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# Intelligent Transformation of Android Apps in Detecting and Mitigating Project Failure Risk Levels

**Sayfuddin, Surya Hadi**
Universitas Islam Al – Azhar Mataram, Indonesia
Email: sayfuddinmtr@gmail.com, hdsurya11@gmail.com

## ABSTRACT

*Building infrastructure plays an important role in the progress of a nation. However, failures in planning, design, construction, and maintenance can hinder development goals. The risk of failure of a construction project can come from technical aspects, human error, and natural factors. Indonesia, especially Lombok in West Nusa Tenggara, faces challenges in infrastructure sustainability, especially after being designated as a National Tourism destination through Presidential Decree No. 84/2021. Despite the increase in infrastructure development, many cases of construction failures still occur. This research aims to develop a digital transformation-based intelligent Android application that can detect and mitigate the risk of project failure. The research used a mixture of qualitative and quantitative methods, with the Likert scale for risk measurement. The results of the study identified 19 risk factors, with 4 variables related to building failure and 15 variables related to construction failure implementation. Risk is classified into high, medium, and low categories, where 3 variables have high risk, 14 medium risk variables, and 2 low risk variables. This research also formulates risk management strategies, including steps to reduce and anticipate risks. In addition, the research resulted in the application of Risk Check Level, which aids in the detection, analysis, and management of failure risks, thereby contributing to the improvement of the success and sustainability of future construction projects.*

**KEYWORDS** *Project Failure, Management Strategy, Risk Check Level*



## INTRODUCTION

Failure to implement construction refers to a condition of irregularities, errors, and/or damage to the results of construction work that can result in building collapse (Błazik-Borowa et al., 2022; Gamil & Abdul Rahman, 2020; Hamdani et al., 2023; Nguyen & Chileshe, 2015; Shahhosseini et al., 2018; Winge & Albrechtsen, 2018). Such failures can be caused by natural factors such as hurricanes, tsunamis, earthquakes, and explosions, as well as by human error (Ghanbari et al., 2024; Manatunge & Abeysinghe, 2017; Menegaki & Damigos, 2018). In this study, the researcher uses guidelines referring to *Article 60 paragraph 1 of Law Number 2 of 2017* to determine the occurrence of building failures and failures in the implementation of construction in accordance with engineering rules. Problems in project implementation will arise if project objectives are not achieved (Bhattarai et al., 2016; Hosseini et al., 2020; Machfudiyanto et al., 2023; Maryati et al., 2021; Shinde & Meshram, 2020; Wibowo, 2015; Yuan et al., 2018).

This research has significant novelty compared to previous studies. Muriana and Vizzini (2017) developed deterministic quantitative methods for project risk management, but their approach remains theoretical and has not integrated technology into its application. On the other hand, Chen et al. (2018) focused on social risk analysis in construction projects using social networks, but their research was limited to human factors without considering technical and natural aspects. The strength of this research lies in the development of a Flutter-based Android application called *Risk Check Level*, which provides a practical and accessible solution. Furthermore, this study adopts a hybrid approach that combines qualitative and quantitative analysis, including the Severity Index and the Probability–Impact Matrix, while expanding the scope of risk assessment to include natural factors such as earthquakes and floods—highly relevant to Indonesia's geographical conditions. Thus, this research not only fills a gap in the existing literature but also offers innovative, comprehensive, and applicable solutions for the construction industry.

The risk assessment of building construction project failure is an innovation aimed at simplifying the process of evaluating risks in such projects, as it covers risk identification, assessment, management, and supervision. By providing an assessment of construction and building failures, this approach enables easier analysis and prevention of failures in building projects. This research was conducted to assess the risk of failure in building projects by helping to identify and measure related risks, address construction problems, prevent project delays, and avoid cost overruns. Additionally, it allows users to collect data and analyze both the probability and impact of risks through an application-based system.

Based on the above background, the formulation of the problem in this study includes several important questions. First, what are the main factors that cause failure in the implementation of construction, whether due to natural factors or human error? Second, how can the process of identifying and measuring the risks of construction failure be carried out in accordance with engineering rules, based on *Article 60 paragraph 1 of Law Number 2 of 2017*? Furthermore, this study aims to formulate effective strategies for managing the risks of construction failure so that project goals can be achieved in terms of time, cost, and quality. Finally, how can Android application-based models be developed to detect, analyze, and mitigate construction failure risks quickly and accurately?

The purpose of this study is to identify the main factors causing failures in construction implementation, whether from natural causes or human error. In addition, it seeks to develop methods for identifying and measuring the risk of construction project failure in accordance with engineering principles. This study also aims to formulate effective risk management strategies to minimize the potential for construction failure and ensure the achievement of project objectives. Moreover, the research will develop an intelligent, Android-based application model to efficiently and accurately detect, analyze, and mitigate construction failure risks.

The expected benefits of this study include contributing theoretically to the enrichment of construction risk management literature through an analysis of the factors causing failure. It is also expected to provide a foundation for drafting or revising government policies related to construction, thereby improving safety, quality, and project sustainability. Furthermore, this research supports the implementation of more effective risk management by assisting in the identification, measurement, and mitigation of failure risks. Finally, it aims to produce an intelligent Android-based application to detect and manage construction project failure risks, improve efficiency, and support fast, accurate decision-making.

## RESEARCH METHODS

The location of this research encompasses all project activities in West Nusa Tenggara, particularly those related to acceleration program projects. This aligns with *Peraturan Presiden*

*Republik Indonesia Nomor 84 Tahun 2021* concerning the Master Plan for the *Lombok–Gili Tramena* National Tourism Destination for 2012–2022.

**Form of Research**

This study employs a combination of quantitative and descriptive approaches. The quantitative approach is used to collect and analyze data on the failure risk assessment model for the implementation of building construction projects that utilize risk management applications. Meanwhile, the descriptive approach provides a detailed overview of the characteristics of these projects, particularly those involving the use of applications in managing risk.

**Research Stages**

Interviews and questionnaires were conducted with experts in their respective fields to identify the key research variables, which were then developed into research questionnaires.

**Data Analysis**

Data analysis is carried out to determine the causative factors, influences, and risk levels associated with construction project failure. The average score for each factor is calculated from the questionnaire data. Furthermore, latent variable analysis is applied to explore the complex relationships between variables that are not directly measured. Validity and reliability tests are conducted on the questionnaire items to ensure that the measurement instrument accurately and consistently records data. Subsequently, risk levels are assessed using risk analysis techniques involving latent variable models. Demographic data, such as age, highest level of education, and length of work experience, obtained from the questionnaires, are processed using *Excel* software.

## RESULTS AND DISCUSSION

The data analysis in this study includes the analysis of building failure variables and construction implementation based on literature studies as research support, respondent analysis, data analysis of building failure projects and construction implementation failures. Risk variables, Impact analysis, failure frequency analysis, failure impact analysis, validity and reliability analysis, failure risk level analysis and model analysis using the MS. Excel program.

**Results of Questionnaire Analysis Phase 1**

Based on the questionnaire distributed by the researcher, a total of 22 respondents were obtained that revealed the distribution of respondents based on the demographics of the respondents.

**Table 1. Results of Questionnaire Analysis Phase 1**

| Risk Variables | Score 1 | Score 2 | Score 3 | Score 4 | Score 5 | Total Respondents | Validity Result | Total Score |
|---|---|---|---|---|---|---|---|---|
| b | c | d | e | f | h | l | j | k |
| | | | | | | (c+...+h) | R table (0.537) | = (c*1) ...+(h*5) |
| FROM THE CONTRACTOR/PROVIDER SIDE | | | | | | | | |
| Low Project Manager Performance Factor (X1) | 0 | 0 | 7 | 7 | 8 | 22 | 0.758 | 89 |
| Inadequate contractor finances (X2) | 0 | 1 | 6 | 7 | 8 | 22 | 0.596 | 88 |
| Poor contractor management/poor performance | 6 | 6 | 10 | 0 | 0 | 22 | 0.168 | 50 |
| Inadequate contractor experience | 8 | 10 | 4 | 0 | 0 | 22 | 0.232 | 44 |
| Delay in payment of progress to subcontractors (X3) | 1 | 6 | 8 | 7 | 0 | 22 | 0.795 | 80 |
| Shortage of raw materials (X4) | 1 | 7 | 7 | 7 | 0 | 22 | 0.744 | 83 |
| Lack of efficient manpower and resources/difficulty attracting good personnel | 8 | 6 | 7 | 1 | 0 | 22 | 0.522 | 42 |

| Risk Variables | Score 1 | Score 2 | Score 3 | Score 4 | Score 5 | Total Respondents | Validity Result | Total Score |
|---|---|---|---|---|---|---|---|---|
| b | c | d | e | f | h | l | j | k |
| Inadequate equipment availability (X5) | 1 | 8 | 1 | 6 | 6 | 22 | 0.782 | 82 |
| Lack of Coordination Between Teams (X6) | 2 | 6 | 6 | 8 | 0 | 22 | 0.549 | 83 |
| Labor Conflict | 5 | 11 | 1 | 6 | 0 | 22 | 0.441 | 43 |
| Conflict Between Parties (x7) | 2 | 7 | 7 | 6 | 0 | 22 | 0.697 | 82 |
| Delays in Delivery of Imported Materials | 7 | 7 | 7 | 1 | 0 | 22 | 0.521 | 42 |
| Lack of Workforce Qualifications | 8 | 10 | 4 | 0 | 0 | 22 | 0.232 | 44 |
| Disruption to Material Delivery Routes | 8 | 6 | 7 | 1 | 0 | 22 | 0.522 | 41 |
| Subcontractor Work Issues | 6 | 6 | 10 | 0 | 0 | 22 | 0.168 | 42 |
| Poor Material Quality (X8) | 0 | 2 | 7 | 8 | 5 | 22 | 0.783 | 84 |
| FROM CONSULTANT | | | | | | | | |
| Poor design capacity and frequent design changes (X9) | 0 | 0 | 2 | 8 | 12 | 22 | 0.755 | 98 |
| Design errors, especially with regard to construction methods and use | 5 | 10 | 7 | 0 | 0 | 22 | 0.034 | 46 |

Source: Primary data analysis, 2025

**Results of Questionnaire Analysis II**

Results of the validity testMeasurement The test is carried out by determining the value of Rxy and Rtotal using the CORREL formula to compare the value of N with the value of Rxy to determine its validity.

**Table 2. Results of Questionnaire Analysis II**

| Validity Probabilities/Frequency (P) | | | | Impax/Impact Validity (I) | | | |
|---|---|---|---|---|---|---|---|
| NO | Rxy | Table | Status | NO | Rxy | Table | Status |
| X1 | 0.396 | 0.207 | Valid | X1 | 0.466 | 0.207 | Valid |
| X2 | 0.812 | 0.207 | Valid | X2 | 0.215 | 0.207 | Valid |
| X3 | 0.398 | 0.207 | Valid | X3 | 0.384 | 0.207 | Valid |
| X4 | 0.378 | 0.207 | Valid | X4 | 0.653 | 0.207 | Valid |
| X5 | 0.451 | 0.207 | Valid | X5 | 0.477 | 0.207 | Valid |
| X6 | 0.445 | 0.207 | Valid | X6 | 0.270 | 0.207 | Valid |
| X7 | 0.416 | 0.207 | Valid | X7 | 0.216 | 0.207 | Valid |
| X8 | 0.753 | 0.207 | Valid | X8 | 0.719 | 0.207 | Valid |
| X9 | 0.213 | 0.207 | Valid | X9 | 0.710 | 0.207 | Valid |
| X10 | 0.217 | 0.207 | Valid | X10 | 0.470 | 0.207 | Valid |
| X11 | 0.309 | 0.207 | Valid | X11 | 0.530 | 0.207 | Valid |
| X12 | 0.589 | 0.207 | Valid | X12 | 0.516 | 0.207 | Valid |
| X13 | 0.654 | 0.207 | Valid | X13 | 0.466 | 0.207 | Valid |
| X14 | 0.821 | 0.207 | Valid | X14 | 0.595 | 0.207 | Valid |
| X15 | 0.406 | 0.207 | Valid | X15 | 0.526 | 0.207 | Valid |
| X16 | 0.784 | 0.207 | Valid | X16 | 0.307 | 0.207 | Valid |
| X17 | 0.569 | 0.207 | Valid | X17 | 0.334 | 0.207 | Valid |
| X18 | 0.228 | 0.207 | Valid | X18 | 0.318 | 0.207 | Valid |
| X19 | 0.267 | 0.207 | Valid | X19 | 0.310 | 0.207 | Valid |

Source: Validity test results, 2025

**Reliability Test Results**

The results of the calculation of the Reliability test with the equation formula According to Samuels (2015), a Realism value of > 0.2 was produced, the results of the Reliability Test calculation are attached.

**Table 3. Reliability Test**

| Probability Reliability Test | | Impax Reliability Test | |
|---|---|---|---|
| Number of Variants of Grains | 12,08 | Number of Variants of Grains | 14,80 |
| Total Variants | 1.978,00 | Total Variants | 2.375,00 |
| R11 | 0,21 | R11 | 0,21 |
| Reliability Value | 0,21 | Reliability Value | 0,21 |

Source: Reliability analysis (Samuels, 2015)

With a reliability value of 0.21, it has reached or exceeded the minimum threshold of 0.2 which is commonly used in the context of reliability. The elixirity can be considered still acceptable. The value still indicates that there is room for improvement in the reliability of the measurement instruments or variable items used in the analysis.

**Determining the Risk Level of the Probability and Impact Matrix**

We determine the probability level (P) and impact level (I) on a scale of 1 to 5, with 1 low and 5 high. Then we will calculate the result of P x I to get the "*Probability x Impact"*. The following results of the calculation are presented.

**Table 4. Determining the Risk Level of the Probability and Impact Matrix**

| Variable | Probability (P) | Impact (I) | Probability x Impact | Matrix Values | Risk Level |
|---|---|---|---|---|---|
| X01 | 3.08 | 3.89 | 11.98 | 12 | Medium |
| X02 | 2.86 | 4.09 | 11.71 | 12 | Medium |
| X03 | 2.16 | 2.51 | 5.42 | 5 | Low |
| X04 | 3.08 | 3.81 | 11.76 | 12 | Medium |
| X05 | 2.86 | 3.35 | 9.60 | 9 | Medium |
| X06 | 2.11 | 2.55 | 5.40 | 5 | Low |
| X07 | 2.69 | 3.66 | 9.86 | 10 | Medium |
| X08 | 2.86 | 3.03 | 8.69 | 9 | Medium |
| X09 | 2.76 | 3.78 | 10.46 | 10 | Medium |
| X10 | 2.82 | 2.95 | 8.32 | 8 | Medium |
| X11 | 2.81 | 3.12 | 8.79 | 9 | Medium |
| X12 | 2.88 | 3.12 | 8.99 | 9 | Medium |
| X13 | 2.78 | 3.27 | 9.10 | 9 | Medium |
| X14 | 2.82 | 3.23 | 9.12 | 9 | Medium |
| X15 | 3.01 | 3.94 | 11.87 | 12 | Medium |
| X16 | 2.81 | 4.39 | 12.34 | 12 | Medium |
| X17 | 3.71 | 4.34 | 16.11 | 16 | High |
| X18 | 4.47 | 4.57 | 20.43 | 20 | High |
| X19 | 4.30 | 4.57 | 19.67 | 20 | High |

Source: Risk assessment using P x I Matrix, 2025

**Classification of Building Failure**

Actor source-based building failure classification table

**Table 5. building failure classification**

| Variable Ratio | Code | Actor Base | | Risk Level | | |
|---|---|---|---|---|---|---|
| | | | | Low | Med | High |
| No maintenance and operational budget | X15 | OW4 | Owner | | V | |

Source: Actor-based risk categorization, 2025

Segment building failures based on the actors involved and the level of risk. The risk variable of the absence of maintenance and operational budget is considered low if the budget has been prepared well, medium if there is little uncertainty, and high if there is no budget at all.

Risk source-based classification of building failures.

**Table 6. classification of building failures**

| Risk Variables | Code | Risk Source Base | Risk Level | | |
|---|---|---|---|---|---|
| | | | Low | Med | High |
| Damage to building structures | X17 | NR1 - Natural Risk | | | V |
| Flood/Landslide Consequences | X18 | NR2 - Natural Risk | | | V |
| Impact of Earthquakes above 6 Richter Scale | X19 | NR3 - Natural Risk | | | V |

Source: Risk source classification, 2025

Group building failures based on their source of risk. Each risk variable has a code, a risk source base, and a risk level that is divided into three levels: Low, Medium, and High.

Application is a process that connects theory to practical life, requires a deep understanding of the concept or theory to be applied, and then identifies its relevance in real-life situations. The main purpose of applying this concept is to solve various problems, meet needs, or achieve certain goals both in everyday life and in the context of industry.

The result or output of this research is the development of a Risk Check Level application that provides solutions for risk management in construction projects. After downloading the Risk Check Level application on the Play store, the "Welcome Splashscreen" display will immediately appear (figure 1),


**Figure 1. Display "Welcome Splashscreen**

Source: Author's developed application, 2025

Then this application provides facilities to enter customer biodata (figure 5.8), next will display the Contractor Dashboard, consultant, Owner, human risk, and Natural risk (figure 5.9), then the contractor dashboard details (Figure 5.10) will appear which contains a selection of risk variables sourced from the contractor side, Consultant Dashboard Details (figure 5.12) which contains a selection of risk variables sourced from the consultant side,  The Owner Dashboard

Details (figure 5.13) which contains a selection of risk variables sourced from the owner side, the Human Risk Dashboard Detail (figure 5.11) which contains a selection of risk variables sourced from the human risk side, and the Natural Risk Dashboard Detail (figure 5.14) which contains a selection of risk variables sourced from the natural risk side, and provides information about the type of failure that may occur (figure 5.15). then the display of the Selected Risk page of the selected results will appear on the detailed dashboard (figure 5.16), then the menu of the selected risk results from the selected risk page will appear (figure 5.17), followed by the display of the step page to reduce risk, the anticipation step (the display is like figure 5.18) and the last step is the conclusion will appear the display of the conclusion page containing the customer's biodata, The type of risk, the risk level of the failure category, and the recommended solution.

Once the Risk Check Level App is launched and available for download via the web and Play Store, we welcome many responses from users who actively leave reviews about their experience using the app. These reviews provide valuable insights into various aspects of the app, user feedback also helps us identify areas that need improvement or improvement, as well as additional features that can be incorporated into future versions of the app. By paying attention to feedback from users, we aim to continuously improve the quality and performance of the Risk Check Level App to meet the needs and expectations of our users to the maximum.

## CONCLUSION

Based on quantitative and qualitative data analysis, this study identified 19 risk factors that contribute to building failure and construction execution issues, including low project manager performance, inadequate contractor finances, and poor material quality. The risk levels for these factors range from low to high. The results of the analysis using the *Matrix Probability–Impact* method indicate that several factors—such as damage to building structures and the impact of earthquakes above magnitude 6 on the Richter scale—carry high risks. This research also formulates a risk management strategy to mitigate potential losses and develops a Flutter-based application called *Risk Check Level* to detect and manage risks in construction projects. The implementation of these strategies includes contractor evaluation, project manager training, and strict quality control, all aimed at improving project success. Recommendations from this research include the development of more accurate risk assessment methods and the implementation of field validation to ensure alignment with real-world conditions. Comparative studies with existing risk models are also advised to identify their strengths and weaknesses for further improvement. It is expected that future research will produce a comprehensive and integrated risk assessment methodology to enhance the quality of construction risk management.

After analyzing the risk factors contributing to construction and building implementation failures, it is further recommended to develop more precise risk assessment methods using mathematical models or advanced analytical techniques. These assessments should comply with both national and international safety standards through regular consultations with relevant agencies. Field validation is crucial to ensure the assessments are applicable to actual conditions, and the results should be used to calibrate the models. Additionally, comparative studies with existing risk models should be carried out to identify advantages and limitations, serving as a basis for further development. Future research is expected to result in a more comprehensive and integrated risk assessment methodology that considers a wide range of factors and incorporates new technologies, thereby improving the quality and accuracy of construction risk management.

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