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THE ROLE OF PLANNING AND CONSTRUCTION FACTORS IN THE PERFORMANCE OF DESIGN AND BUILD CONTRACTS FOR THE EAST SURABAYA HOSPITAL PROJECT

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Abstrak
The design and build (D&B) method, while efficient, introduces risks that jeopardize hospital construction timelines. This study investigates how planning and construction factors in D&B contracts impact the time performance of the East Surabaya Hospital project, addressing gaps in localized risk management frameworks. Using a quantitative approach, data from stakeholders were analyzed via Pearson correlation and multiple linear regression. Results revealed that construction factors, particularly contractor expertise ($r = 0.854$, $p < 0.001$) and execution quality ($\beta = 0.404$, $p = 0.001$), had stronger impacts on success than planning factors (e.g., design delays, $r = 0.028$, $p = 0.8$). The regression model ($R^2 = 0.698$) confirmed these factors explain 69.8% of time performance variance. Key novel contributions include identifying high-impact variables unique to hospital D&B projects and proposing mitigation strategies for Surabaya's context. Findings underscore the need to prioritize contractor competency and real-time risk monitoring, offering practical insights for policymakers and practitioners to enhance project delivery. Future research should explore dynamic risk models and cross-method comparisons to generalize findings.

Keywords: Construction Industry, Design and Build, Multiple Linear Regression, Pearson Correlation, Risk Factors.

INTRODUCTION

The construction industry plays a crucial role in developing infrastructure, including essential facilities like hospitals. In recent years, the design and build method has gained popularity due to its ability to integrate design and construction phases under a single contract, offering efficiency in both time and cost (Hwang & Ng, 2019). However, alongside its advantages, this method brings numerous risks that can significantly affect project outcomes, especially in terms of completion delays.

According to prior research, procurement processes frequently pose challenges, with incomplete data and delays in material delivery being key issues (Simanjuntak & Tumanggor, 2019). On the design team side, delays in finalizing contract documents and discrepancies between the design and the initial project concept are common problems (Tarigan et al., 2018). Moreover, builder teams often struggle with implementing designs and maintaining coordination with project owners (Simanjuntak & Tumanggor, 2019).

In the context of hospital construction, success is measured not only by quality and cost efficiency but also by timely project completion. Delays can lead to increased costs, reduced work quality, and failure to meet the project's intended goals (Alam,

2011). Therefore, identifying and understanding the risk factors that impact project timelines is vital. This knowledge enables the formulation of effective mitigation strategies to minimize risk impacts and ensure smooth project execution (Simanjuntak & Tumanggor, 2019).

Risk management in the construction industry still faces significant challenges that impact the time, cost, and quality of work (Hwang & Ng, 2019). Meanwhile, Ribera and Rojas (2020) emphasized that risks in construction projects often stem from weaknesses in planning, resource management limitations, and ineffective coordination among stakeholders. If not addressed with appropriate mitigation strategies, these factors can worsen project performance, leading to financial losses, project delays, and reduced construction quality. Thus, an in-depth analysis of potential risks in design and build contracts for hospital projects, particularly in Surabaya, is necessary. This analysis aims to identify the main types of risks, assess their impact on project success, and formulate effective mitigation strategies.

Construction projects in highly complex areas, such as Hong Kong, require comprehensive risk management frameworks. Risks arising during the design and implementation stages must be identified and addressed early to minimize the impact of delays (Tse and Chan, 2021). There is a significant relationship between effective risk management and improved project time performance. Their research in China showed that risks related to design, material procurement, and labor shortages are dominant factors affecting the success of construction projects (Cao and Zhang, 2022).

Risks in the design and build method for hospital construction projects are often influenced by limitations in human resources, repetitive design changes, and suboptimal coordination between project owners, contractors, and planning teams (Kurniawan and Saputra, 2021). Several theories on the origin of land settlement accompanying compaction have been proposed (Patriadi, 2022). Accurate risk identification and the application of appropriate mitigation strategies can minimize the impact of risks on project time and cost (Aditya and Setiawan, 2020). Based on these studies, it can be concluded that risk management in design and build projects plays a significant role in project success, particularly in maintaining time performance. Unidentified and unmanaged risks will lead to delays, increased costs, and reduced work quality. Therefore, this study aims to analyze the influence of design and build risk factors on the time performance of hospital construction projects. Using a quantitative approach through Pearson correlation and multiple linear regression analysis, this study is expected to identify the most significant risks and provide recommendations for effective mitigation strategies to minimize their impact.

The Design and Build contract type is commonly referred to as an Integrated Design and Build Contract, where planning and construction processes are included in a single contract. The Design and Build system is often considered the fastest procurement system as it promotes continuity between the planning and construction stages simultaneously. Construction activities can commence even while planning is still ongoing, minimizing mismatches on the project site and optimizing execution.

Furthermore, the design generated in the Design and Build contract type can minimize potential changes in planning outcomes.

In recent years, the Surabaya City Government has implemented the Design and Build system, particularly for projects categorized as strategic regional projects. The Design and Build system is applied to construction works deemed complex and/or urgent, as regulated by the Minister of Public Works and Public Housing Regulation No. 1 of 2020 on Standards and Guidelines for Integrated Design and Build Procurement Work through Providers. Some projects that have adopted the Design and Build system in Surabaya include the construction of the Joyoboyo Intermodal Terminal, Mohamad Soewandhie Regional Hospital (Phase 1 and phase 2), and East Surabaya Hospital.

Through this study, it is hoped that contractors, consultants, and project owners can better understand and anticipate risks in setting up design and build contracts. Additionally, the study's results are expected to contribute to the development of risk management in the construction industry, particularly for healthcare projects that have unique needs and standards.

The objectives of this research are to identify risk variables from planning and construction factors in design and build contracts that impact the time performance of the East Surabaya Hospital construction project and to develop effective mitigation strategies to manage and minimize these risks during the project's implementation. This study advances existing literature by specifically analyzing risk factors in design and build (D&B) contracts for hospital projects in Surabaya, a context underexplored in prior research. While previous studies (e.g., Hwang & Ng, 2019; Cao & Zhang, 2022) broadly address risk management in construction, this research uniquely identifies planning and construction factors with varying correlation strengths (e.g., perfect correlation [0.854] for construction variables vs. insignificant planning factors [0.028]), providing granular insights into their differential impacts on time performance. Unlike Tarigan et al. (2018), who focused on general D&B risks, this study employs Pearson correlation and multiple linear regression to quantify these relationships, revealing that contractor experience (regression coefficient: 0.512) and execution quality (0.404) are critical success drivers—a finding not highlighted in earlier works. Additionally, it proposes targeted mitigation strategies for high-impact factors, addressing gaps in localized risk frameworks (Kurniawan & Saputra, 2021). The research also pioneers future directions, such as dynamic risk modeling, to address limitations in real-time monitoring, a gap noted in Tse and Chan’s (2021) Hong Kong-based studies.

METHOD

The object of this research is the factors, impacts, and risk mitigation strategies in Surabaya Timur Hospital project. The research was conducted from September 2024 to the field in January 2025 which began in stages from problem formulation, establishment of theoretical basis, determination of data collection methods, data collection, data processing, data analysis, discussion of research findings, and presentation of research report.

The types of data in this study include primary data and secondary data. The primary data in this research was obtained through questionnaires designed to gather information regarding the risk factors of design and build on project success. Respondents included directly involved parties such as owners, contractors, project managers, and experts. The secondary data in this research was obtained from relevant institutions. Secondary data is essential for analysis during problem identification and determining corrective actions.

Data analysis includes:

1. Data Cleaning and Verification
   Data from questionnaires are checked to ensure no missing or inconsistent values. Once verified, the data is input into SPSS (Statistical Package for the Social Sciences) software to facilitate statistical data processing.
2. Validity and Reliability Testing
   Validity Test: Compares the R-count value of each questionnaire item to the R-table to confirm that each statement accurately measures the studied variables. Reliability Test: Uses Cronbach's Alpha method to measure the internal consistency of the questionnaire. A Cronbach's Alpha value above 0.6 indicates the research instrument is reliable and suitable for use.
2. Descriptive Analysis
   Descriptive statistical techniques are employed to provide an overview of respondent characteristics and data distribution. Mean and standard deviation values are calculated to assess the significance level of each risk factor as evaluated by respondents. Factors with the highest mean values indicate risks with the most significant impact on project time performance.
3. Pearson Correlation Analysis
   This technique is applied to determine the relationship between independent variables (risk factors) and the dependent variable (project time performance). Pearson correlation analysis reveals the strength and direction of relationships based on the correlation coefficient (r). A significance value (p-value) < 0.05 indicates a statistically significant relationship.
4. Multiple Linear Regression Analysis
   This technique measures the partial and simultaneous influence of risk factors on project time performance. The regression equation is expressed as:

$$\mathbf{Y=a+b_1X_1+b_2X_2+b_3X_3+\cdots+b_nX_n}$$

   Where Y is a dependent variable (project performance), X1, X2, ..., Xn are independent variables (risk factors), a is a constant, and b are regression coefficients. Partial effects of each variable are tested using t-values and p-values. The F-test is used to examine the simultaneous influence of independent variables. If p-value < 0.05, the risk factor significantly impacts project time performance.
5. Coefficient of Determination

The R^2 value is used to measure the extent to which the examined risk factors contribute to project time performance. An R^2 value close to 1 indicates that the independent variables have a strong influence on the dependent variable, while the remainder is explained by other factors outside the scope of the study.

6. Interpretation
   The results from descriptive analysis, correlation, and multiple linear regression are interpreted in a narrative format, explaining the significance level of risk factors, relationships between variables, and their impact on project time performance. Additionally, these findings inform the formulation of recommendations, including effective risk mitigation strategies derived from the research outcomes.

RESULTS AND DISCUSSION

Validity and Reliability Testing

The data analysis results indicate that all questionnaire items have R-count values greater than the R-table values, thereby deemed valid. This validity confirms that each statement in the research instrument effectively measures the intended variables. Following the validation process, a reliability test was conducted to assess the consistency of the instrument. The test results show that all variables have Cronbach's Alpha values above 0.6, indicating that the instrument is reliable. Thus, the questionnaire is declared to have a high level of reliability and is suitable for further data analysis, hypothesis testing, and addressing the research objectives.

Correlation Analysis

The examination of the correlation between design and build risk factors and the success of the construction project was carried out using basic correlation techniques. This analysis produced results that highlight relationships identified through Pearson correlation coefficients and determine the presence or absence of a relationship based on a significance threshold of less than 0.05.

Table 1. Pearson Correlation

Factor	Pearson's Correlation	Type of Correlation	Sig.
Planning	0.028	No Correlation	0.8
	0.566	Moderate Correlation	0.01
	0.422	Moderate Correlation	0.072
	0.484	Moderate Correlation	0.035
	0.53	Moderate Correlation	0.016
	0.494	Moderate Correlation	0.03
	0.224	Weak Correlation	0.29
	0.232	Weak Correlation	0.275
	0.242	Weak Correlation	0.26
	0.206	No Correlation	0.32
	0.098	No Correlation	0.55
Construction	0.854	Perfect Correlation	<0.001
	0.674	Strong Correlation	<0.001
	0.602	Moderate Correlation	0.005
	0.008	No Correlation	0.93

	0.458	Moderate Correlation	0.048
	0.314	Weak Correlation	0.16
	0.278	Weak Correlation	0.21
	0.064	No Correlation	0.67

Based on the results of a simple correlation analysis using Pearson's coefficient, it can be concluded that the relationship between risk factors and project success varies depending on the level of correlation and significance. Regarding the planning factor, a moderate correlation is indicated by several variables, with values of 0.566 (significant at 0.01) and 0.53 (significant at 0.016). This moderate correlation suggests that aspects of planning, such as proper resource allocation and scheduling, play an important role in the success of a project. However, there are variables with low and insignificant correlation values, specifically 0.028 and 0.098, indicating that these factors do not significantly contribute to project success.

For the construction factor, one variable demonstrates a perfect correlation with a value of 0.854, which is significant at a level of <0.001. This confirms that the effectiveness of project construction has a substantial impact on determining project success. A strong correlation is also observed with a value of 0.674. However, some variables show no significant relationship, with very low correlation values, such as 0.008, and a significance level of 0.93.

Based on the results of the simple correlation analysis using Pearson's coefficient, it can be concluded that the construction factor has a significant influence on project success, as evidenced by several variables with strong to perfect correlations. These variables confirm that the effectiveness of project construction is a key factor in supporting success. Meanwhile, some variables in the planning factor show weak or insignificant relationships.

Multiple Regression Analysis

The impact of design-and-build risk factors on the success of the construction project was further examined using multiple linear regression analysis. This method identified positive or negative influences through regression coefficients, with the most significant factors determined by a significance value (Sig.) of < 0.05. In addition, the simultaneous impact was tested using an F-test, while the contribution of these factors to project success was measured through the coefficient of determination. The results of the multiple linear regression analysis are presented to provide a detailed overview of the significant influences.

Table 2. Regression Analysis

Factor	Variable	Regression Coefficient	t-value	Sig.
Planning	Constant	-2.666	-7.532	<0.001
	Delays in the process of creating contract documents	0.017	0.277	0.8
	Time available for personnel to prepare bids	0.34	6.797	0.01

	Violations by the design team in using the design tool build approach	0.253	4.608	0.072
	Incomplete design documents submitted according to TOR	0.29	5.475	0.035
	The design team's understanding of applicable standards and regulations	0.318	6.187	0.016
	The design team's understanding of the time required for work stated in the design and build contract	0.296	5.625	0.03
	Errors in estimating project costs	0.134	2.275	0.29
	Delays in the design process due to revisions requested by the owner	0.139	2.361	0.275
	The design team's understanding of the schedule set by the owner during the tender stage	0.145	2.469	0.26
	Mismatches between design concepts and the initial concept from the owner	0.124	2.084	0.32
Construction	Lack of coordination to meet the owner's unmet needs	0.059	0.975	0.55
	The contractor's experience in executing design work in accordance with requirements	0.512	16.249	0.001
	The contractor's performance in implementing agreed-upon designs in the contract	0.404	9.032	0.001
	The quality of design execution as determined	0.361	7.463	0.005
	The quality of coordination between contractors and owners	0.005	0.079	0.93
	Errors in implementing designs on site	0.275	5.1	0.048
	Delays in the personnel responsible for meeting project needs	0.188	3.274	0.16
	Poor coordination among contractors due to miscommunication	0.167	2.865	0.21
	Input from the implementer's design that is not relevant to the TOR	0.038	0.635	0.67

Based on the results of multiple linear regression analysis, the obtained regression model demonstrates a positive influence of design and build risk factors on the success of the East Surabaya Hospital construction project. This regression model has a constant value of -2.666 and various regression coefficients for each factor. The results indicate that any improvement in managing risk factors will be followed by an increase in project success, as reflected in the regression coefficients of each variable. Significant factors include the contractor's experience in executing design and build projects, with a regression coefficient of 0.512 and a significance level of 0.001. Additionally, the quality of execution by contractors, with a coefficient of 0.404, also has a significant impact, underscoring the importance of high-quality field execution. Simultaneously, the F-test result of 18.372 with a significance level of 0.000 demonstrates that all risk factors collectively have a significant influence on project success. The R^2 value of 0.698

indicates that 69.8% of the variation in project success can be explained by the analyzed risk factors, while the remaining 30.2% is influenced by other factors not covered in this study. These other factors are presumed to include aspects such as regulations, politics, materials, labor, and finances, which may also contribute to project success.

Therefore, managing risks related to contractor experience and execution competency is crucial for improving the success of design and build projects. Optimal management of these factors will significantly enhance the efficiency and effectiveness of project construction, ensuring the project's objectives are achieved as planned.

CONCLUSIONS

The risk analysis of the East Surabaya Hospital construction project reveals varying impacts of risk factors on project success, with construction factors showing strong correlations (e.g., 0.854) and significant influence, while some planning factors exhibit weak or insignificant relationships (e.g., 0.028), highlighting the need for targeted risk management strategies. Future research should explore dynamic risk assessment models with real-time monitoring, investigate contextual reasons behind insignificant planning factors, and conduct comparative studies across different project delivery methods to enhance risk mitigation frameworks and project success predictability.

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