

RESEARCH ARTICLE

Project Risk Evaluation of the Aceh Besar-Lamno Border Road Development in Aceh Jaya, Indonesia

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ABSTRACT

The development of road infrastructure plays a strategic role in supporting regional economic growth. The Government of Aceh, through funding from the Aceh Revenue and Expenditure Budget (APBA) and the Special Autonomy Fund (OTSUS), has consistently promoted the acceleration of road network construction and rehabilitation, one of which is the Aceh Besar-Lamno Border Road Project in Aceh Jaya Regency. This study aims to identify and analyze the risk factors that affect project implementation, as well as to determine the most dominant risk factor. The research employed a quantitative approach using descriptive analysis assisted by SPSS software version 21. Data were collected through field surveys using questionnaires that examined nine main categories of risk. The results indicate the following order of risk factor priorities: contractual risk (mean 26.65), time and control risk (23.58), material risk (22.38), equipment risk (18.45), environmental risk (18.30), change risk (15.50), financial risk (14.60), labor risk (11.95), and government relations risk (9.08). Based on these findings, contractual risk was identified as the dominant factor, whereas government relations risk had the lowest level of influence. These findings contribute to risk management efforts in road infrastructure projects, particularly in supporting decision-making processes and developing risk mitigation strategies for similar projects in the future.

Keywords: Infrastructure Project Risk, Road Construction Management, Quantitative Risk Analysis, Contract Risk Factors, Aceh Infrastructure Development

INTRODUCTION

Infrastructure development is one of the main priorities in supporting economic growth and equitable development in Indonesia. Among various forms of infrastructure, roads play a strategic role as the backbone of the land transportation system [1]. The existence of an adequate road network not only facilitates the mobility of goods and services but also enhances regional accessibility, strengthens national integration, and promotes economic growth in both urban areas and remote regions. Moreover, roads also serve social, cultural, and defense functions, making their development and maintenance a shared responsibility that must be managed sustainably [2,3].

The commitment of both the central and regional governments to road infrastructure development is reflected in the increasing budget allocations each year [4]. For instance, in 2022 the government allocated a significant amount of funding for new road construction, road quality improvement, and national strategic projects, including the Trans-Sumatra Toll Road. In Aceh Province, road infrastructure development is also a priority program, including multiyear projects aimed at opening access to isolated areas and supporting the socio-economic activities of local communities [5,6].

Despite massive road infrastructure development efforts, the quality of completed projects remains a critical issue. Many road projects experience damage within a relatively short period after construction completion. While vehicle overloading is often regarded as the main cause, various other technical factors also contribute, such as weak implementation of quality management systems, the use of materials not meeting specifications, and inefficiencies in equipment and construction methods [7,8]. These conditions highlight that road development not only requires substantial financial investment but also effective management and a robust risk control system [9,10].

As part of quality control efforts, the Ministry of Public Works and Public Housing (PUPR) has issued several regulations, including Ministerial Regulation No. 04/PRT/M/2009 concerning the implementation of quality management systems in construction projects [11]. This regulation aims to ensure work quality from the planning stage through project execution. However, its field implementation still faces various challenges, such as low awareness of the importance of quality systems, weak supervision, and a lack of commitment among contractors to adhere to established standards [12,13].

Failure to identify and manage risks from the early stages of a project can result in significant technical and financial losses [14,15]. Therefore, studies on the risk factors influencing the implementation of road construction projects are essential [16]. This research focuses on identifying and analyzing risk factors in the implementation of the Aceh Besar-Lamno Border Road Project in Aceh Jaya Regency, as well as determining the most dominant risk factors [17]. The results of this study are expected to contribute to improving quality management, risk control, and the development of more appropriate contractor selection criteria to support the sustainable success of road construction projects [18-20].

MATERIALS AND METHODS

This section describes in detail and systematically the processes and stages related to data collection, data processing, and data analysis in order to obtain the research results. The research procedure is outlined in several steps.

RESEARCH LOCATION AND TIME

The research was conducted on the Aceh Besar-Lamno Border Road construction project located in Aceh Jaya Regency, Indonesia (Figure 1). Data collection was carried out in August 2023, during the ongoing implementation of the project. The research respondents consisted of the Budget User Authority

(KPA), the Technical Implementation Officer (PPTK), representatives from the contractor PT. Putra Ananda, and the supervision consultant, all of whom were selected due to their direct involvement in the project execution.



Figure 1. Research location of the Aceh Besar-Lamno Border Road construction project located in Aceh Jaya Regency, Indonesia

DATA SOURCES AND COLLECTION METHODS

Primary data were obtained through structured questionnaires, interviews, and field observations. The questionnaire instrument was developed based on previous studies and consisted of closed-ended questions designed to explore risk factors influencing construction quality [21].

Secondary data were collected from relevant institutions, including the Aceh Provincial Statistics Agency (BPS), PT. Putra Ananda (project documents and internal reports), and the Aceh Public Works and Housing Agency (PUPR). These data were used to complement and validate the primary data, particularly with regard to project specifications, funding, scheduling, and organizational structure.

POPULATION AND SAMPLING TECHNIQUE

The research population comprised project stakeholders, including technical staff from the Public Works and Housing Agency (PUPR), the contractor (PT. Putra Ananda), and the supervision consultant. Respondent selection was conducted

using a total sampling technique. The total sample consisted of 40 respondents: 15 from the PUPR Agency, 14 from the contractor, and 11 from the supervision consultant.

RESEARCH VARIABLES

The research variables were focused on risk factors (independent variables) that affect project quality. Based on a literature review, risks were classified into nine categories comprising a total of 51 indicators, as follows:

Categories and Risk Variables:

1. Material (X1-X7) - issues such as delays, shortages, and material changes.
2. Labor (X8-X11) - shortage of workers, low productivity, and inadequate skills.
3. Equipment (X12-X17) - aging heavy machinery, delivery delays, and poor operation.
4. Financial (X18-X22) - payment delays and economic instability.
5. Environmental (X23-X28) - weather conditions, natural disasters, and site accessibility.
6. Design Changes (X29-X33) - design errors and soil condition issues.
7. Government Relations (X34-X36) - permits and bureaucratic processes.
8. Contract (X37-X45) - conflicts, poor communication, and subcontractor management.
9. Scheduling and Control (X46-X51) - planning, testing procedures, and delays.

DATA COLLECTION TECHNIQUE

The data collection methods included the following:

- Questionnaire: A structured instrument consisting of closed-ended questions measured using a Likert scale. Respondents selected answers based on their own experiences.
- Observation: Direct visits to the project site were conducted to observe the working environment, project progress, and potential risks encountered.
- Interview: Conducted with selected personnel to validate the questionnaire data and obtain deeper insights into the identified issues.

DATA PROCESSING AND INSTRUMENT TESTING

The data obtained from the questionnaires were first tested to ensure the quality of the research instrument. A validity test was conducted to assess the suitability of each question item with its corresponding variable, while a reliability test using the Cronbach's Alpha method was performed to evaluate the consistency of the responses. Data processing was carried out using SPSS software.

DATA ANALYSIS TECHNIQUE

Data were analyzed using descriptive statistical methods to identify the most dominant risk factors. The analysis steps were as follows:

1. Coding and entering data into SPSS.
2. Conducting frequency analysis of respondent characteristics and variable responses.
3. Calculating the mean values for each risk variable.
4. Ranking the risk factors based on their mean values to determine the most influential factors.
5. Presenting the results in the form of tables and graphs.

SUGGESTIONS FOR FUTURE RESEARCH

Future research is recommended to expand the scope of samples and project locations, integrate qualitative analysis to deepen the understanding of risk factors, evaluate mitigation strategies in similar projects, and examine the relationship between specific risk categories and the degree of project delay.

RESULTS AND DISCUSSION

The research results are presented in the form of graphs, which can be used to discuss issues related to the project plan.

FREQUENCY DISTRIBUTION OF RESPONDENT CHARACTERISTICS

The respondents in this study consist of individuals directly involved in the implementation of the Aceh Besar-Lamno Border Road Construction Project in Aceh Jaya District, totaling 40 participants. This number was purposively determined to represent various elements of the project implementation team, including project managers, field supervisors, technical personnel, and administrative staff, in order to obtain a comprehensive overview of project execution. The selection of 40 respondents was based on the accessibility of the population, the relative homogeneity of respondent characteristics, and the adequacy of data for quantitative descriptive analysis—such as validity, reliability, and descriptive statistical testing. The identified respondent characteristics include gender, age, level of education, work experience, and position within the project organization. This general profile aims to describe the respondents' attributes comprehensively and ensure that the data collected accurately reflect the actual conditions of the project personnel.

The characteristics of the 40 respondents showed that, based on gender distribution, all respondents (100%) were male. Based on age distribution, it was found that among the 40 respondents, none (0%) were aged 18–25 years, 7 respondents (17.5%) were aged 26–35 years, 12 respondents (30%) were aged 36–45 years, 17 respondents (42.5%) were aged 46–55 years, and 4 respondents (10%) were aged over 55 years. The percentage distribution of respondents by age is shown in Figure 2.

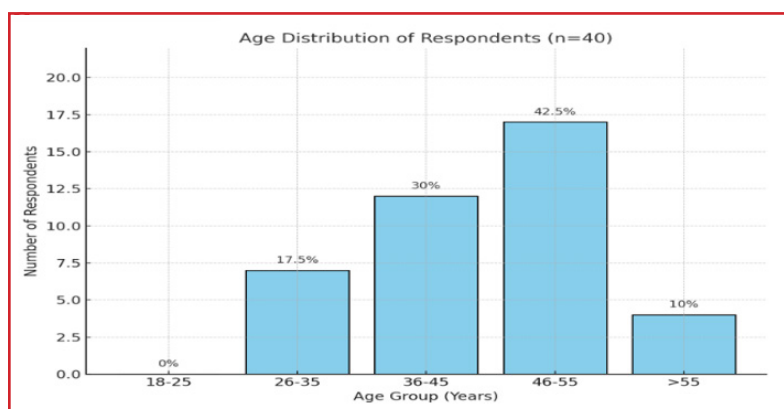


Figure 2. Graph of respondent frequency distribution by age

The characteristics of the 40 respondents showed that, based on educational level, 7 respondents (17.5%) had completed senior high school (SMA), none (0%) had a diploma (D3), 29 respondents (72.5%) held a bachelor's degree (S1), 4 respondents (10%) held a master's degree (S2), and none (0%) held a doctoral degree (S3). The percentage distribution of respondents based on educational level is presented in Figure 3.

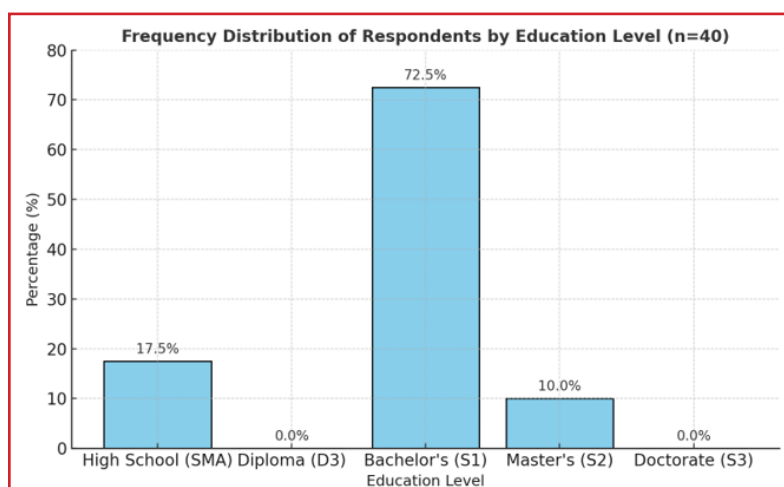


Figure 3. Graph of respondent frequency distribution by educational level

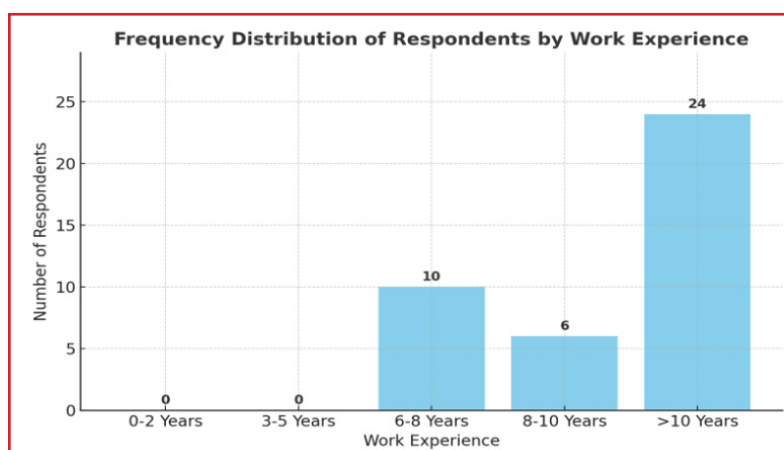


Figure 4. Graph of respondent frequency distribution by work experience

The characteristics of the 40 respondents showed that, based on work experience, none (0%) had 0–2 years of experience, none (0%) had 3–5 years of experience, 10 respondents (25%) had 6–8 years of experience, 6 respondents (15%) had 8–10 years of experience, and 24 respondents (60%) had more than 10 years of experience. The percentage distribution of respondents based on work experience is presented in Figure 4.

The characteristics of the 40 respondents showed that, based on job position, 1 respondent (2.5%) held the position of Budget User Authority (KPA), 2 respondents (5%) were Technical Implementation Officers (PPTK), 10 respondents (25%) were Expert Staff, 21 respondents (52.5%) were Field Supervisors, 2 respondents (5%) were Site Engineers, 2 respondents (5%) were Supervisors, and 2 respondents (5%) were Managers. The percentage distribution of respondents based on job position is presented in Figure 5.

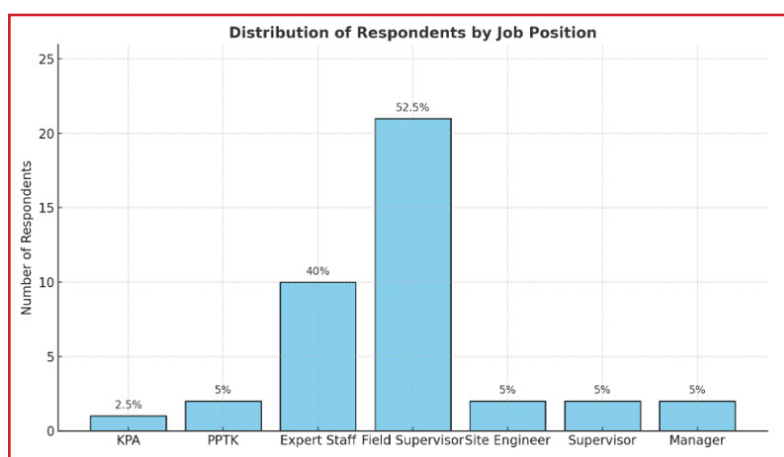


Figure 5. Graph of respondent frequency distribution by job position

FREQUENCY DISTRIBUTION OF RESEARCH VARIABLES

In this section, the frequency distribution of each research variable is analyzed descriptively to provide a comprehensive overview of the characteristics of the sample used. The research variables observed include key aspects of project management, namely: materials, labor (manpower), equipment, finance, environment, changes, government relations, contracts, and scheduling and controlling.

This descriptive analysis aims to identify the distribution and trends of data for each variable, such as frequency, percentage, maximum and minimum values, and measures of central tendency (mean or median). These insights provide an initial understanding of the actual conditions in the field prior to conducting further inferential analysis. This approach aligns with modern quantitative research practices in project management, where understanding the characteristics of variables forms an essential foundation for interpreting results and supporting data-driven decision-making.

DESCRIPTIVE ANALYSIS

Descriptive statistical analysis refers to the use of statistics to analyze data by describing or summarizing the data that have been collected. Descriptive statistics transform raw data into clearer and more easily understood information, providing an overview of the research findings and illustrating the relationships among the independent variables. The research results for each variable can be identified, and the descriptive analysis of the nine examined variables is presented in Table 1.

Table 1. Descriptive statistics of the nine examined variables

Risk Factor	N	Range	Minimum	Maximum	Sum	Mean
Material	40	28	7	35	895	22.38
Labor	40	16	4	20	478	11.95
Equipment	40	24	6	30	738	18.45
Finance	40	20	5	25	584	14.60
Environment	40	24	6	30	732	18.30
Changes	40	20	5	25	620	15.50
Government Relation	40	12	3	15	363	9.08
Contract	40	36	9	45	1066	26.65
Time and Control	40	32	8	40	943	23.58
Valid N (listwise)	40					

Based on the descriptive analysis of the nine variables studied, it was found that the dominant factor in this research, with the highest mean value, was the contract factor (26.65), followed by the time and control factor (23.58), the material factor (22.38), the equipment factor (18.45), the environmental factor (18.30), the change factor (15.50), the financial factor (14.60), and the labor factor (11.95). The factor with the lowest mean value was government relations, with a score of 9.08.

CONCLUSION

Based on the research conducted using descriptive analysis with the assistance of SPSS version 21, the analysis results show that among the nine variables examined, the most dominant risk factors influencing the implementation of the Aceh Besar-Lamno Border Road Project in Aceh Jaya Regency are as follows:

1. The mean values of the risk factors are as follows: contract risk factor (26.65), time and control risk factor (23.58), material risk factor (22.38), equipment risk factor (18.45), environmental risk factor (18.30), change risk factor (15.50), financial risk factor (14.60), labor risk factor (11.95), and government relations risk factor (9.08).
2. The most dominant risk factor affecting the implementation of the Aceh Besar-Lamno Border Road Project in Aceh Jaya Regency is the contract risk factor, while the least dominant is the government relations risk factor.

This study presents a novelty by identifying and ranking nine risk factors that influence the implementation of the Aceh Besar-Lamno Border Road Project in Aceh Jaya Regency through a descriptive analysis approach assisted by SPSS version 21. The findings indicate that the contract risk factor is the most dominant, whereas the government relations factor has the least influence. These results reveal a different risk characteristic compared to construction projects in other regions, where time or financial risks are usually more dominant. This approach represents an innovation in infrastructure project risk evaluation, as it provides context-specific data that can assist decision-makers in formulating more targeted and effective risk mitigation strategies, particularly in regions with complex social and administrative conditions such as Aceh Jaya.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Munawar: methodology, data curation, writing- original draft preparation.
Bunyamin Bunyamin: visualization, supervision, writing - review & editing.
Heru Pramanda: formal analysis, investigation, writing- original draft preparation.

DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are included within the article.

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