

The Assessment of Occupational Safety and Health Risk Management on Construction Projects During the Covid-19 Pandemic

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Abstract

The Covid-19 pandemic has weakened various business sectors, including the construction services business. This research aims to identify OHS risks in building construction projects during the Covid-19 pandemic, provide an assessment and provide control solutions for these risks. The research method begins with identifying risk factors and distributing risk assessment questionnaires to thirty building construction companies. Then determine the risk rating with the Relative Importance Index (RII) and the risk category using the AS/NZS 4360:2004 standard. The risk control questionnaire was finally distributed to three selected respondents, including a director, a project manager, and an OHS manager, all of whom have at least an undergraduate degree. Based on the analysis, it is found that there is a similarity in the ranking of risk factors from the calculation of the RII value and the AS/NZS 4360:2004 standard, indicating that there is a positive and significant relationship between these two methods. The top three risk factors based on RII are: Covid-19 spread, falling from a height, and being electrocuted. Based on the AS/NZS 4360:2004 standard, these three factors are considered high and moderate risk, while the risk control solutions are: comply with and implement health protocols, use PPE, strong/sturdy scaffolding, install safety nets, arranging safe electrical lines, conduct socialization, and educate workers about Covid-19.

Keywords: construction project; covid-19; occupational safety and health; risk management.

Introduction

A construction project is a series of activities related to the construction of a structure that must be completed within a certain period to achieve a goal. Therefore, the application of management in construction projects has a vital role in the stages of construction projects so that construction projects can achieve goals and correct cost, quality, and time (Jaya et al., 2021). However, every construction project has risks, and the higher the level of complexity of a project, the greater the project risks that will occur (Harjono & Hakim, 2021). The presence of uncertainty factors and other unforeseen things often lead to failure to achieve project goals (Situmorang et al., 2018). Risk causes uncertainty about the occurrence of an event during a specific time interval in which the event occurs (Islamiah et al., 2020) and causes small or large losses (Subagyo, 2020) that affect the sustainability of a company's business (Lokobal et al., 2014). In addition, risks are hazards, impacts, or consequences that can occur due to an ongoing process or future event (Hartono et al., 2019). In a project, a risk is an event that is uncertain or likely to occur and affect the implementation of the project (Yuni et al., 2021). Risk is the result of uncertainty, and of course, many uncertainty factors in a project can produce various risks (Tagueha et al., 2018). Every risk



that arises in construction projects is generally mutually influential. For example, risks caused by human resources can affect the time, cost, and safety of construction projects and vice versa (Fassa et al., 2021).

Occupational Safety and Health (OSH), which refers to the discipline concerned with protecting the health, safety, and welfare of people engaged in work or employment. OSH aims to prevent work-related accidents, injuries, and illnesses by identifying and eliminating or minimizing hazards in the workplace. It encompasses a wide range of activities, including the development and implementation of safety policies and procedures, training programs, hazard assessments, and risk management strategies (Alli, 2008). OSH is one crucial aspect that requires special attention in construction work, if OSH is ignored, it will increase the risk of work accidents, affecting the decline in work quality, so that all forms of activities carried out in construction projects will experience disruption (Manurung, 2020). The government expects contractors to be able to implement OHS in the field. However, the implementation of OHS in Indonesia still needs to be improved. With calls for implementing the Construction Safety Management System (CSMS) by the government, fatal work accidents still occur and cause losses and even failures in the implementation of construction projects (Jaya et al., 2021). Based on data from the Employment Social Security Organizing Agency (BPJS), in 2017, there were 123,041 work accidents in Indonesia, while in 2018, there were 173,105 work accidents (Rini & Aswin, 2020). The work accident cases resulted in health insurance claims of up to IDR 1.2 Trillion (Monalisa et al., 2022). The categories of work accidents that occur from mild to severe, and for work accidents in the high fatality category, one of them is dominated by construction work (Jaya et al., 2021). According to a report by the International Labour Organization (ILO), Indonesia has made progress in improving occupational safety and health in recent years, including the establishment of the National Occupational Safety and Health Council and the development of various regulations and guidelines related to workplace safety (Setiawan et al., 2022). However, challenges remain in terms of enforcing these regulations and addressing the needs of workers in the informal sector, where OSH standards are often not met. One of the challenges facing OSH in Indonesia is the lack of awareness and understanding among employers and workers about the importance of workplace safety. This has led to a high rate of workplace accidents and injuries, particularly in the construction and manufacturing sectors (Lestari et al., 2020). Another challenge is the limited resources and capacity of government agencies responsible for enforcing OSH regulations. The ILO report suggests that there is a need for increased investment in training, inspection, and enforcement activities to improve OSH outcomes in Indonesia (Adiratna et al., 2022).

In addition to the risk factor of work accidents, the risk factor currently affecting work activities on construction projects today is the risk of spreading the Covid-19 virus (Sami Ur Rehman et al., 2022). This outbreak first appeared in Wuhan, China, and has spread rapidly to various countries, including Indonesia (Susila & Arbianto, 2021). Covid-19 was declared a pandemic on March 11, 2020, by WHO (Dryhurst et al., 2020); this determination is based on the geographical spread of the virus, which has reached 114 countries (Bank Indonesia, 2020). The outbreak of Covid-19 has had a global impact on public health, economic growth, and social life, including the construction industry and construction markets across the world, public health, economic growth, social life, causing supply chain disruptions, workforce restrictions, and legislative changes (Iqbal et al., 2021). However, construction markets in developing countries are perceived to be more vulnerable to the pandemic's challenges (Al-Mhdawi et al., 2022). The present epidemic has brought tremendous healthcare, economic, and social difficulties in the contemporary world. It has had a wide-ranging influence, amplifying the construction industry's inefficiencies and shortcomings (Ayat et al., 2021). The Covid-19 pandemic has weakened various sectors in Indonesia, and the construction sector is no exception. Construction is a sector that has significantly impacted its operations and has been one of the hardest hit in terms of the Covid-19 pandemic (Stiles et al., 2021). Construction work involves many human resources, and interaction between workers can only be avoided. This is very vulnerable to spreading diseases such as the Covid-19 virus to workers (Susila & Arbianto, 2021). As a

result, workers' health is jeopardized, and construction projects can be delayed or even halted. In addition, restrictions on social interaction and human gathering in public places stalled and temporarily delayed various works in construction projects. Research conducted on a private building construction project in Badung Regency conducted a specific analysis of all work items in order to achieve the project objectives of cost, quality, time, and orderly administration with the results, namely: first, there are 36 risks with the first-level priority that cause the impact of death and permanent injury; second, second-level priority is 20 risks with moderate categories; and third, third-level priority is 26 risks with low and mild categories (Yuni et al., 2021). Research conducted on the construction work of the F3 building of the Faculty of Medicine, Health Sciences (FKIK) Warmadewa University to assess the potential hazards that can occur in construction work with the results: first, 16 identified risks have a high-risk rating; second, 28 identified risks have a medium risk rating; third, 21 identified risks have a low-risk rating (Triswandana & Armaeni, 2020). The results of research using the AS/NZS 4360:2004 standard on the Sambirejo former dumping area construction project on ten staff from the contractor found 92 hazard variables, consisting of 2 high risks, 34 low risks, and 56 moderate risks. The problems caused by these risks can cause all activities on the project to stop (Firdaus et al., 2021).

From the above studies, there are many risks in construction projects, both high, medium, and low, which can affect the success of a construction project. Therefore, accurate risk assessment and control are critical to ensure the project is achieving success, namely on time, quality, and cost (Zulfaika, 2018). In addition, it is necessary to monitor risks as a form of continuous improvement, which is done to determine the effectiveness of the response in identifying changes in risk or the emergence of new risks and to realize zero accidents (Cahyo & Sutarto, 2022). Palangka Raya City is the capital city of Central Kalimantan province which continues to increase infrastructure development, especially building construction during the Covid-19 pandemic, some of which are high-rise buildings and are of particular concern, where the higher the building, the greater the risk of work accidents that occur (Hartono et al., 2019). Based on BPJS Employment data during 2018, the number of work accidents recorded in Central Kalimantan was 2,705 cases (Mardlotillah, 2020). Workplace accidents cause death, material loss, morale, and environmental pollution and can also impact society's productivity and welfare. Work accidents also affect the Human Development Index and national competitiveness, so the government invites all stakeholders, including employers, trade unions, workers, and the community, to continue to increase awareness of the importance of Occupational Safety and Health (K3) and its supervision (Gati et al., 2020). In connection with the Covid-19 pandemic and the determination of the Corona outbreak as an Extraordinary Event (KLB), it is necessary to prevent the spread and impact of Covid-19 in the implementation of Construction Services. The government to prevent the impact of Covid-19 has established a protocol for preventing the spread of Covid-19 in the implementation of Construction Services for Users and Service Providers, which is part of the overall policy to realize construction safety, including occupational safety and health, public safety, and environmental safety at every stage of the implementation of Construction Services. The Ministry of PUPR issued PUPR Ministerial Instruction Number 02 of 2020 concerning the Protocol for Preventing the Spread of Corona Virus Disease 2019 (Covid-19) in the implementation of Construction Services signed on March 27, 2020 (Sari, 2021).

Despite many previous studies that have been conducted and the implementation of risk management before the action of construction projects begins, it is still inevitable that risks will still occur. Coupled with the Covid-19 pandemic, there is an increase in OHS risks due to the spread of viruses and infectious diseases, which impact construction projects' performance. The implementation of OSH concept has changed significantly before and during the pandemic. The Covid-19 pandemic has brought about new and unprecedented workplace safety challenges that require organizations to revise their OSH policies and procedures to ensure the health and safety of their workers. Before the pandemic, OSH measures typically focused on preventing traditional workplace hazards such as falls, chemical exposure, and machinery-related accidents. However, during the pandemic, OSH

measures have had to shift to address the risk of Covid-19 transmission in the workplace. This includes measures such as social distancing, wearing masks, frequent hand washing, sanitizing surfaces, and implementing remote work arrangements (Prajogo et al., 2021).

The pandemic has also highlighted the importance of employee health and well-being, and organizations have had to incorporate mental health support and stress management programs as part of their OSH efforts. Additionally, the pandemic has accelerated the adoption of new technologies and virtual communication tools, which have become critical for remote work and virtual training and meetings (Peters et al., 2022). In summary, the pandemic has necessitated a shift in OSH measures to address the unique challenges presented by Covid-19. Organizations have had to adapt quickly to implement new policies and procedures to ensure the safety of their workers, and OSH has become more focused on employee health and well-being in addition to traditional workplace safety hazards.

For this reason, it is necessary to apply risk management, where risk management is a systematic process or stage in overcoming and minimizing or avoiding the occurrence of a risk (Jaya et al., 2021). Previous studies discussed risk management in construction projects. Still, they have yet to specifically review OHS risks in building projects during the Covid-19 pandemic using the Relative Importance Index (RII) method to determine risk ratings and risk assessments using the AS/NZS 4360:2004 standard. This is the basis for researchers to research the importance of risk management so that risks can be handled appropriately and reduce the occurrence of work accidents, especially during the Covid-19 pandemic. This research aims to identify, assess, and provide solutions for handling OHS risks in building construction projects in Palangka Raya during the Covid-19 pandemic. The results of this study are expected to provide information on the impact of risks on the project and input for project managers regarding responses that can be made by related parties, both project owners and contractors and other stakeholders in dealing with OHS risks during the Covid-19 pandemic.

Methods

This type of research is exploratory research using literature study and survey methods using questionnaires. The research variables are risks that have the potential to occur in building construction projects obtained from the results of risk identification sourced from literature review of previous studies in the form of articles from journals, proceedings, book chapters, as well as books and recent scientific works. The questionnaire in this study consists of two stages, namely: the first stage questionnaire was given to all respondents (thirty building construction companies) to know how they assessed the risks identified from the literature study. The second stage of the questionnaire was given to three respondents selected based on position (1 director; 1 project manager; 1 OHS manager) and the last education is an undergraduate to find out how risk control against the risks that have been assessed from the first stage questionnaire. The research location is in the city of Palangka Raya, where most of the existing building projects are government-owned, with a population of construction companies that have building construction projects taken from the list of tender winners on the Palangka Raya City Government Electronic Procurement Service (LPSE) website from 2020 - 2022, it can be ascertained that the companies/respondents who are the research sample have worked on building projects during the covid-19 pandemic, so they are considered worthy of representing building construction companies in Palangka Raya. The sample calculation using the Slovin formula in this study with a population of 32 and a standard error of 5% is as follows:

$$n = \frac{N}{1+N(e)^2} \quad (1)'$$

where:

n = sample size

N = population size

e = standard error

$$n = \frac{32}{1+32 (5\%)^2} = 29,63 \approx 30 \text{ samples}$$

The data collected through questionnaires that respondents have completed is first tested for validity and reliability. The validity test in this study used the Pearson Bivariate test, while the reliability test used Cronbach's Alpha. Because the data to be measured must be valid, the validity test is first carried out, then continued with the reliability test; if the data measured is invalid, the reliability test is not carried out (Janna & Herianto, 2021). This study's validity and reliability tests were carried out with the help of Statistical Product and Service Solution (SPSS) software version 25.

Valid and reliable data is then analyzed using the Relative Importance Index (RII) value to determine the risk rating. The RII approach describes the relative importance of specific causes and impacts based on the likelihood of occurrence and effect on the project (Kassem et al., 2020). It is used to determine the relative importance of different causes and effects of delay using a five-point Likert scale. (Gebrehiwet & Luo, 2017). The RII value is calculated for each probability and impact, then multiplied by the probability RII value by the impact RII to determine the risk rating for each variable. The formula used to calculate RII refers to the formula below (Ardiyawan et al., 2019).

$$RII = \frac{\sum_{i=1}^5 W_i X_i}{\sum_{i=1}^5 X_i} \quad (2)'$$

Where:

RII = Relative Importance Index

W_i = weight given to the i-th response

X_i = i-th response frequency

i = response category index

The risk assessment uses the AS/NZS 4360:2004 standard in Australian and New Zealand standards. This standard is a form of qualitative analysis used to determine the risk of a facility or activity if complete data is unavailable (Kartika et al., 2022) by multiplying the average risk frequency value by the average risk value impact. To calculate the average value of risk frequency and risk impact using the formula:

$$\text{Frequency average} = \frac{\sum \text{frequency}}{\text{total number of respondents}} \quad (3)'$$

$$\text{Average impacts} = \frac{\sum \text{impacts}}{\text{total number of respondents}} \quad (4)'$$

According to the AS/NZS 4360:2004 standard, the possibility or probability ranges from risks that rarely occur (rare) to risks that can occur at any time (almost certain). Meanwhile, severity or consequence is categorized between events that do not cause injury or small losses to the most severe impact, namely, causing fatal events (death) or significant damage to company assets. The probability scale, severity, and risk assessment matrix based on this standard can be seen in Table 1 and Table 2 below.

Table 1. Probability scale based on AS/NZS 4360:2004 Standard

Level	Criteria	Explanation
1	Rare	May occur only under particular circumstances/after once a year
2	Unlikely	May occur in some circumstances but is unlikely
3	Possible	May occur in certain conditions
4	Likely	May occur in almost all conditions
5	Almost Certainly	May occur in all conditions

Source: (Joint Standards Australia/Standards New Zealand Committee OB-007, 2004)

Table 2. Severity scale based on AS/NZS 4360:2004 Standard

Level	Criteria	Explanation
1	Insignificant	No loss/very little material loss
2	Minor	Minor injuries require minor treatment and can be treated immediately at the scene, minor material loss
3	Moderate	Requires medical treatment, moderate material loss
4	Major	Injury results in disability or loss of body function, significant material loss
5	Extreme	Causes death, huge material losses

Source: (Joint Standards Australia/Standards New Zealand Committee OB-007, 2004)

Based on the risk multiplication results, it will then be grouped into risk categories, namely low risk, moderate risk, high risk, and very high risk, as can be seen in Fig. 1. After obtaining the risk rating results and risk category, the next step is to distribute the second stage of the questionnaire to obtain risk control methods.

		SEVERITY				
		Insignificant	Minor	Moderate	Major	Extreme
PROBABILITY	Almost Certainly	Moderate	High	High	V. High	V. High
	Likely	Moderate	Moderate	High	High	V. High
	Possible	Low	Moderate	High	High	High
	Unlikely	Low	Low	Moderate	Moderate	High
	Rare	Low	Low	Moderate	Moderate	High
		1	2	3	4	5

Figure 1. Risk assessment matrix based on AS/NZS 4360:2004 Standard (Joint Standards Australia/Standards New Zealand Committee OB-007, 2004)

Results

Based on the literature study results, there are 28 OHS risks and Covid-19 risks, which are then used to compile the first stage of the research questionnaire, which aims to obtain a risk assessment, which can be seen in Table 3 below.

Table 3. Risk factor identification results

Code	Risk Factors	Source/Reference						
		(Hartono et al., 2019)	(Tamim & Ismail, 2020)	(Firdaus et al., 2021)	(Yuni et al., 2021)	(Alfarezi et al., 2021)	(Chigara & Moyo, 2022)	(Fauziyah et al., 2022)
X1	Workers scratched and punctured by materials.	✓						✓
X2	Falling on materials	✓						✓
X3	Bumped head	✓						✓
X4	Skin irritation	✓						✓
X5	Workers were tripping over materials.	✓						✓
X6	There was a spark that caused a fire.		✓					✓

Code	Risk Factors	Source/Reference						This research
		(Hartono et al., 2019)	(Tamim & Ismail, 2020)	(Firdaus et al., 2021)	(Yuni et al., 2021)	(Alfarezi et al., 2021)	(Chigara & Moyo, 2022)	
X7	Workers are injured while working.		√					√
X8	Respiratory problems due to sand/cement dust		√					√
X9	Falling on work tools			√				√
X10	Lumbar muscle injury			√				√
X11	Falling into excavation holes				√			√
X12	Buried in the excavation soil				√			√
X13	Hit by heavy equipment				√			√
X14	Exposed to chemicals				√			√
X15	Falling from a height				√			√
X16	Cut by grinder				√			√
X17	Cut by bar bender/bar cutter				√			√
X18	Being electrocuted				√			√
X19	Spread of Covid-19			√				√
X20	Reactive/positive Covid-19			√				√
X21	Workers exposed to Covid-19 due to crowding.					√		√
X22	Workers are infected with the Covid-19 virus due to not wearing masks.					√		√
X23	Workers infected with Covid-19 due to the addition of workers outside the project.					√		√
X24	Workers exposed to Covid-19 due to direct contact.					√		√
X25	Lack of outbreak prevention materials such as disinfectants, hand sanitizers, and masks							√
X26	Lack of assertiveness in implementing health protocols						√	√
X27	Work standards that do not prioritize health protocols						√	√
X28	Lack of knowledge of workers about the consequences of not complying with health protocols						√	√

Based on sample calculations from the population of construction companies and having building construction projects or as tender winners from the list on the LPSE website of the Palangka Raya City Government from 2020 - 2022, a target of 30 respondents was obtained. Filling out the questionnaire is represented by personnel working in the company; a general description of the respondents based on the number and percentage can be seen in Table 4, where respondents who are more than 40 years old are 60%, with the last education level of undergraduate degree as much as 70%, and hold the position of Director as much as 86.67%. The respondents' work length is more than five years, as much as 96.67%.

Table 4. General description of respondents

Level of Education	Quantity	Percentages	Age (Years)	Quantity	Percentages
Undergraduate	21	70.00%	25-30	3	10.00%
Bachelor's degree	2	6.67%	31-40	9	30.00%
High school or equivalent	7	23.33%	>40	18	60.00%

Position	Quantity	Percentages	Length of Service (Years)	Quantity	Percentages
Director	26	86.67%	<5	1	3.33%
Project Manager	1	3.33%	5-10	16	53.33%
OHS Manager	1	3.33%	10-15	8	26.67%
Deputy Director	2	6.67%	>15	5	16.67%

The validity test in this study used the Pearson Bivariate test, namely by comparing r_{count} with r_{table} from the Product Moment table. The validity test data in this study are as follows: the number of respondents ($n = 30$); two-sided testing (2-tailed) with $\alpha = 5\%$; degrees of freedom ($df = n-1 = 30-1 = 29$). In the product moment table, the r table value with $df = 29$ and $\alpha = 5\%$ is 0.367. The statement will be said to be valid if $r_{\text{count}} > r_{\text{table}}$. The results of the validity test in this study are presented in Table 5 below.

Table 5. Validity test results

No.	Code	Frequency Validity Test			Impact Validity Test		
		r_{count}	r_{table}	Remarks	r_{count}	r_{table}	Remarks
1	X1	0.085	0.367	Invalid	0.018	0.367	Invalid
2	X2	0.444	0.367	Valid	0.210	0.367	Invalid
3	X3	0.449	0.367	Valid	0.296	0.367	Invalid
4	X4	0.292	0.367	Invalid	0.368	0.367	Valid
5	X5	0.306	0.367	Invalid	0.318	0.367	Invalid
6	X6	0.677	0.367	Valid	0.709	0.367	Valid
7	X7	0.181	0.367	Invalid	0.310	0.367	Invalid
8	X8	0.413	0.367	Valid	0.483	0.367	Valid
9	X9	0.593	0.367	Valid	0.717	0.367	Valid
10	X10	0.410	0.367	Valid	0.345	0.367	Invalid
11	X11	0.591	0.367	Valid	0.616	0.367	Valid
12	X12	0.533	0.367	Valid	0.677	0.367	Valid
13	X13	0.590	0.367	Valid	0.719	0.367	Valid
14	X14	0.541	0.367	Valid	0.638	0.367	Valid
15	X15	0.723	0.367	Valid	0.664	0.367	Valid
16	X16	0.743	0.367	Valid	0.866	0.367	Valid
17	X17	0.590	0.367	Valid	0.762	0.367	Valid
18	X18	0.534	0.367	Valid	0.401	0.367	Valid
19	X19	0.504	0.367	Valid	0.762	0.367	Valid
20	X20	0.743	0.367	Valid	0.840	0.367	Valid
21	X21	0.625	0.367	Valid	0.864	0.367	Valid
22	X22	0.689	0.367	Valid	0.830	0.367	Valid
23	X23	0.657	0.367	Valid	0.848	0.367	Valid
24	X24	0.532	0.367	Valid	0.886	0.367	Valid
25	X25	0.482	0.367	Valid	0.577	0.367	Valid
26	X26	0.335	0.367	Valid	0.679	0.367	Invalid
27	X27	0.462	0.367	Valid	0.708	0.367	Valid
28	X28	0.017	0.367	Invalid	0.531	0.367	Valid

Based on the validity test that has been carried out, the statements with the code X1 (Workers are scratched, punctured by materials); X2 (Falling on materials); X3 (Bumped head); X4 (Skin irritation); X5 (Worker's trip over materials); and X7 (Workers are injured while working); X10 (Lumbar muscle injury); X26 (Lack of assertiveness in implementing health protocols); and X28 (Lack of knowledge of workers about the consequences of not complying with health protocols) are declared invalid and cannot be used for the next stage because the r_{count} value of risk frequency and risk impact does not reach the r_{table} value of 0.367. The calculation to determine the risk rating will then be continued using statements valid for frequency or risk impact, namely 19 statements. The reliability test in this study uses the Cronbach's Alpha test, namely by comparing the Cronbach's Alpha SPSS value with the r_{table}

from the Product Moment table. The validity test data in this study are as follows: the number of respondents ($n = 30$); degrees of freedom ($df = n-1 = 30-1 = 29$). In the product moment table, the r_{table} value with $df = 29$ and $= 5\%$ is 0.367. The statement will be valid if $r_{alpha} > r_{table}$, where the reliability test results show that all variables tested for validity are reliable, as shown in Table 6 below.

Table 6. Reliability test results

No.	Code	Frequency Reliability Test			Impact Reliability Test		
		r_{count}	r_{table}	Remarks	r_{count}	r_{table}	Remarks
1	X6	0,913	0.367	Reliabel	0,948	0.367	Reliabel
2	X8	0,920	0.367	Reliabel	0,951	0.367	Reliabel
3	X9	0,916	0.367	Reliabel	0,948	0.367	Reliabel
4	X11	0,914	0.367	Reliabel	0,949	0.367	Reliabel
5	X12	0,916	0.367	Reliabel	0,948	0.367	Reliabel
6	X13	0,911	0.367	Reliabel	0,947	0.367	Reliabel
7	X14	0,913	0.367	Reliabel	0,948	0.367	Reliabel
8	X15	0,909	0.367	Reliabel	0,948	0.367	Reliabel
9	X16	0,909	0.367	Reliabel	0,946	0.367	Reliabel
10	X17	0,911	0.367	Reliabel	0,947	0.367	Reliabel
11	X18	0,917	0.367	Reliabel	0,952	0.367	Reliabel
12	X19	0,920	0.367	Reliabel	0,947	0.367	Reliabel
13	X20	0,907	0.367	Reliabel	0,945	0.367	Reliabel
14	X21	0,909	0.367	Reliabel	0,944	0.367	Reliabel
15	X22	0,907	0.367	Reliabel	0,946	0.367	Reliabel
16	X23	0,909	0.367	Reliabel	0,946	0.367	Reliabel
17	X24	0,912	0.367	Reliabel	0,945	0.367	Reliabel
18	X25	0,918	0.367	Reliabel	0,951	0.367	Reliabel
19	X27	0,921	0.367	Reliabel	0,949	0.367	Reliabel

The risk rating calculation in this study uses the RII value, calculated for each frequency and impact value. The frequency RII value is multiplied by the impact RII value, so each statement's risk rating can be known. The calculated RII values of risk frequency and risk impact are presented in Table 7. An example of the calculation of the frequency RII value for the statement coded X19 with the number of respondents who chose frequency scale 1 as many as 4, frequency scale 2 as many as 4, frequency scale 3 as many as 8, frequency scale 4 as many as 5, and frequency scale 5 as many as 9 is as follows.

$$RII = \frac{(1 \times 4) + (2 \times 4) + (3 \times 8) + (4 \times 5) + (5 \times 9)}{(5 \times 30)} = 0.673$$

Table 7. Calculation results of RII values frequency and impact

Code	Frequency						Impact					
	Risk Frequency Scale						Impact Frequency Scale					
	1	2	3	4	5	RII	1	2	3	4	5	RII
X6	15	8	5	0	2	0.373	6	4	6	9	5	0.620
X8	2	13	11	1	3	0.533	5	15	7	3	0	0.453
X9	10	7	7	4	2	0.473	4	7	10	7	2	0.573
X11	10	12	7	1	0	0.393	4	12	8	5	1	0.513
X12	16	7	5	1	1	0.360	10	8	4	5	3	0.487
X13	13	11	4	1	1	0.373	7	4	3	10	6	0.627
X14	15	10	3	1	1	0.353	6	5	13	4	2	0.540
X15	8	5	10	5	2	0.520	2	2	9	7	10	0.740
X16	12	6	4	5	3	0.473	3	3	6	13	5	0.693
X17	14	5	7	3	1	0.413	4	3	7	13	3	0.653
X18	3	10	14	0	3	0.533	3	6	10	3	8	0.647
X19	4	4	8	5	9	0.673	6	2	11	4	7	0.627
X20	8	6	10	2	4	0.520	5	0	16	1	8	0.647
X21	10	5	9	1	5	0.507	5	3	12	1	9	0.640
X22	10	8	6	2	4	0.480	2	2	15	2	9	0.693
X23	11	6	7	2	4	0.480	6	1	13	1	9	0.640
X24	10	7	7	3	3	0.480	5	2	11	3	9	0.660

Code	Frequency						Impact					
	Risk Frequency Scale						Impact Frequency Scale					
	1	2	3	4	5	RII	1	2	3	4	5	RII
X25	6	6	13	2	3	0.533	8	4	12	4	2	0.520
X27	7	7	8	2	6	0.553	6	8	9	0	7	0.560

The result of multiplying the RII value of risk frequency with risk impact is used to determine the risk ranking and can be seen in Table 8. The risks that occupy the top five rankings are obtained as the most significant and likely to occur in the context of our study are as follows:

1. X19: Spread of Covid-19
2. X15: Falling from a height
3. X18: Being electrocuted
4. X20: Reactive/positive Covid-19
5. X22: Workers are infected with the Covid-19 virus due to not wearing masks

Table 8. Risk rating based on RII

Code	Risk Factors	RII Frequency	RII Impact	RII Frequency × RII Impact	Ranking
X19	Spread of Covid-19	0.673	0.627	0.422	1
X15	Falling from a height	0.520	0.740	0.385	2
X18	Being electrocuted	0.533	0.647	0.345	3
X20	Reactive/positive Covid-19	0.520	0.647	0.336	4
X22	Workers are infected with the Covid-19 virus due to not wearing masks	0.480	0.693	0.333	5
X16	Cut by grinder	0.473	0.693	0.328	6
X21	Workers exposed to Covid-19 due to crowding	0.507	0.640	0.324	7
X24	Workers exposed to Covid-19 due to direct contact	0.480	0.660	0.317	8
X27	Work standards that do not prioritize health protocols	0.553	0.560	0.310	9
X23	Workers infected with Covid-19 due to the addition of workers from outside the project	0.480	0.640	0.307	10
X25	Lack of outbreak prevention materials such as disinfectants, hand sanitizers, and masks	0.533	0.520	0.277	11
X9	Falling on work tools	0.473	0.573	0.271	12
X17	Cut by bar bender/bar cutter	0.413	0.653	0.270	13
X8	Respiratory problems due to sand/cement dust	0.533	0.453	0.242	14
X13	Hit by heavy equipment	0.373	0.627	0.234	15
X6	There was a spark and caused a fire	0.373	0.620	0.231	16
X11	Falling into excavation holes	0.393	0.513	0.202	17
X14	Exposed to chemicals	0.353	0.540	0.191	18
X12	Buried in the excavation soil	0.360	0.487	0.175	19

Fig.2 shows the OHS risk factors by frequency and impact of occurrence in building construction projects and presents the overall relative importance of each factor. When compared, it is found that there is a similarity in the ranking of risk factors from the calculation of RII values and the AS/NZS 4360:2004 standard, indicating a significant and positive relationship between the two methods in determining the ranking and category of risk assessment. Although the level of impact and probability of OHS risks varies, this method determines the risk impact on building construction projects. It can be classified according to risk categories using the AS/NZS 4360:2004 standard, as seen in Table 8.

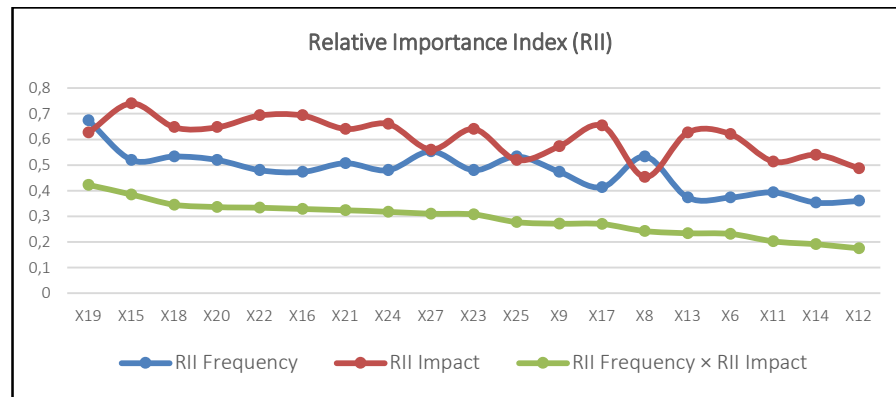


Figure 2. Graph of Relative Importance Index (RII)

Risk assessment using the AS/NZS 4360:2004 standard is obtained by multiplying the average risk frequency with the average risk impact. As a result, a risk category is grouped into risk categories, namely high risk consisting of risk factors ranked 1 and 2, and moderate risk consisting of risk factors ranked 3-19. Risk assessment and risk categories based on the AS/NZS 4360:2004 standard is presented in Table 9 below.

Table 9. Risk assessment using AS/NZS 4360:2004 standard

No.	Code	Risk Factors	Average Risk Frequency	Average Risk Impact	Frequency x Impact	Risk category
1	X19	Spread of Covid-19	3.4	3.1	10.5	High
2	X15	Falling from a height	2.6	3.7	9.6	High
3	X18	Electrocuted	2.7	3.2	8.6	Moderate
4	X20	Reactive/positive Covid-19	2.6	3.2	8.4	Moderate
5	X22	Workers are infected with the Covid-19 virus due to not wearing masks	2.4	3.5	8.3	Moderate
6	X16	Cut by grinder	2.4	3.5	8.2	Moderate
7	X21	Workers exposed to Covid-19 due to crowding	2.5	3.2	8.1	Moderate
8	X24	Workers exposed to Covid-19 due to direct contact	2.4	3.3	7.9	Moderate
9	X27	Work standards that do not prioritize health protocols	2.8	2.8	7.7	Moderate
10	X23	Workers infected with Covid-19 due to the addition of workers from outside the project	2.4	3.2	7.7	Moderate
11	X25	Lack of outbreak prevention materials such as disinfectants, hand sanitizers, and masks	2.7	2.6	6.9	Moderate
12	X9	Falling on work tools	2.4	2.9	6.8	Moderate
13	X17	Cut by bar bender/bar cutter	2.1	3.3	6.8	Moderate
14	X8	Respiratory problems due to sand/cement dust	2.7	2.3	6.0	Moderate
15	X13	Hit by heavy equipment	1.9	3.1	5.8	Moderate
16	X6	There was a spark and caused a fire	1.9	3.1	5.8	Moderate
17	X11	Falling into excavation holes	2.0	2.6	5.0	Moderate
18	X14	Exposed to chemicals	1.8	2.7	4.8	Moderate
19	X12	Buried in the excavation soil	1.8	2.4	4.4	Moderate

Risk control in this study was obtained from distributing the second phase of questionnaires was given to three respondents selected based on their position and work experience. Table 10 shows the cross tabulation between position and education level. The selected respondents were a director, project manager, and K3 manager, each

holding an Undergraduate degree. This aimed to assess risk control for previously identified risks from the first questionnaire.

Table 10. Cross tabulation of position and last education of respondents

Cross Tabulation of Respondent's Position and Last Education				
		Respondent's Last Education		
		Undergraduate	Bachelor's degree	High school or equivalent
Position	Director	18	2	6
	Project Manager	1	0	1
	OHS Manager	1	0	0
	Deputy Director	1	0	0
	Total	21	2	7
				30

The results of the risk control questionnaire for risks ranked 1 to 5 can be seen in Table 11. The implementation of health protocols refers to the PUPR ministerial instruction Number 02/IN/M/2020 concerning the Protocol for Preventing the Spread of Corona Virus Disease 2019 (Covid-19). Risk control through engineering, including using strong/sturdy scaffolding, making, or arranging safe electrical lines, and installing safety nets and warning signs. Risk control through administration includes carrying out safety induction, creating a supervision and sanction system, and making work standards following health protocols.

Table 11. Risk control for top-five ranking

Risk Ranking	Code	Risk Factors	Risk Control
1	X19	Spread of Covid-19	a) Follow and implement health protocols b) Educate workers to prevent and protect themselves from Covid-19
2	X15	Falling from a height	a) Use PPE (especially body harness and safety helmet) b) Using strong/sturdy scaffolding c) Installing safety net d) Followed up with medical action
3	X18	Being electrocuted	a) Creating or arranging safe electrical lines b) Use PPE c) Followed up with medical action
4	X20	Reactive/positive Covid-19	a) Perform self-isolation and treatment b) Comply with and implement health protocols
5	X22	Workers are infected with the Covid-19 virus due to not wearing masks	a) Comply with and implement health protocols b) Supervise workers to work following procedures c) Give a mandatory warning to wear a mask d) Provide masks

Discussion

Based on the study's results, there is a similarity in the ranking of risk factors from the calculation of the RII value and the AS/NZS 4360: 2004 standard. This shows a positive and significant correlation between the two methods in determining the ranking and category of risk assessment. The five risks that have the top ranking in the government building construction project in Palangka Raya city are the spread of Covid-19 (X19), falling from a height (X15), being electrocuted (X18), reactive/positive Covid-19 (X20) and workers are infected with the Covid-19 virus due to not wearing masks (X22). Based on calculations with the AS/NZS 4360: 2004 standard, the two risks are included in the high-risk category. The coronavirus infection or Corona Virus Disease 2019 (Covid-19) can cause mild disorders of the respiratory system, severe lung infections, and death (Timah, 2021). Covid-19 has caused around 6.4 million positive cases and 158,000 deaths in Indonesia (Pribadi, 2022).

Meanwhile, based on data from the Multi-Media Center of Central Kalimantan, the Covid-19 container in Palangka Raya has caused around 18 thousand positive cases and around 550 deaths (Natalia, 2022). The spread of Covid-19 is very dangerous and can occur in the implementation of construction projects because its spread cannot be

avoided. Indonesia has the third greatest number of deaths from Covid-19 infection in Asia as of September 20, 2020, and the second highest number of confirmed cases in Southeast Asia (Sufri et al., 2021). The spread of Covid-19 is very dangerous and can occur in the implementation of construction projects because its spread cannot be avoided. Working at height is a high-risk job; based on BPJS Ketenagakerjaan 2015 data, the number of work accidents reached 105,182 cases, and of that total, the most common cause of as much as 38% was the accident of workers falling from a height (Pisceliya & Mindayani, 2018). The main danger of working at heights is falling, causing severe injuries and even death, and can also fall on workers or people below. Workers' lack of knowledge about the consequences of not complying with health protocols can increase the spread of Covid-19, so workers feel no need to implement health protocols.

In comparison with previous research on the construction project of the former Sambirejo disposal area (Firdaus et al., 2021), using the risk assessment with the AS/NZS 4360: 2004 standard, there is a similarity in the risk category assessment, where the risk of spreading Covid-19 (X19) and reactive/positive Covid-19 (X20) are included in the high-risk category, the risk of being hit by work tools (X9) and lumbar muscle injuries (X10) are included in the moderate risk category. When compared with the results of research on building construction using a risk assessment based on Permen PU No. 05-PRT-M-2014 (Yuni et al., 2021), There is a similarity in the risk category assessment for the risk factors of falling into an excavation pit (X11), being hit by heavy equipment (X13), exposure to chemicals (X14), falling from a height (X15), being cut by grinders (X16), being cut by bar-benders and bar cutters (X17), and being electrocuted (X18) in the medium risk category.

In order to improve worker training and education on health protocols, increase safety measures for working at height, and implement more effective Covid-19 prevention strategies on construction sites, some suggestions include:

- Develop a comprehensive training program that covers all aspects of health and safety, including Covid-19 prevention, working at height, and the proper use of personal protective equipment (PPE).
- Provide ongoing training and education to ensure that workers are up-to-date on the latest health and safety protocols and best practices.
- Conduct regular safety audits and inspections to identify potential hazards and implement appropriate measures to mitigate them.
- Encourage workers to report any safety concerns or issues they encounter and provide a system for reporting and resolving these issues.
- Provide workers with the necessary PPE, such as hard hats, safety glasses, and fall protection equipment, and ensure that they are properly trained in their use.
- Implement Covid-19 prevention strategies, such as social distancing, mask-wearing, and regular testing, and screening, to reduce the risk of transmission on construction sites.
- Ensure that all workers, including contractors and subcontractors, are aware of and comply with health and safety regulations and guidelines.
- Foster a culture of safety and accountability on construction sites by encouraging open communication, recognizing safe behaviors, and addressing unsafe practices promptly.

Given that the implementation of this research was carried out during the Covid-19 pandemic and health protocols are still being implemented, there are limitations, namely: first, the number of respondents is limited to only one city in Central Kalimantan, namely the city of Palangka Raya. Second, the construction projects reviewed are only building construction projects from several project types that can be implemented during the Covid-19 pandemic, and third, the limited time to meet face-to-face with respondents, so that the interview time

is limited. However, the findings of this paper can provide valuable insights and recommendations for stakeholders to improve OSH outcomes in the region. For example, the identification of specific hazards and risks in the workplaces surveyed can help inform the development of targeted interventions to address these issues. The recommendations provided in the paper, such as implementing health protocols through engineering, the need for increased training and awareness-raising activities, through administration socializing and educating workers about Covid-19, can be used by employers, government agencies, and other stakeholders to improve OSH practices and policies. In addition, the methodology used in this study, which involved conducting surveys and interviews with workers and employers, can serve as a model for future research in the region. By using a participatory approach that involves input from all relevant stakeholders, future studies can generate more comprehensive and accurate data on OSH in Palangka Raya and other regions of Indonesia. Overall, this paper can contribute to the improvement of OSH management practices and policies in Palangka Raya and Indonesia by providing insights and recommendations based on empirical data and a participatory approach.

Conclusions

Based on the literature study, 28 risk factors can affect the construction project implementation; after conducting validity and reliability tests, there are 19 valid and reliable risk factors consisting of 11 OHS risk factors and 8 Covid-19 risk factors. Based on the RII calculation, the top five ranked risks are the spread of Covid-19 (X19), falling from a height (X15), being electrocuted (X18), reactive/positive Covid-19 (X20), and workers being infected with Covid-19 virus due to not wearing masks (X22), based on the AS/NZS 4360: 2004 standard, the two first risks are in the high-risk category, and the others are moderate category. It is discovered that the ranking of risk factors based on the computation of RII values and the AS/NZS 4360:2004 standard is similar, showing a substantial and positive association between the two methodologies in establishing the ranking and category of risk assessment. Risk control that can be implemented includes implementing health protocols through engineering, namely using strong/sturdy scaffolding, making, or arranging safe electrical lines, installing safety nets, and installing warning signs, through administration socializing and educating workers about Covid-19, carrying out safety induction, creating a supervision and sanction system, and making work standards following health protocols, and using Personal Protective Equipment (PPE). Comprehensive training programs, ongoing education, safety audits and inspections, reporting systems, proper provision, and training in the use of PPE, Covid-19 prevention strategies, compliance with regulations and guidelines, and fostering a culture of safety and accountability are all necessary to enhance worker training and education on health protocols, improve safety measures for working at heights, and implement more effective Covid-19 prevention strategies on construction sites. In the future, building construction projects need to adjust work methods during the Covid-19 pandemic or during the new normal era to avoid these risks. Given the limited scope, number of respondents, types of projects and the limited time of survey implementation, further research can use more respondents with a wider scope, and it is recommended to examine other types of projects, such as road, bridge, and drainage / waterway projects, to get more diverse variables or risk factors, future research can use more respondents with a broader range; it is also advisable to research other types of projects, such as road, bridge, and drainage/channel projects, to obtain more diverse variables or risk factors.

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