

## RESEARCH ARTICLE

## PROPOSING SOLUTIONS TO REDUCE FACTORS AFFECTING THE DELAY OF CONSTRUCTION PHASE IN HIGH-RISE BUILDING PROJECTS

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## ABSTRACT

Along with the rapid development of the construction industry in recent years, high-rise projects have grown in both quantity and scale. However, delays are common in this type of project in developing countries. It causes significant economic damage and has a very serious impact on investor confidence. Following a previous study on factors affecting the delay of construction phase in high-rise building projects, this study will propose solutions to reduce the factors mentioned in the previous study. Nine groups of solutions corresponding to nine groups of factors will be analyzed in this study. The investor chooses a designer and project management consultant who has expertise, experience and is suitable for the project; the investor clearly determined the scale and purpose of using the project; skilled labor and suitable construction methods; provide adequate and timely materials; the investor has to confirm the contractor's capacity are suggested as mitigation activities. The results could help stakeholders learn from the mentioned factors and apply solutions so that they can avoid delays.

## KEYWORDS

construction, delay, high-rise building, mean score, solutions

### 1. RESEARCH PROBLEM

Along with the rapid development of the construction industry in recent years, high-rise projects have grown in both quantity and scale. However, delays are common in this type of project in developing countries (Kiet et al., 2020). Because the construction industry plays an important role in the national economy. It contributes to the economic growth of a country (Long et al., 2008). Therefore, delays in construction projects lead to serious consequences that can slow down the development of the construction industry in particular and the overall economy of a country in general. For the above reasons, it is necessary to better understand the factors affecting construction delays in High-rise Building projects and solutions to reduce those delays. This knowledge could help stakeholders learn from the mentioned factors and apply solutions so that they can avoid delays.

### 2. LITERATURE REVIEW

The previous studies chosen for literature review in this study are referred from various literature sources, such as the global databases of Google Scholar, Web of Science, Emerald Insight, Taylor and Francis, Science Direct, Scopus, Engineering Journals, SpringerLink, and Wiley Online Library, PMI Online Library, ASCE Library. Pourrostan and Ismail suggested methodologies to reduce construction delays from consultant and contractor viewpoints in Iran as well as other developing countries (Pourrostan and Ismail, 2011). Adequate funding throughout the project, competent project manager, awarding bids to the right designer/contractor, complete and proper design at the right time, availability of resources, clear objective and scope, and the use of experienced subcontractors and suppliers were considered effective methods of minimizing delay in construction projects.

A group researchers conducted a study to identify the major causes of construction project delays in the construction industries in Sri Lanka and find out how planning and mitigation methods would minimize their impacts (Kesavan et al., 2015). The results had been shown 52 affecting factors that were grouped into seven categories such as client, contractor, consultant, materials, equipment, labour and external factors. This study also finds out seven mitigation methods to reduce the impact of project delays. They are proper project planning and scheduling, effective strategic planning, site management and supervision, collaborative working in construction, frequent coordination between the parties involved, frequent progress meeting, accurate initial cost estimates.

A group researchers carried out a case study research on finding out the major causes of project delays in Saudi Arabia (Alzara et al., 2016). There were 27 factors that delayed public projects in Saudi Arabia. Nine of them are proved to be important factors. Out of 27 factors, Late in Reviewing and Approving Design Documents Owner, Delay in Progress Payments to Contractors Owner, Poor Contractor Performance Contractor, Contractor's Lack of Qualifications Contractor, Lack of Contractor Experience Contractor, Shortage of Manpower Contractor, Lack of Consultancy Employees Consultant, Material Delivery Problems Other, and Bidder System were identified as major causes of delays. The Performance Information Procurement System (PIPS) and the level of experience and risk assessment documents are submitted via vendors were suggested as mitigation activities.

Based on similar domestic and foreign studies that have been published that are aforementioned and suggestions from experts. This study proposed a model consisting of nine groups of solutions compatible with nine groups of factors affecting the construction delay in high-rise building projects, namely: Project, Investor, Project Supervision and Management Consultant, Contractor, Design, Materials, Labor, Construction equipment, and External factors.

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### 3. RESEARCH METHODOLOGY

Figure 1 displays the research framework adopted for this study, including the processes and techniques used.

#### 3.1 Proposed Model

Following up on a previous study by the authors that have been published and suggestions from experts, this study proposed a model which consists of 52 solutions for factors that affect the construction delay in high-rise building projects (Kiet et al., 2020). Those solutions were divided into nine groups according to nine groups of factors. They are Project, Investor, Project Supervision and Management Consultant, Contractor, Design, Materials, Labor, Construction equipment, and External factors (Kiet et al., 2020).

#### 3.2 Data Collection

A questionnaire survey was used to collect data in this study for six months. The survey was conducted on 201 construction engineers in Vietnam. Out of 201 responses, 18 (nine percent) work for investors, 82 (40.8 percent) work for contractors, 56 (27.9 percent) work for project supervision companies, 27 (13.4 percent) work for project management consultants, and 18 (nine percent) work for design companies, respectively. 192 of them (corresponding to 95.5 percent) have at least five years of experience in the construction industry. 183 (corresponding to 91 percent) have ever participated in a project that has been delayed. Previously, to obtain the final questionnaire used for this survey, five experts with postgraduate qualifications in the construction industry were invited for face-to-face interviews. They had worked for more than ten

years in construction organizations.

The objective of the interviews was to reach a consensus among experts on the contents of the preliminary questionnaire. The final result is a questionnaire with a structure consisting of two main parts. In the first part, respondents have to rate their agreement about 52 solutions according to a Likert scale from 1 (impossible) to 5 (absolutely possible). The other is five questions about respondents' personal information and

their company characteristics. The reliability test yielded a Cronbach's alpha coefficient of internal consistency value of 0.810 ( $>0.80$ ), which was indicated reliable. In addition, the Spearman's rank correlation test does not indicate any difference in assessing an individual item ( $\text{sig.} = 0$ ). The analysis of variance (ANOVA) test is used to examine whether the mean values of each item rated by the different groups are different.

#### 3.3 Data Analysis

The solutions for each of nine factor groups are calculated and ranked using mean score method - a widely applied method in previous research (Dang et al., 2018). Ranking solutions can help understand the consensus of experts with those solutions. In addition, the results of ANOVA test and Kruskal Wallis test show that there is no significant difference in the ratings of the four aforementioned groups at the significance level of 5 percent.

### 4. RESULTS AND DISCUSSION

Table 1 presents nine top solutions corresponding to nine groups of factors affecting construction delays in high-rise building projects.

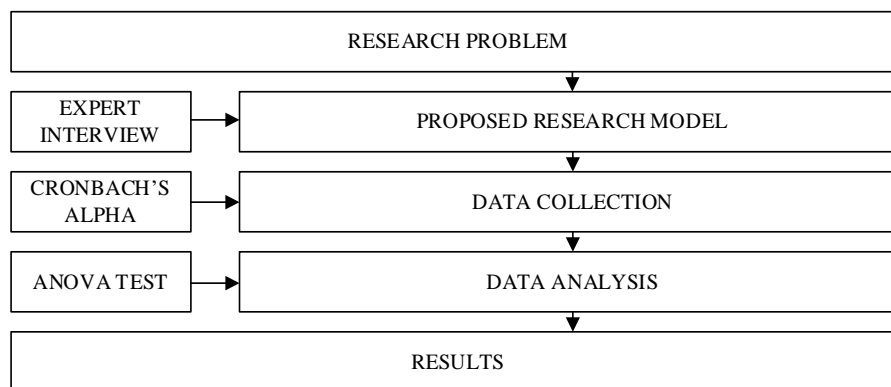


Figure 1: The research framework.

**Table 1: Nine Top Solutions Corresponding to Nine Groups of Factors Affecting Construction Delays in High-Rise Building Projects.**

| Group         | Solutions                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Mean |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Projects      | <ul style="list-style-type: none"> <li>- The terms in the contract on penalty for delays must be clear, complete, strict and strictly comply with the agreements.</li> <li>- The documents related to the compensation and clearance must be completed before the site starts.</li> </ul>                                                                                                                                                                               | 4,34 |
| Investor      | <ul style="list-style-type: none"> <li>- Professional design service is required to complete the design and limit errors.</li> <li>- Change orders must be recorded and confirmed by competent persons of the participating parties.</li> <li>- Provide a clear scale and purpose of use. The technical design has to verify to limit change orders.</li> <li>- Hire a capable project management consultant to assist the investor in project coordination.</li> </ul> | 4,78 |
| PM consultant | <ul style="list-style-type: none"> <li>- The project management consultant promptly reports the obstacles in the project implementation and proposes the solutions.</li> </ul>                                                                                                                                                                                                                                                                                          | 4,54 |
| Contractor    | <ul style="list-style-type: none"> <li>- Prepare professional bid documents and bid evaluation process.</li> <li>- Contractor interviews are required.</li> <li>- Visiting the contractor's office and construction sites.</li> <li>- Interviewing ex-investors and ex-material suppliers.</li> </ul>                                                                                                                                                                   | 4,69 |
| Designer      | <ul style="list-style-type: none"> <li>- Select competent and experienced designers who have performed similar projects.</li> <li>- Thoroughly advise the project investor on the design documents, propose many options to choose from, and carefully review the errors before issuing the final design documents.</li> <li>- When the design requires adjustment, the designer quickly implements it with the confirmation of the relevant participants.</li> </ul>   | 4,73 |
| Materials     | <ul style="list-style-type: none"> <li>- The plan for the supply of materials must be agreed in writing on the types and sizes that are available in the market. Progress for the procurement of materials is also prepared in detail.</li> </ul>                                                                                                                                                                                                                       | 4,10 |
| Labor         | <ul style="list-style-type: none"> <li>- Use skilled labor.</li> <li>- Apply appropriate construction measures.</li> <li>- Provide timely and complete materials and equipment as required.</li> </ul>                                                                                                                                                                                                                                                                  | 4,70 |
| Equipment     | <ul style="list-style-type: none"> <li>- Establish an equipment layout plan according to project schedule.</li> </ul>                                                                                                                                                                                                                                                                                                                                                   | 4,29 |
| External      | <ul style="list-style-type: none"> <li>- When an occupational accident occurs, it is necessary to quickly fix the problem and report it to the relevant authorities and participants. The effects on the project schedule have to limit to the lowest level.</li> </ul>                                                                                                                                                                                                 | 4,37 |

From Table 1, some outstanding solutions for reducing factors affecting delays in high-rise building projects can be mentioned below:

Firstly, the Investor is the owner of the construction work, so the Investor has the right to decide to hire a professional designer to minimize errors in the design process. The investor should also provide a clear scale and purpose of use for the project. From there, the designer will understand clearly to avoid problems later. During the construction process, if there are any design changes, the designer will quickly produce minutes and drawings for immediate construction. Next, the Investor needs to sign a contract with a professional project management consultant to minimize the delay in construction progress. It is the optimal solution for investors who want to improve construction progress.

Next, the quality of labor is a decisive factor for the success or failure of the contractor in particular and the project in general. Therefore, the more skilled the workforce and the appropriate construction methods will help the Contractor achieve full results and complete the project on time. At the same time, the material suppliers must provide a timely to avoid the situation that workers have too much free time, which will affect the progress of the project. The contractor is the main implementing participant and has a decisive influence on the project schedule. Therefore, it is necessary to confirm the contractor's capacity. Some common ways are contractor interviews, visits to offices and construction sites that the contractor is working on. Another effective way to be sure to know the contractor's qualifications is the former investors interview. To find out if the contractor is reputable, it is advisable to interview material suppliers who have cooperated with that contractor before.

## 5. CONCLUSION

In continuation of a previous study on factors affecting the delay of construction phase in high-rise building projects, this study proposed solutions to reduce nine factor groups mentioned in the previous study. Nine factor groups are namely: Project, Investor, Project Supervision and Management Consultant, Contractor, Design, Materials, Labor, Construction equipment, and External factors. Accordingly, the solutions for each of nine factor groups are ranked and analyzed. The mean score ranking results indicate several solutions with high consensus from the

responders. Such as the investor chooses a designer and project management consultant who has expertise, experience and is suitable for the project; the investor clearly determined the scale and purpose of using the project; skilled labor and suitable construction methods; provide adequate and timely materials; the investor have to confirm the contractor's capacity. The solutions given in this study can only be applied to high-rise building projects in Vietnam. If additional data collection is available across other countries and for other types of projects, the findings of the study could be broadly applicable. This is a promising research direction in the future.

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