in which $\rho = \text{level of consensus between two groups} \ (0 \leq \rho \leq 1)$; $d = \text{the difference in ranking of a risk factor}$, and $n = \text{number of ranking places}$.

Table 3 shows the results of Spearman’s Rank-Order Correlation and significance level calculations among the respondents. The results show that there is generally good agreement between the three groups of respondents in ranking the importance of these CSFs. The highest degree of agreement is between owners and contractors (79%) while the lowest degree of agreement is between owners and consultants (68%). Due to high degree of agreements, the data is considered acceptable for further analysis between all parties.

| Groups                  | SRC  | Sig. level |
|-------------------------|------|------------|
| Owners - Contractors    | 0.792| 0.001      |
| Contractors - Consultants| 0.781| 0.001      |
| Owners - Consultants    | 0.676| 0.001      |

**Factor Analysis**

The relationships between each of the CSFs were further investigated in order to identify the most significant ones. Factor analysis was used to, first, measure the multivariate interrelationships between and within the CSFs, and second, analyze the structure and correlations between the variables by defining a set of common underlying dimensions (also known as factors or components) (Hair et al., 1998). The Kaiser-Meyer Olkin (KMO) and Bartlett’s Test of Sphericity were conducted to verify the legitimacy of factor analysis. In this study, Bartlett’s test approximate of Chi-square is 1461.034 with 253 degrees of freedom, which is significant at the 0.001 level of significance, suggesting that the population correlation matrix is not an identity matrix. The KMO statistic of 0.857 is also greater than 0.5 which is satisfactory for the factor analysis.

The Principal Component method was utilized for factor extraction. The Oblimin rotations with Kaiser Normalization rotation method was selected for this analysis. Four (4) components were identified with Eigenvalues to be greater than 1 (shown in Table 4). These four components account for approximately 63.4% of the variances in construction success factors.
Table 4: Total Variance Explained

| Component | Initial Eigenvalues | Extraction Sums of Squared Loadings | Rotation Sums of Squared Loadings |
|-----------|---------------------|-------------------------------------|----------------------------------|
|           | Total               | Cumul %                             | Total                            |
|           |                     | % Cumul                             | % Cumul                          |
| 1         | 10.238              | 44.514                              | 44.514                           |
| 2         | 1.732               | 7.529                               | 52.042                           |
| 3         | 1.491               | 6.482                               | 58.524                           |
| 4         | 1.130               | 4.913                               | 63.437                           |

Table 5 shows the four (4) component loadings extracted from the factor analysis and exclude the factors with loading values of less than 0.5. The four components are interpreted and labeled as follow:

- Component 1 – Improving Management Capability
- Component 2 – Adequate Pre-Planning
- Component 3 – Stakeholders’ Management
- Component 4 – Performance-based Procurement

Table 5: Factor Analysis Loading and Results

| Components | Eigenvalue | Variance (%) | Success Factors                                                                 | Factor Loading |
|------------|------------|--------------|----------------------------------------------------------------------------------|----------------|
| 1          | 10.238     | 44.514       | Measurable construction company’s performance for improvement                     | 0.536          |
|            |            |              | Introduce effective construction management                                       | 0.527          |
| 2          | 1.732      | 7.529        | Owners understand their responsibility for timely payment to contractors          | 0.800          |
|            |            |              | Have a plan to assist inexperienced owners                                         | 0.736          |
|            |            |              | Select high performing consultants to evaluate design works                       | 0.631          |
|            |            |              | All project parties clearly understand their responsibilities                     | 0.625          |
|            |            |              | Project team members need to be well matched to particular projects                | 0.595          |
|            |            |              | All project parties, especially contractors, understand their responsibility to provide materials on time | 0.573          |
| 3          | 1.491      | 6.482        | Effective communication between owner and designer                                | 0.555          |
|            |            |              | Projects are inspected by government officials                                    | 0.834          |
|            |            |              | Foreign experts are involved                                                      | 0.759          |
|            |            |              | Good relationships between both central and local governments                    | 0.729          |
| 4          | 1.130      | 4.913        | Promote pre-qualification of tenders and selective bidding                        | 0.910          |
|            |            |              | More serious consideration during contractor selection stage                      | 0.820          |
|            |            |              | Test contractors’ experience and competency through successful projects in the past | 0.731          |
|            |            |              | Select designer based on experience and past performance                           | 0.522          |
Component 1: Improving Management Capability

Nowadays, there are many reputable and high-performance Vietnamese contractors such as CotecCons, Hoa Binh, Coffico etc. that could compete and win big projects against foreign competitors. Despite having high quality contractors, the Vietnam construction industry is still lacking competent project managers (Le-Hoai et al., 2008) who can utilize the expertise of those contractors and perform necessary project management tasks to achieve success. This factor suggests that project managers should utilize performance metrics or indicators to improve their management capability. Component 1 is responsible for 44.5% of the total variance of critical success factors (Table 5). There are two CSFs in this group: ‘Measurable construction company’s performance for improvement’, and ‘Introduce effective construction management’.

In order to improve, one first has to be aware of their current performance. The first loading component ‘Measurable construction company’s performance for improvement’ (Table 5: Factor loading 0.536) suggests construction practitioners to benchmark their current performance with measurable metrics for improvement. Determined performance metrics would provide directions for project managers to develop or employ proper strategies to achieve success as indicated by the second loading component ‘Introduce effective construction management’ (Table 5: Factor loading 0.527). Metrics should not only include time, cost, and customer satisfaction, but also those that show the quality or value that the stakeholders are receiving (Kashiwagi, 2019). Chan (2004) also conducted a study on key performance indicators (such as those pertaining to time, cost, value and profit, environmental performance, quality, functionality, etc.) that could be utilized to measure success in construction projects. As different stakeholders have different views on success (Sanvido et al., 1992), the metrics pertaining to performance and success also vary from project to project. It is the project manager’s role to coordinate with all the stakeholders before the project starts to determine a set of performance metrics to be tracked throughout the project. Additionally, common metrics from multiple projects could be compiled in a report to reveal a company’s strongpoints, weaknesses, past performance, and common risk encounters. Such report would be a useful tool for the project managers to develop long-term development strategic plan for their organizations.

Component 2: Adequate Pre-Planning

The pre-planning phase is important as it sets the right conditions such as money, resources, people, communication, etc. to ensure the project runs smoothly. This factor emphasizes the importance of necessary preparations before construction starts and is responsible for 7.5% of the total variance of critical success factors (Table 5). There are seven CSFs components in this group:

- Owners understand their responsibility for timely payment to contractors,
- Have a plan to assist inexperienced owners,
- Select high performing consultants to evaluate design works,
- All project parties clearly understand their responsibilities,
- Project team members need to be well matched to particular projects,
- All project parties, especially contractors, understand their responsibility to provide materials on time,
• Effective communication between owner and designer.

The two highest loading components in this group are related to owners: ‘Owners understand their responsibility for timely payment to contractors’ (Table 5: Factor loading 0.800) and ‘Have a plan to assist inexperienced owners’ (Table 5: Factor loading 0.736). Owners keep projects going with their payments; however, they are also the party that cause most project risks and deviations (Elawi et al., 2016). Hence, having a plan to assist owners and ensure that they can fulfill their role comfortably are fundamental throughout the project and should be addressed upfront.

As discussed elsewhere, the design is critical for project success. As projects develop, the cost of changes for design increases, while the effect of those changes decreases. Hence, the design should be evaluated by high performing consultants during pre-construction to ensure quality, constructability, and accurate translation of owner’s ideas to the designer. This is presented by the third and seventh loading components in this group (Table 5: Factor loading 0.631 and 0.555, respectively).

‘All project parties clearly understand their responsibilities’ (Table 5: Factor loading 0.625) is another important component that should be considered pre-construction. A stakeholder not fulfilling their role could slow, or even prevent, project development. That risk could be reduced by having clear and constantly updated project objectives, scope, and plans available to all stakeholders. A project also has higher chance of success when the plans are presented in simple formats with the right level of details (Nguyen Duy et al., 2004). This practice also creates uniform commitment, agreement, and clarity towards project goals. One of the most important responsibilities is timely delivery of materials (Table 5: Factor loading 0.573).

It should be emphasized that project teams, not project managers, implement and deliver projects (Nguyen Duy et al., 2004). In Vietnam, a developing country, it is relatively more difficult to assemble a team of necessary specialists, professionals, and experts to direct projects to success. Hence, additional efforts should be made during Pre-planning phase to ensure that project team members are well matched to project requirements (Table 5: Factor loading 0.595).

Component 3: Stakeholders’ Management

This factor emphasizes the stakeholders’ management and is responsible for 6.5% of the total variance of critical success factors (Table 5). There are three CSFs in this group: ‘Project are inspected by government officials’, ‘Foreign experts are involved’, and ‘Good relationships between both central and local governments’.

The government is an important stakeholder as they provide permits, pass laws, and create development plans that have high impacts on construction industry and projects. However, construction projects in Vietnam have been facing high risks of delays and cost overruns due to bureaucratic administrative system (Le et al., 2019). The legal system governing construction projects in Vietnam is still primitive, continues to change unexpectedly, is consistent on various levels, and requires excessive time and effort to obtain permits. Thus, having projects inspected by government officials (Table 5: Factor loading 0.834) and maintaining good relationships with
the governments (Table 5: Factor loading 0.729) are necessary measures to address potential legal issues that could delay, halt, or even terminate projects. Due to the complexity in managing different stakeholders, owners could choose to involve foreign experts (Table 5: Factor loading 0.759) as their representatives or construction managers. This is a potential, but temporary, solution for the lack of competent local project managers in Vietnam.

**Component 4: Performance-based Procurement**

The procurement process is important as it helps identifying the right designers, contractors, and other entities needed to successfully deliver projects. This factor emphasizes on prioritizing performance in tendering and is responsible for 4.9% of the total variance of critical success factors (Table 5). There are four CSFs in this group: ‘Promote pre-qualification of tenders and selective bidding’, ‘More serious consideration during contractor selection stage’, ‘Test contractors’ experience and competency through successful projects in the past’, and ‘Select designer based on experience and past performance’.

Compared to open competitive bidding, pre-qualification and selective bidding (Table 5: Factor loading 0.910) could quickly bring in high quality and reputable contractors to bid on projects. During selection phase, contractors should be considered more seriously (Table 5: Factor loading 0.820) based on criteria other than cost. Past experience and successful projects in the past closely relate to project success as they indicate a contractor’s competency (Nguyen Duy et al., 2004) (Table 5: Factor loading 0.731). However, it is a common misconception that only contractors should be selected based on performance. As construction is a dynamic environment that involves multiple parties, if one party fails to perform its role, the project is likely to fail. Therefore, not only the contractors, the remaining of project team including designers (Table 5: Factor loading 0.522), consultants, and sub-contractors should also be selected based on experience and past performance.

**Conclusion**

As a developing country, the economy in Vietnam has been growing fast and steady with significant contribution from construction activities. However, multiple studies in the past 15 years identify that there are still risks existing in the Vietnam Construction Industry (VCI)’s projects that hinder performance. Hence, it is imperative to continuously develop research on solutions to improve the VCI performance.

This paper identified 23 Critical Success Factors (CSFs) pertaining to common risk factors in the VCI. A questionnaire survey was developed, administered, and analyzed to assess current effective CSFs with participants from the VCI. The relative importance of those CSFs was revealed from the response data of three main project participating groups (owners, contractors, and consultants). ‘All project parties clearly understand their responsibilities’, ‘More serious consideration during contractor selection stage’, ‘Test contractors’ experience and competency through successful projects in the past’, ‘Project team members need to be well matched to particular projects’, ‘Promote pre-qualification of tenders and selective bidding’ were found to be the most important CSFs. There were no significant disagreements between each party in
ranking these CSFs. Further factor analysis examined the principal success factor groupings and resulted into four factors: ‘Improving Management Capability’, ‘Adequate Pre-Planning’, ‘Stakeholders’ Management’, and ‘Performance-based Procurement’. These four factors emphasize the basic elements of CSFs for project risk management in Vietnam. They should be constantly considered by VCI project managers throughout the development of projects.

Other countries that face similar construction risks as Vietnam would also find these results useful. The findings could help construction practitioners in developing countries improve their understanding in project management. Project managers could make better plans and form strategies accordingly in their projects to ensure performance with the suggested CSFs and analyzed factors.

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