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Analysis of OHS Risk Management and Risk Impact on Project Implementation Time Using the Risk Breakdown Structure (RBS) Method in the Construction of the RKB MIN 5 Tulungagung Building

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ABSTRACT

The construction of the New Classroom Building (RKB) at MIN 5 Tulungagung has potential Occupational Safety and Health (OSH) risks because it involves construction activities, work equipment, labor, and diverse project environmental conditions. This study aims to identify OSH risk factors, determine risk levels and priorities, and analyze the impact of dominant risks on project implementation time. The results show that there are 20 OSH risk factors classified into environmental, human, equipment, work method, and management/organizational factors. The highest dominant risk is the lack of internal communication and coordination among project parties, with a risk value of 12.240. Other priority risks include extreme weather 11.778, dust exposure due to construction activities 10.444, and lack of worker skills 10.427, which are classified as high risks, while not using personal protective equipment (PPE) 9.747 is classified as a moderate risk. No risks are classified as very high. Based on expert judgement, extreme weather has the greatest estimated delay of 1–7 days, while other risks may cause delays of 1–3 days. Therefore, OSH risk control needs to be implemented systematically to improve work safety, maintain work smoothness, and support timely project implementation

INTRODUCTION

The construction of educational buildings is a construction activity that has a high potential for Occupational Safety and Health (OHS) risks because it involves various work elements, such as labor, equipment uses, construction materials, implementation methods, and project environmental conditions that continue to change during the work process. The importance of OHS risk management in this sector can be seen from national data showing that the number of work accidents in Indonesia in 2024 reached 462,241 cases (Kontan, 2024; Ministry of Manpower of the Republic of Indonesia, 2024). Entering 2025, a number of publications and secondary data also show that the number of work accidents remains at a high level (LSP Katiga Pass, 2025; KSPI CITU, 2025). On a regional scale, East Java Province recorded 43,824 cases of work accidents throughout 2025 based on BPJS Employment data submitted by the East Java Manpower and Transmigration Office (Memorandum, 2026). This data indicates that the implementation of OHS, particularly in the construction sector in East Java, still faces various challenges, necessitating more structured and systematic risk management.

These OHS issues are also related to local conditions in Tulungagung Regency. In 2025, a work accident was reported on a building construction project, which is still under investigation by authorities (ANTARA East Java, 2025). This incident demonstrates that the potential for work accidents in construction activities in the Tulungagung region still requires serious attention, particularly on educational building projects, which are characterized by high-risk work. These risks can arise during excavation work, foundation work, structural work, material distribution through limited access roads, and interactions between project activities and the surrounding community and road users in residential areas. Furthermore, drainage conditions, material placement, and construction waste management also have the potential to impact safety and smooth work progress, as the project site directly borders residential areas.

Referring to PUPR Ministerial Regulation No. 10 of 2021 concerning the Construction Safety Management System (SMKK), construction safety implementation should be carried out in an integrated manner through the planning, implementation, control, and risk evaluation stages. However, based on a review of the Construction Safety Plan (RKK) and Construction Safety Quality Plan (RMKK) documents for the MIN 5 Tulungagung RKB construction project, OHS risk management has not been systematically and comprehensively structured. At the planning stage, the RKK document does not include a quantitative risk assessment, including parameters for risk likelihood, impact level, and risk value. It also does not demonstrate the use of a risk matrix as a basis for determining control priorities. Furthermore, the risk control strategy has not been fully developed based on a control hierarchy, is not complemented by an evaluation of control effectiveness, and does not demonstrate a clear relationship between risk levels and the implemented construction safety action plan. At the implementation stage, the RMKK document also still shows several limitations, including the lack of a comprehensive Job Safety Analysis (JSA) for each work activity, the absence of a detailed explanation of safe work methods, and the less-than-optimal implementation of the monitoring system, audits, OHS documentation, reporting, and evaluation of work safety indicators. These conditions indicate that the integration between the RKK and RMKK documents in OHS risk management still needs to be improved, especially in linking risk levels with control strategies and their impact on the smoothness and time of project implementation. Therefore, a more structured OHS risk analysis is needed so that the process of identification, assessment, prioritization, and risk control can be used as a basis for more effective decision-making in the MIN 5 Tulungagung RKB development project.

These conditions indicate that OHS risk management in the MIN 5 Tulungagung RKB construction project still requires strengthening, particularly in linking risk levels to control strategies implemented in the field. Control efforts that are still focused on the provision of personal protective equipment (PPE) are deemed inadequate to address all potential risks, as risk management also requires support in the form of occupational safety supervision, technical controls, work area arrangements, safety outreach, and control of interactions between project activities and the surrounding community. Therefore, an analysis is needed to prioritize risks and develop control strategies appropriate to the actual project conditions, thereby optimally maintaining occupational safety, smooth work progress, and timely project implementation.

During the construction of the New Classroom Building (RKB) at MIN 5 Tulungagung, initial observations revealed several conditions that could potentially pose Occupational Safety and Health (OHS) risks. These potential risks include inadequately organized material placement, the presence of sharp objects in construction materials that lack protective equipment, high worker mobility and material distribution, inadequate use of personal protective equipment (PPE), and limited installation of warning signs and work area boundaries. Furthermore, the project's location in a residential area with limited road access also poses potential risks to the surrounding community, particularly during the mobilization of project materials and equipment. This situation indicates that the OHS risks in this project relate not only to the safety of workers but also to the safety of the environment and the surrounding community.

These field findings align with several previous studies, which state that human factors, work methods, equipment, environmental conditions, and project management are the primary causes of the increased risk of workplace accidents in construction projects. The dominant risks in building projects are generally related to low worker discipline, lack of compliance with PPE use, suboptimal implementation of OHS standards, weak supervision, and ineffective control of work methods and equipment use (Setiawan et al., 2023; Safitri, 2023; Suyitno et al., 2025). Furthermore, Yamin et al. (2022) explain that risks in construction projects can also be influenced by suboptimal coordination between project parties, thus impacting the smooth implementation of work. Poorly managed OHS risks not only impact worker safety but can also hinder the smooth progress of work and potentially impact project implementation time. Therefore, an OHS risk analysis is required that can identify risk factors, determine risk levels and priorities, and serve as the basis for developing control strategies for the RKB MIN 5 Tulungagung Building construction project.

Studies on OHS risk management in construction projects generally discuss the stages of risk identification, risk grouping, risk level assessment, and determining dominant risks. The Risk Breakdown Structure (RBS) and Probability Impact Matrix approaches, for example, have been widely used to assist in the process of mapping and prioritizing risks in construction projects (Yamin et al., 2022). In building projects, dominant risks are also often associated with workforce factors, compliance with personal protective equipment (PPE) use, implementation of OHS standards, and on-site safety supervision (Suyitno et al., 2025). However, most of this research focuses on risk mapping and ranking, while the relationship between dominant OHS risks and their potential impact on project implementation time has not been specifically discussed. Furthermore, research on OHS risks in educational building construction projects located in residential areas with limited environmental access is also relatively limited. In fact, this condition is important to study because construction activities not only affect the safety of workers, but also have the potential to disrupt the smooth running of work and cause delays in project implementation.

The novelty of this research lies in the integration of the Risk Breakdown Structure (RBS) method, the Probability Impact Matrix, risk control strategies, and an expert judgment approach to analyze the impact of dominant risks on project implementation time. Thus, this research not only produces an OHS risk ranking but also provides an overview of the potential delays that could occur due to dominant risks in the MIN 5 Tulungagung RKB Building construction project.

To control potential Occupational Safety and Health (OHS) risks in construction projects, a structured risk management approach is required, implemented through the stages of identification, analysis, evaluation, and risk control. The implementation of this risk management is intended to identify each potential hazard early, then assess it based on its likelihood of occurrence and the magnitude of its impact, allowing control measures to be implemented according to the risk priority level. This principle aligns with the Construction Safety Management System, which emphasizes that construction safety management must be implemented through a continuous process of planning, implementation, control, and evaluation (Ministerial Regulation of the Ministry of Public Works and Public Housing No. 10 of 2021). Therefore, OHS risk management is not solely aimed at preventing workplace accidents but also supports the smooth implementation of construction activities as a whole. In this study, the Risk Breakdown Structure (RBS) method was used because it is considered capable of identifying and breaking down risks hierarchically based on their causes. Through this approach, OHS risks can be classified into several groups, namely human factors, equipment, work methods, the environment, and management/organization. This grouping facilitates the process of risk identification, risk level assessment, determining dominant risks, and developing control strategies tailored to the characteristics of field conditions. This finding aligns with research by Yamin et al. (2022), which states that the RBS method is effective for grouping risks and assisting in the process of determining control priorities in construction projects.

Essentially, there are several methods that can be used in Occupational Safety and Health (OHS) risk analysis, including Hazard Identification, Risk Assessment and Risk Control (HIRARC), Failure Mode and Effect Analysis (FMEA), and Job Safety Analysis (JSA). The HIRARC method focuses more on the process of hazard identification, risk assessment, and potential hazard control in specific work activities. Meanwhile, FMEA focuses on analyzing the likelihood of failure and prioritizing risks based on severity, likelihood of occurrence, and detectability. The JSA method is generally used to outline work stages and identify potential hazards at each step of the project. In contrast, the Risk Breakdown Structure (RBS) approach is used to group risks based on their source of origin and supports the risk prioritization process in construction projects (Yamin et al., 2022). Adapting to the characteristics of the RKB MIN 5 Tulungagung Building construction project, which has potential risks from human factors, equipment, work methods, the environment, and management/organization, the RBS method is considered more relevant as a basis for grouping risks before analyzing risk levels and determining control priorities. The selection of the RBS method for the construction project of the RKB MIN 5 Tulungagung Building is considered appropriate because this project has quite diverse risk characteristics, both from technical and non-technical aspects. These risks are not only related to construction work activities, but also include material mobilization in limited environmental access, work interactions with the surrounding community, and coordination between parties involved in the project. Therefore, the application of RBS in this study is expected to produce a more systematic K3 risk analysis and can be used as a basis for determining control priorities and analyzing the impact of risks on project implementation time.

Based on the description, this research is directed to compile a systematic and structured Occupational Safety and Health (OHS) risk management analysis on the MIN 5 Tulungagung RKB Building construction project in 2026. This research aims to identify OHS risk factors, determine the level and priority of risks based on probability and impact values, formulate risk control strategies, and analyze the influence of dominant risks on project implementation time through an expert judgment approach. The concrete output expected from this research is the compilation of risk priorities and control recommendations that can be directly implemented in the field, such as increasing the mandatory use of personal protective equipment (PPE), implementing safety briefings or toolbox meetings, supervising workers in risky areas, arranging materials and work access, installing signs and project area boundaries, and adjusting work to weather conditions as part of construction safety control (PUPR Ministerial Regulation No. 10 of 2021). In addition, the implementation of monitoring mechanisms, providing rewards, and sanctions (punishments) can also be utilized to improve worker compliance with OHS procedures in the field (Safitri, 2023). Thus, the results of this study are expected to contribute not only to academic aspects but also to serve as practical guidelines for project implementers in improving occupational safety, ensuring smooth work flow, and supporting timely construction project implementation (Riana et al., 2021).

The object of this research focuses on the physical construction work for the New Classroom Building (RKB) at MIN 5 Tulungagung in 2026. The research activities were conducted at the new building construction site in Tulungagung Regency, East Java Province, as part of the development of state Islamic elementary education facilities under the Ministry of Religious Affairs of the Republic of Indonesia. The location was selected based on the project's relatively high level of risk complexity. This is because the building is constructed on land directly adjacent to a residential area and is supported by limited access roads. These conditions give the project unique risk characteristics, as they relate not only to the safety of construction workers but also include the protection of the surrounding community, road users, and the security of the project area during the work process.

The scope of this research is limited to the implementation of physical construction work that directly poses Occupational Safety and Health (OHS) risks, specifically during the preliminary work, excavation, foundation, and structural stages. These work stages include project area preparation, earthwork and excavation, foundation work, reinforcement, formwork installation, and initial structural casting. Each stage has different risk characteristics, both in terms of technical aspects of implementation, the use of materials and equipment, and the potential interaction between construction activities and the surrounding community and road users. Based on these conditions, this research focuses on analyzing OHS risk management through the Risk Breakdown Structure (RBS) approach to identify and categorize risk factors, determine risk levels based on probability and impact, determine dominant risks, and analyze their impact on project implementation time. With this scope, the construction project of the RKB Building at MIN 5 Tulungagung is considered relevant for research because it is able to represent the complexity of risks in educational building projects located in residential areas with limited environmental access. Based on the description, this research needs to be conducted to systematically and structuredly assess Occupational Safety and Health (OHS) risk management in the 2026 RKB MIN 5 Tulungagung Building construction project. The research was conducted using the Risk Breakdown Structure (RBS) and Probability Impact Matrix methods to identify, classify, evaluate, and prioritize OHS risks, while developing control strategies tailored to actual conditions in the field. In addition, this research also examines the influence of dominant risks on project implementation time through an expert judgment approach. Thus, the research results are expected to be able to produce applicable risk control recommendations for project implementers in improving occupational safety, maintaining the smoothness of the work implementation process, and supporting the timely completion of construction projects.

THEORETICAL REVIEW

This study identified 24 risk items that occurred in housing projects, with the dominant risks originating from the construction process and suboptimal coordination between project parties. Analysis using the RBS and Probability Impact Matrix was able to group and determine the level of risk, while the ANP method was used to determine risk priorities more comprehensively. The results showed that improved project coordination and oversight are key factors in risk control to minimize the impact on project implementation. (Yamin et al. (2022)

The research results show that the dominant risks in building construction projects originate from labor factors, particularly related to indiscipline, low compliance with the use of personal protective equipment (PPE), and weak implementation of OHS standards in the field. The Risk Breakdown Structure (RBS) method has proven effective in systematically identifying and categorizing risk sources, particularly those originating from human factors. This research confirms that labor behavior is a key factor in the successful implementation of OHS risk management in construction projects. (Setiawan et al. (2023)

METHODOLOGY

The research phase began with problem identification through a review of potential Occupational Safety and Health (OHS) risks in the Physical Construction Works project for the New Classroom Building (RKB) at MIN 5 Tulungagung in 2026. The issues studied then focused on identifying risk factors causing workplace accidents, determining risk levels and priorities, and analyzing the impact of these risks on project implementation time.

To strengthen the research foundation, a literature review and field study were conducted. The literature study aimed to examine theories related to OHS, risk management, the Risk Breakdown Structure (RBS) method, and the concept of risk impact on project implementation time. Meanwhile, the field study was conducted to obtain a picture of the actual conditions of project implementation in the residential area.

The next stage involved data collection, which included primary and secondary data. Primary data was obtained through questionnaires and interviews with respondents directly involved in the project, while secondary data was obtained from technical and administrative documents. Interviews were conducted using an expert judgment approach to estimate the impact of dominant risks on project implementation time based on experience and actual conditions in the field. The collected data was then processed through the stages of respondent data tabulation, risk grouping using the RBS method, probability and impact analysis, risk level calculation, and risk priority ranking. Based on these analysis results, a further stage was conducted, analyzing the impact of dominant risks on project implementation time based on interviews and expert judgment. The results of the processing and analysis were then discussed to obtain a comprehensive overview of dominant risks, risk priority levels, and potential delays that could impact project implementation.

The final stage of the research involved drawing conclusions and developing recommendations that serve as answers to the research questions and provide recommendations for improving the implementation of OHS risk management and risk control to ensure the smooth implementation of educational building construction projects.

The research subjects in this study are the parties who act as the main source in providing data for the purposes of OHS risk analysis in construction projects. The determination of subjects is carried out by involving all elements directly involved in the implementation of the Physical Construction Work of the New Classroom Building (RKB) of MIN 5 Tulungagung through 2026 SBSN funding. The basis for the selection is based on the consideration that each party has the capacity, experience, and technical understanding of field conditions related to potential occupational safety and health risks. The research subjects include the work owner (owner), implementing contractor, supervisory consultant, site engineer, OHS officer, and field implementer or foreman. The involvement of all these elements is intended to obtain a comprehensive picture of the source of risk, the level of probability and impact caused, as well as alternative control strategies that are relevant to the actual conditions of the educational building construction project located in the surrounding community and road users for learning activities.

The population in this study includes all parties directly involved or having a role and authority in the implementation of the RKB MIN 5 Tulungagung Building construction project. The population coverage includes elements of the work owner (owner), implementing contractor, supervising consultant, site engineer, K3 officer, and field implementer who has an understanding of all stages of construction work. In the context of K3 risk management research, the population is not solely reviewed from the number of individuals, but rather focuses more on parties who have technical experience, direct involvement, and the ability to assess the probability and impact of risks. Therefore, the population in this study is limited and specific, namely only including parties relevant to the decision-making and supervisory functions in the project.

The sample in this study was determined using a purposive sampling technique, selecting respondents based on specific criteria tailored to the research needs. These criteria included work experience, position within the project's organizational structure, level of involvement in the implementation or supervision of the work, and understanding of OHS implementation and potential risks.

The sample focused on respondents with expert judgment competencies, namely individuals who possess the ability to assess risk factors, probability levels, impact magnitudes, and risk control strategies. Respondents included site managers, site engineers, OHS officers, field implementers, supervisory consultants, and representatives from the owner. The planned number of respondents was between 5 and 10, which was deemed sufficient for expert judgment-based research. This number was determined considering that the quality of expert assessments is prioritized over the quantity of respondents, ensuring that the data obtained has a good level of validity and representativeness of the actual project conditions.

Research instruments are tools used to obtain primary and secondary data in the OHS risk analysis process for construction projects. In this study, instruments were developed to identify risk factors, assess their probability and impact levels, and formulate risk control measures for the RKB MIN 5 Tulungagung Building construction project. The instruments used included questionnaires, interviews, observation sheets, and project documents.

A questionnaire was used as the primary instrument to obtain expert assessments of OHS risk factors. Its development was based on literature studies, initial observations, and a joint validation process with the project team. Respondents included competent and experienced individuals, such as site engineers, OHS officers, supervisory consultants, and field implementers. The questionnaire consisted of two main components: a probability scale and an impact scale. The probability scale was used to measure the likelihood of a risk occurring, while the impact scale was used to assess the magnitude of the consequences for the safety of workers, the surrounding community, the quality of work, and the timeliness of project implementation. Assessments were conducted using an ordinal scale of 1–5, ranging from very low to very high. Furthermore, the questionnaire was used to validate the suitability of risk factors to actual conditions in the field, including risks related to material mobilization through environmental road access and public safety around the project site.

Interviews in this study were used to obtain more in-depth information regarding OHS risk factors, the causes of these risks, risk control strategies, and the influence of dominant risks on project implementation time. The interview method used was a semi-structured interview, a process conducted based on a guideline of main questions, while still allowing respondents to explain actual conditions in the field in greater detail.

Respondents involved in the interviews were experts, individuals with direct experience and understanding of construction project implementation. These respondents included site managers, OHS officers, supervisory consultants, and field implementers. Through the interviews, information was obtained regarding dominant risks, the potential impact of these risks on the smooth running of the project, and estimates of possible delays due to these risks. Delay estimates were expressed in days based on the respondents' experience and the actual conditions of the MIN 5 Tulungagung RKB Building construction project.

The observation sheet is used as an instrument to record and document the actual conditions of K3 implementation at the project site, while ensuring the conformity between the results of the respondents' assessments with the actual conditions in the field. Aspects observed include the condition of the work area, the use of personal protective equipment (PPE), the condition of scaffolding, material distribution routes (material handling), project area security, the condition of environmental road access, and interactions between construction activities with the surrounding community and public road users around the project site. Data obtained from this observation serves as supporting information in the risk analysis process.

Project documents are used as secondary data sources to support risk analysis from both technical and administrative perspectives. These documents are obtained from the project implementer and utilized to understand the scope and stages of work implementation. The types of documents used include working drawings, time schedules, Construction Safety Plans (RK3K), implementation methods, and shop drawings. The availability of these documents plays a crucial role in supporting the risk identification process at each stage of the work, particularly for activities with high potential hazards, material mobilization activities, and the arrangement of work areas adjacent to village settlements.

Field observations were conducted through direct observation at the construction site of the RKB MIN 5 Tulungagung Building. This activity aims to identify hazards or potential dangers that actually arise in the project area, especially in preliminary work, excavation, foundation, structure, use of scaffolding, and material distribution routes. In addition, observations also focused on environmental conditions around the project bordering village settlements, such as the condition of environmental road access, material mobilization arrangements, installation of guardrails, the presence of safety signs, and potential interactions between construction activities with the surrounding community and public road users. The results of these observations were used as a basis for validating the risk factors obtained from the literature study.

Interviews were used in this study as a supporting method to obtain more in-depth information regarding the risk factors occurring in the field. Furthermore, interviews served as a means of verifying the risk identification results obtained through literature review and observation. Interviews were aimed at respondents with competence and direct involvement in the project, such as site engineers, OHS officers, field implementers, and supervisory consultants.

The interview results were used to gather information regarding the causes of the risks, actual conditions in the field, and control measures implemented during project implementation. The data obtained was qualitative and used to support the discussion of the risk analysis results and in developing risk control strategies.

Once the risk variables are declared valid, the next step is to distribute questionnaires to respondents who act as expert judges. This questionnaire is used to obtain an assessment of the probability and impact levels of each formulated risk factor. The probability value represents the likelihood of a risk occurring, while the impact value describes the magnitude of the consequences if the risk occurs, including for worker safety, public safety, work quality, and project implementation time. The results of the respondents' assessments are then used in the risk level calculation process and to determine priority rankings, thereby identifying dominant risk factors that require primary management.

The respondents in this study were selected using a purposive sampling method, a sampling technique based on specific considerations tailored to the research needs (Sugiyono, 2019). This method was chosen because the study focused on Occupational Safety and Health (OHS) risk analysis, thus requiring assessments from parties with competence, experience, and understanding in the construction field. The respondents involved were parties directly involved in the implementation of the New Classroom Building (RKB) project at MIN 5 Tulungagung. These respondents served as expert judges, assessing the probability and impact of each identified risk factor.

The respondent criteria for this study included:

1. having at least two years of work experience in the construction sector;
2. being directly involved in project implementation;
3. understanding Occupational Safety and Health (OHS) aspects; and
4. having a role in decision-making or supervision in the field.

Based on these criteria, the study respondents consisted of site managers, site engineers, OHS officers, supervisory consultants, field implementers, and foremen. The number of respondents involved ranged from 5 to 15 people, who were deemed to represent expert assessments of the project's risk conditions. Purposive sampling is expected to yield more accurate and relevant data, as the respondents selected are those with direct understanding of field conditions and the potential risks that arise during construction project implementation.

The documentation stage was carried out as an effort to collect supporting data, both visual and administrative. In this study, documentation included photographs of field conditions, weekly reports on work implementation, and technical project documents such as working drawings, shop drawings, implementation methods, and RK3K. This documentation plays a role in strengthening the findings of the observation results, supporting the risk analysis process based on work stages, and serving as supporting evidence in the discussion of research results, particularly regarding project area security, material mobilization, and the interaction of construction activities with the surrounding community. With the availability of adequate documentation, the OHS risk analysis process can be carried out more objectively and has a higher level of scientific accountability.

Data analysis techniques in this study were used to process various information obtained from observations, interviews, questionnaires, and project documents into relevant analytical results to answer the problem formulation. The analysis process was carried out through a series of stages, including identifying risk factors, assessing probability and impact levels, determining risk levels, establishing risk priority rankings, and formulating OHS risk control strategies for the project.

The initial stage in the analysis process is carried out through risk identification, namely determining all factors that have the potential to cause work accidents or disruption to the surrounding community during project implementation. In this study, the number of risk factors analyzed is planned to be 20 variables obtained from the results of literature studies, field observations, interviews, and a validation process with expert respondents. Next, these risk variables are classified based on the type of work, including preparatory work, excavation, foundation, structure, architecture, and finishing. In addition, grouping is also carried out based on risk sources that include human factors, equipment, materials, work methods, and environmental conditions of the project which is directly adjacent to village settlements and has limited environmental road access.

After the risk identification stage is completed, the next step is to develop a Risk Breakdown Structure (RBS). This method is used to systematically classify risk sources in a hierarchical structure based on the type of work and its causal factors. Through the RBS approach, risks are broken down from general categories to more specific levels, such as risks related to structural work, scaffolding use, material handling, and risks related to the safety of the surrounding community and road users. This hierarchical structure simplifies the risk level analysis process and determines control priorities at each stage of the work.

Probability analysis was conducted to assess the likelihood of each risk occurring based on expert assessments. Probability values were obtained from questionnaire results using an ordinal scale of 1–5, ranging from very low to very high. Probability values reflect the frequency or chance of a risk occurring during the construction of the RKB MIN 5 Tulungagung Building project.

In addition to the likelihood level, each risk variable is also analyzed based on the magnitude of the impact or consequences it would have if the risk occurred. The impacts examined in this study include project costs, work quality, implementation time, worker safety, and the safety of the surrounding community and road users. The impact assessment uses an ordinal scale of 1–5, ranging from very low to very high impact. This assessment aims to describe the level of consequences that could impact project implementation and the surrounding environment.

The next step is to determine the risk level based on the product of the probability (P) and impact (I) values. The resulting values are then mapped to a risk matrix to classify the risk levels into specific categories, ranging from low to very high. This risk matrix serves as a tool to visualize risk levels and prioritize handling of dominant risks that require immediate control.

Validity and reliability tests were conducted to ensure that the research instrument, a questionnaire, used in this study had adequate accuracy and consistency. These tests were conducted prior to the risk analysis stage to ensure the data obtained was suitable for use as a basis for research.

Validity testing aims to determine the extent to which each question in the questionnaire accurately measures the variables being studied. Testing is conducted using the Pearson Product Moment correlation method, which involves correlating the scores of each question item with the total score of the variable. An item is declared valid if the correlation coefficient (r-count) is greater than the r-table value at a predetermined significance level.

Reliability testing is used to assess the level of consistency of respondents' responses to the research instrument. This testing is conducted using the Cronbach's Alpha method to measure the internal consistency of all items in the questionnaire. A research instrument is considered reliable if the Cronbach's Alpha value is greater than 0.70.

Vol. 5, No. 6, 2026: 1403-1424

Validity and reliability testing was conducted after the questionnaire data was obtained from respondents. The testing stages included:
a. collecting questionnaire data from respondents;
b. conducting validity testing on each question item;
c. conducting reliability testing on all questionnaire items;
d. determining which items were suitable for use in the research; and
e. using items that had been declared valid and reliable as the basis for risk analysis in the next stage.

Once the risk level values are obtained, the next step is to rank them by arranging them in order from highest to lowest. The resulting ranking is then used to classify risks into very high, high, medium, and low categories. Risks with the highest values are designated as the top priority for management because they have the highest probability of occurrence and the most significant impact on occupational safety and the safety of the community surrounding the project site.

The final stage in the analysis process is the development of a risk control strategy based on the dominant risk factors previously identified. This strategy is based on the risk control hierarchy, which includes elimination, substitution, engineering control, administrative control, and the use of personal protective equipment (PPE). In this study, the control strategy was also adapted to the characteristics of the project, which is located in a rural residential area. These adjustments include the installation of work area fences, restrictions on public access around the project site, arrangement of material mobilization routes through neighborhood roads, installation of safety signs, control of material distribution times, and securing scaffolding to prevent potential hazards to workers and the community around the project area.

RESULTS AND DISCUSSION

Respondent data in this study were obtained from parties directly involved in the construction of the New Classroom Building (RKB) at MIN 5 Tulungagung. Respondents were selected using an expert judgment approach, selecting individuals deemed to have experience, knowledge, and involvement in construction activities, as well as an understanding of potential Occupational Safety and Health (OHS) risks in the field. Respondents included project implementers, field supervisors, and workers directly involved in construction activities. Respondent characteristics were further classified based on job title and work experience to illustrate their level of competence in assessing the probability and impact of risks.

The respondent information data for this study involved a total of 15 individuals, comprising workers within the MIN 5 Tulungagung RKB Building Construction project.

No.	Position	Number (People)	Percentage
1	Site Engineer	1	6.67%
2	Site Manager	2	13.33%
3	HSE/K3 Officer	2	13.33%

4	Field Implementer	4	26.67%
5	Contractor Foreman	3	20.00%
6	Supervisory Consultant/MK	3	20.00%
	Total	15	100%

Based on the data above, the number of respondents in this study was 15 people consisting of Site Engineers, Site Managers, HSE/K3 Officers, Field Implementers, Contractor Foremen, and Supervisory Consultants/MK. The largest number of respondents came from Field Implementers, namely 4 people or 26.67%, considering their role which is directly involved in the implementation of construction work activities in the field. The composition of respondents is considered appropriate because all respondents have direct involvement in the project and understand the potential K3 risks that arise during the work implementation process.

The majority of respondents had a Bachelor's degree (S1) with a minimum of 5 years of work experience, amounting to 10 people or 66.67% of the total respondents. In addition, there were also respondents with a vocational high school education background of 3 people and a Diploma (D3) of 2 people who also had a minimum of 5 years of work experience in the construction sector. These characteristics indicate that the respondents in this study had an adequate level of competence, experience, and involvement in the implementation of construction projects, so that the assessment given on the probability and impact of K3 risks was considered capable of representing actual conditions in the field. In addition, respondents were in the age range of 25–50 years, which is considered a productive age group in carrying out work activities in the field.

Risk identification in this study was conducted using the Risk Breakdown Structure (RBS) method. This method is applied to systematically group various risk factors based on their causes, thereby simplifying the analysis process and determining risk priorities. The risk identification stage was carried out through literature studies, field observations, and expert judgment from respondents who were directly involved in the implementation of the New Classroom Building (RKB) construction project at MIN 5 Tulungagung. The identified risks were then classified into several categories, namely environmental factors, human factors, equipment factors, work method factors, and social environmental factors.

The identified risk factors are dominated by human and social environmental factors. Human factors relate to worker behavior, the use of personal protective equipment (PPE), work discipline, and awareness of OHS implementation in the field. Meanwhile, social environmental factors arise from the project's location in a residential area with limited road access, potentially disrupting the surrounding community.

Furthermore, work methods and equipment are also sources of risk that require attention because they are directly related to the construction process. Therefore, the application of the RBS method to risk identification provides a systematic overview of the various risk sources that could potentially lead to workplace accidents in the MIN 5 Tulungagung RKB Building construction project.

Risk probability and impact analysis was conducted based on respondents' assessments through a questionnaire using an expert judgment approach. This assessment was applied to all risk factors identified in the Risk Breakdown Structure (RBS) stage. Each respondent was asked to rate the probability of a risk occurring and the magnitude of its impact using a Likert scale of 1–5. The probability value represents the likelihood of a risk occurring during construction project implementation, while the impact value reflects the degree of influence the risk will have on occupational safety and project implementation. Both values were obtained from the average of all respondents' assessments of each risk factor.

The assessment of risk probability and impact in this study used a Likert scale of 1–5. The concepts of probability and impact refer to the risk management principles developed by the Project Management Institute (PMI), while the assessment scale adopted the Likert scale approach proposed by Sugiyono (2019).

Questionnaire Results

Data collection in this study was conducted by distributing questionnaires to respondents directly involved in the construction of the New Classroom Building (RKB) at MIN 5 Tulungagung. The questionnaire was developed based on the identification of risk factors using the Risk Breakdown Structure (RBS) method, which encompasses factors such as the work environment, workforce, implementation methods, work equipment, and the interaction between project activities and the surrounding community.

Each respondent was asked to provide an assessment of the probability and impact of each risk factor using a predetermined rating scale. The assessment results were then summarized by summing the probability and impact values for each risk factor.

It was found that each risk factor had a different total probability and impact score, according to the respondents' assessments. The highest total probability score was for the risk factor of lack of communication and internal coordination between project parties, with a score of 54. This was followed by the risk of not using PPE (51), and extreme weather affecting construction work and exposure to dust due to construction activities, each with a score of 50.
Meanwhile, the highest total impact score was for the risk factor of using inappropriate work tools, with a score of 57, followed by unsafe temporary electrical installations (56), and worker fatigue due to working hours and a lack of awareness of OHS (K3), each with a score of 55. These conditions indicate that several risk factors related to worker behavior, equipment condition, and OHS implementation management have the potential for significant impacts if not optimally managed.

The recapitulation results were then used as the basis for calculating the average probability and impact scores for each risk factor. This average score was then used to calculate the risk level to determine risk categories and control priorities for the MIN 5 Tulungagung RKB Building construction project.

A validity test was conducted to assess the validity of the questionnaire instrument used in this study. This test aimed to ensure that each question accurately represented the risk variables studied and met the research objectives.

In this study, the validity test was conducted using the Pearson Product Moment method with the aid of Microsoft Excel. The validity value was obtained through a correlation process between the scores of each question item and the total score of all items. An instrument is considered valid if the calculated r value is greater than the table r value at a significance level of 5%. With 15 respondents, the table r value was 0.514.

The validity test was conducted to determine the appropriateness of each question item in the questionnaire instrument. The test was conducted using the Pearson Product Moment correlation, which involves correlating the scores of each question item with the total score. The number of respondents in this study was 15, so the degrees of freedom were determined using the formula df = n - 2 = 15 - 2 = 13. Based on the table of critical values for the Pearson Product Moment correlation at a significance level of 5%, the table r value was 0.514. Thus, each question item is declared valid if the calculated r value is greater than the table r. Conversely, an item is declared invalid if the calculated r value is smaller than 0.514. The r table value of 0.514 has also been included in Appendix 7 as a basis for comparison in testing the validity of the instrument.

It is known that testing was conducted on two assessment variables: risk probability and risk impact. Validity testing was conducted using an r-value of 0.514 with 15 respondents at a 5% significance level. The test results showed that for the risk probability variable, 16 items were declared valid and 4 items were declared invalid. Meanwhile, for the risk impact variable, 18 items were valid and 2 items were invalid. Overall, 15 risk items were declared generally valid because they met the validity criteria for both probability and impact assessments.

Several items declared invalid were retained in the study because these risk factors were compiled based on literature studies, field observations, and were relevant to the conditions of the MIN 5 Tulungagung RKB Building construction project. Furthermore, the research instrument underwent a reliability test to determine the overall consistency of respondents' responses.

Reliability testing was conducted to assess the consistency of the questionnaire instrument used in this study. An instrument is considered reliable if it produces consistent data when used to measure the same variable. In this study, reliability testing was conducted using the Cronbach's Alpha method with the aid of Microsoft Excel. The reliability value was obtained from processing respondents' answers to all questions related to the probability and impact variables of risk. According to Ghozali (2018), a research instrument is considered reliable if its Cronbach's Alpha value is greater than 0.60.

For example, a reliability test was conducted on a risk probability variable consisting of 20 questions. Based on the data processing results, the total item variance was 25.419 and the total variance was 240.781. Using the Cronbach's Alpha formula, an alpha value of 0.942 was obtained. This value is greater than 0.60, thus the risk probability variable instrument is considered reliable and suitable for use in subsequent analyses. According to formula (2.5), namely:

- Number of items (k) = 20
- Total item variance ($\sum \sigma$ i2) = 36.985

- Total variance (σt2) = 245.543
- Cronbach's Alpha (α) = 0.968

$$\propto = \frac{k}{k-1}\left(1 - \frac{\sum S_i^2}{S_t^2}\right) \quad \propto = \frac{20}{20-1}\left(1 - \frac{36,985}{451,543}\right)$$

$$\propto = \frac{20}{19}(1 - 0,080) = 0,968$$

The Cronbach Alpha value obtained was 0.942 for the risk probability variable and 0.968 for the risk impact variable. Both values are greater than the reliability limit of 0.60, so the questionnaire instrument is declared reliable. These results indicate that the questionnaire used in the study has a very good level of consistency in measuring the probability and impact of OHS risks. Thus, the questionnaire data is considered suitable for use as a basis for the next analysis process, namely calculating probability values, impact values, risk levels, and determining risk priorities in the RKB MIN 5 Tulungagung Building construction project.

Based on the analysis, this study successfully identified various OHS risk factors in the RKB MIN 5 Tulungagung Building construction project using the Risk Breakdown Structure (RBS) method. These identified risk factors were then assessed based on their probability and impact levels through questionnaires distributed to respondents directly involved in the project.

The risk level calculation results indicated that the highest dominant risk was a lack of internal communication and coordination between project parties, with a risk score of 12.240, categorized as high. This risk demonstrates that coordination between implementers, supervisors, OHS officers, foremen, and workers play a crucial role in supporting smooth work and the implementation of occupational safety in the field. Other priority risks include extreme weather affecting construction work with a risk score of 11.778; exposure to dust due to construction activities with a risk score of 10.444; lack of worker skills with a risk score of 10.427; and failure to use PPE with a risk score of 9.747; categorized as medium. Based on these results, there were no risks categorized as very high. Nevertheless, all dominant risks still require control because they have the potential to disrupt occupational safety and the smooth running of construction projects.

Risk control strategies focus on the highest priority risk factors. Implemented control measures include improving internal project coordination, adjusting work schedules to weather conditions, controlling dust through spraying work areas, improving worker skills through technical briefings, mandating the use of PPE, conducting safety briefings/toolbox meetings, inspecting temporary electrical installations, and increasing occupational health and safety (K3) supervision in the field.

Based on expert judgment, dominant risks also have the potential to impact project implementation time. The risk with the greatest estimated delay is extreme weather affecting construction work, with a potential delay of approximately 1–7 days. Other risks, such as lack of communication and internal coordination between project parties, dust exposure, lack of worker skills, unsafe temporary electrical installations, and indiscipline among workers, have the potential to cause delays of approximately 1–3 days.

Therefore, K3 risk management plays a crucial role in improving occupational safety, ensuring smooth work progress, and supporting project timeliness. Therefore, risk control needs to be implemented systematically and continuously to minimize the potential for workplace accidents and work delays.

CONCLUSION AND RECOMMENDATION

Based on the analysis of OHS risk management using the Risk Breakdown Structure (RBS) and Probability Impact Matrix methods for the construction of the RKB MIN 5 Tulungagung Building, the following conclusions were drawn:

1. The risk level and priority ranking of risk factors causing work accidents using the Risk Breakdown Structure (RBS) method for the physical construction of the RKB MIN 5 Tulungagung Building revealed 20 OHS risk factors with the potential to cause work accidents. These risk factors were grouped into several categories, including environmental factors, human factors, equipment factors, work method factors, and management/organizational factors. The risk level calculation results indicated that the highest dominant risk was a lack of internal communication and coordination between project parties, with a risk score of 12.240, categorized as high. Other priority risks were extreme weather (11.778), dust exposure due to construction activities (10.444), and lack of worker skills (10.427) (categorized as high), as well as failure to use PPE (9.747) (categorized as medium). Based on the four-category classification used, no risks were categorized as very high.
2. The appropriate OHS risk control strategy, based on the results of the risk priority analysis for the physical construction work of the RKB MIN 5 Tulungagung Building, includes improving internal project coordination, strengthening OHS supervision, adjusting the work schedule to weather conditions, controlling dust through spraying the work area, improving worker skills through technical briefings, mandating the use of PPE, conducting safety briefings/toolbox meetings, inspecting temporary electrical installations, and periodically evaluating OHS implementation. This strategy is necessary to minimize the potential for workplace accidents and project delays.
3. The impact of risks on project implementation time, based on the dominant risk factors in the RKB MIN 5 Tulungagung Building construction project using the expert judgment method, includes the risk with the greatest estimated delay being extreme weather, which impacts construction work with a potential delay of approximately 1–7 days. Other risks, such as lack of communication and internal coordination between project parties, dust exposure due to construction activities, lack of worker skills, unsafe temporary electrical installations, and labor indiscipline, have the potential to cause delays of approximately 1–3 days. This condition shows that K3 risks not only impact work safety, but can also affect the smoothness and timeliness of project implementation.

Based on the research findings, the following recommendations can be made.

1. For project implementers, internal coordination between contractors, supervising consultants, OHS officers, field implementers, foremen, and workers need to be strengthened so that work instructions, implementation methods, safety instructions, and work schedule adjustments can be clearly communicated to all parties involved. This coordination should also focus on managing outdoor work, such as excavation, reinforcing, formwork installation, and casting, especially when extreme weather conditions can potentially delay project implementation.
2. For OHS officers and field supervisors, regular monitoring of OHS implementation is necessary, particularly regarding the use of PPE, dust control, the suitability of work equipment, the safety of temporary electrical installations, work area restrictions, and the implementation of safety briefings/toolbox meetings to prevent violations of work safety procedures.
3. For workers, increased discipline and awareness of OHS implementation are needed, particularly regarding the use of PPE, implementation of safe work procedures, and compliance with the directions of supervisors and OHS officers to minimize the potential for workplace accidents during construction activities.
4. For further research, it is recommended to add an analysis of the impact of risks on the cost and quality aspects of the project so that the K3 risk management study provides a more comprehensive picture of the achievement of construction project targets.

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