Analysis of Occupational Safety and Health Management System (SMK3) on Workers In Cikeruh Majalengka Bridge Construction Project

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KEYWORDS	ABSTRACT
planning, organization, actuating, controlling, worker productivity	The implementation of safety and health (OSH) systems in the work environment is a crucial component for the running of a business entity, because the consequences of accidents can have a detrimental impact on the workforce and the institution. This study was conducted to evaluate how OHS affects the level of worker productivity. A quantitative approach is the method used by collecting primary data through distributing questionnaires to 35 workers at the Cikeruh Majalengka Bridge Construction Project. Data analysis was carried out using IBM SPSS 26.0 for Windows, by conducting an Instrument Test consisting of Validity Test and Reliability Test. The variables studied consisted of four independent variables: Planning (X1), Organization (X2), Actuating (X3), Controlling (X4) and one dependent variable, namely Worker Productivity (Y). The results showed that Planning has a positive effect on productivity with an average value of 1.98, Organization 2.0, Actuating 1.78, and Controlling 1.94. The four independent variables as a whole have an average value of 1.92 which indicates a positive influence on worker productivity on the project, because it is in the interval class $1.6 \geq x \leq 2.0$. This proves that factors such as planning, organization, implementation, and supervision play a significant role in increasing worker productivity on the Majalengka Cikeruh Bridge Construction Project.

INTRODUCTION

Infrastructure development, especially bridges, has a strategic role in supporting community mobility and economic growth. One of the projects being implemented is the Cikeruh Bridge Construction in Loji Jatiwangi Village, which is on the Cirebon-Bandung vital route with heavy traffic. With a size of 11 meters x 80 meters, this project utilizes heavy equipment such as cranes, excavators, and bore pile equipment, which requires close supervision to avoid potential risks around the work area (Marbun, 2020).

In its execution, the project was faced with various challenges, including unstable river currents, especially during heavy rains, which could jeopardize workers' safety during the bore pile foundation installation process. The technical specifications of the bore pile foundation include 80 cm depth and 1 meter diameter with D16-150 main reinforcement and D19-150 reinforcement (Yoon et al., 2013).

Occupational safety and health (OHS) is an important aspect that cannot be ignored in this project, given the high risk of work accidents in the construction field. The implementation of the Occupational Safety and Health Management System (SMK3) is a solution to ensure worker safety and the smooth running of the project, which refers to Government Regulation Number 50 Year 2012. SMK3 is systematically designed through policy, organization,

planning, actuating, evaluation, audit, and corrective action to create a safe and healthy work environment (Camargo-Acuña et al., 2022).

This study aims to analyze the application of SMK3 in the Cikeruh Bridge construction project in Majalengka using quantitative methods. This study refers to previous relevant research, such as studies conducted by Natasyah et al. (2023), Pangkey et al. (2020), and Fitriani et al. (2022), which discuss the effect of SMK3 on risk control in various construction projects. The main difference of this study lies in the type of project, location, and implementation of the implementation method, so the results of the study are expected to make a significant contribution in the development of SMK3 implementation in similar projects in the future.

The construction industry is inherently high-risk, demanding strict adherence to occupational safety protocols to ensure the wellbeing of workers and the smooth execution of projects. As highlighted by Jaafar et al. (2018), effective occupational safety and health management systems (OSHMS) are crucial for mitigating risks and preventing workplace accidents in the construction sector. In Indonesia, the implementation of the Occupational Safety and Health Management System (SMK3) is mandatory for large-scale projects, as stipulated by Government Regulation No. 50 of 2012 (Indrayana et al., 2023). SMK3 frameworks emphasize systematic planning, execution, evaluation, and corrective actions to create a safe and healthy work environment.

Bridge construction projects, such as the Cikeruh Bridge, often face unique challenges due to environmental and geographical conditions. According to Wibowo et al. (2020), unstable river currents and adverse weather conditions can significantly impact project timelines and worker safety, particularly during critical phases such as bore pile foundation installation. These challenges necessitate the integration of advanced safety measures, real-time monitoring, and adaptive planning to ensure the project's success. Pangkey et al. (2012) underscore the importance of employing competent personnel and using appropriate machinery in high-risk environments to reduce potential hazards (Almost et al., 2018).

Research has consistently demonstrated that the adoption of SMK3 positively influences safety performance in construction projects. For instance, Fitriani et al. (2022) found that periodic safety audits and comprehensive worker training significantly reduced the incidence of workplace accidents. Similarly, Natasyah et al. (2023) highlighted the role of management commitment and worker engagement in enhancing the effectiveness of SMK3. These findings align with the principles of safety leadership, which emphasize proactive risk management and continuous improvement.

The Cikeruh Bridge project exemplifies the application of SMK3 in addressing complex construction challenges. The project's technical specifications, including bore pile foundations with a depth of 80 cm and a diameter of 1 meter, require precise execution to ensure structural integrity. The use of heavy machinery such as cranes and excavators further underscores the need for stringent safety protocols to prevent accidents and ensure smooth operations. Moreover, the project's strategic location on the Cirebon-Bandung route adds urgency to timely completion while maintaining high safety standards.

Despite its proven benefits, implementing SMK3 in construction projects is not without challenges. Siahaan et al. (2022) identified barriers such as limited worker awareness, inadequate training, and insufficient resource allocation as common obstacles to effective safety management. These challenges highlight the need for tailored strategies that consider the specific conditions of each project. As noted by Singh et al. (2024), fostering a culture of safety through regular communication, incentives, and leadership support is essential for overcoming these barriers and achieving long-term improvements.

This study aims to build upon existing research by analyzing the application of SMK3 in the Cikeruh Bridge construction project. By focusing on the project's unique environmental and technical aspects, this research seeks to provide valuable insights for the development of SMK3

implementation strategies in similar infrastructure projects (Setyawan, T., & Nugroho, 2020). The findings are expected to contribute to the broader discourse on occupational safety in construction, supporting efforts to enhance worker protection and project efficiency (Widodo, S., Pratama, A., & Satria, 2021).

The urgency of this research lies in the high-risk nature of construction projects, particularly bridge construction, which demands strict adherence to occupational safety and health (OSH) standards. Accidents and safety issues not only jeopardize worker well-being but also delay project timelines and increase costs. Given the strategic importance of projects like the Cikeruh Bridge, ensuring the effective implementation of the Occupational Safety and Health Management System (SMK3) is crucial for safeguarding workers and achieving project goals on time and within budget.

While numerous studies have explored OSH practices in construction, limited attention has been given to the application of SMK3 in medium-scale projects like the Cikeruh Bridge. Most existing research focuses on high-rise buildings or large infrastructure, leaving a gap in understanding the challenges and solutions specific to bridge construction. Additionally, the role of factors such as planning, organization, actuating, and controlling within the SMK3 framework in influencing worker productivity has not been sufficiently examined.

The novelty of this study lies in its application of the SMK3 framework to a medium-scale bridge construction project in Indonesia, with a specific focus on the interaction between safety management and worker productivity. By incorporating variables such as planning, organization, actuating, and controlling, this research provides a comprehensive analysis of how safety protocols directly contribute to productivity. This approach bridges the gap between safety management practices and operational efficiency in construction.

The objective of this research is to evaluate the impact of SMK3 implementation on worker productivity in the Cikeruh Bridge construction project. The findings aim to provide actionable insights for contractors and project managers to enhance safety practices and improve productivity. This study also benefits policymakers by highlighting the effectiveness of SMK3 in medium-scale projects, contributing to the development of more robust safety regulations. Ultimately, the research supports the broader goal of fostering a culture of safety and efficiency in the construction industry.

RESEARCH METHOD

Research Location

This research is located at the Cikeruh bridge construction project which is located on St. Raya Cirebon - Bandung, Loji, Jatiwangi District Majalengka, West Java 45455.
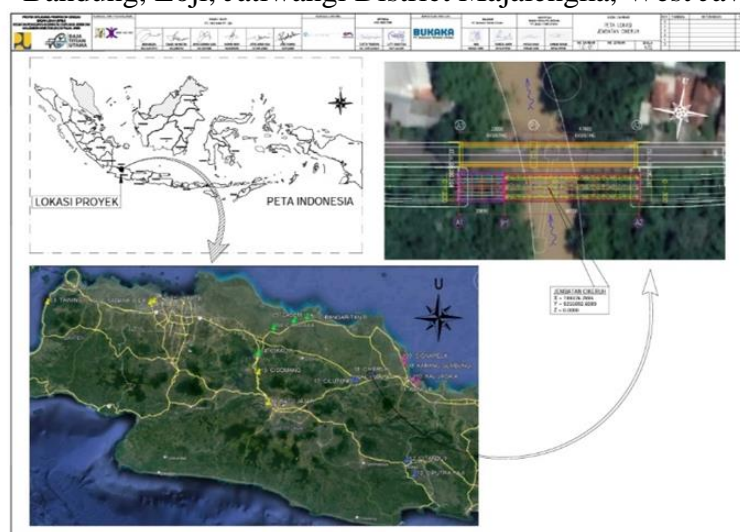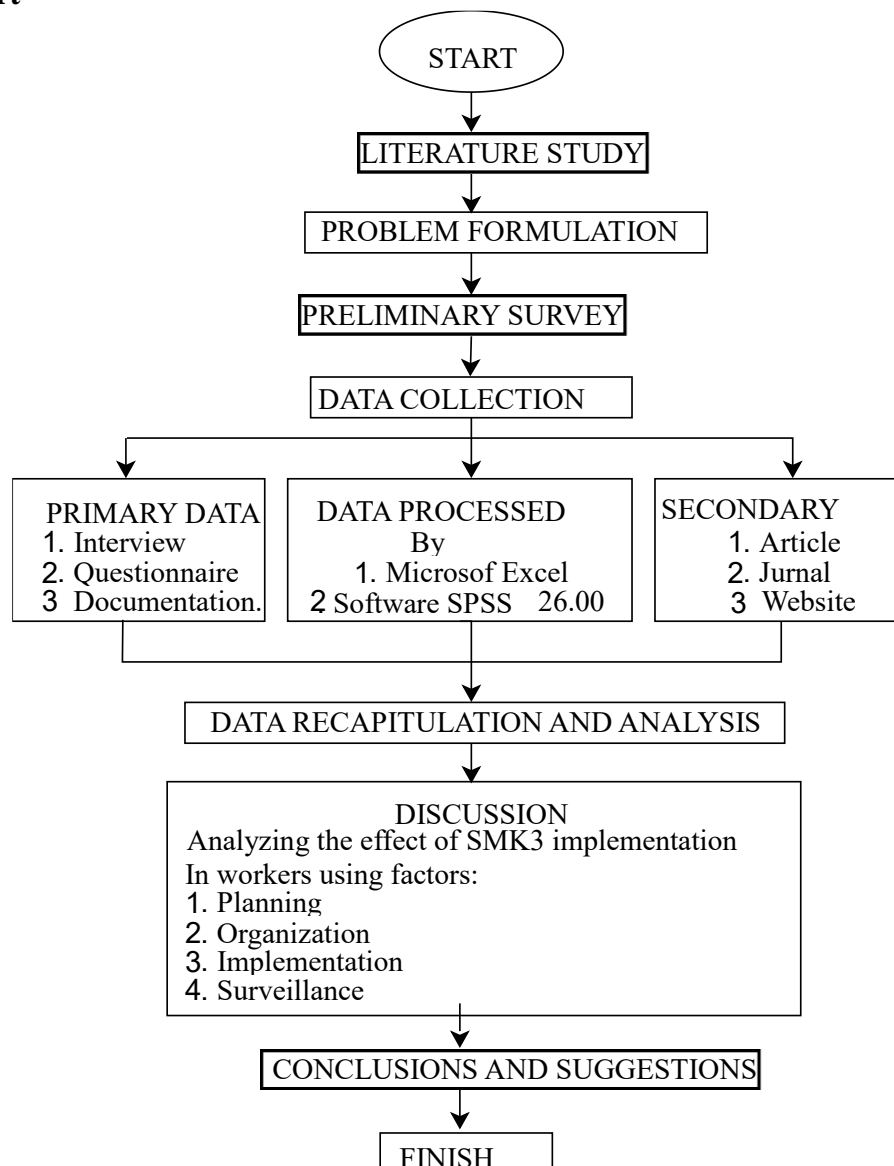
This research uses quantitative methods to analyze the relationship between variables under controlled conditions. This method was chosen because it is in accordance with the systematic research objectives in evaluating the influence between variables. Data were collected through a questionnaire with a Likert scale and analyzed using IBM SPSS version 26.0 software and Microsoft Excel. SPSS was chosen because of its ability to process statistical data in depth.

This study involves two types of variables, namely independent variables which include planning, organization, implementation, and supervision, and the dependent variable in the form of worker productivity. The study population consisted of 54 workers of the Cikeruh Bridge construction project, with a sample of 35 workers taken using the Slovin formula. Validity and reliability tests were conducted to ensure the research instruments could be used accurately and consistently.

Data analysis was conducted to measure the effect of each variable on worker productivity. The results of the analysis aim to provide an overview of the effectiveness of the application of construction management in the field, so that it can be used as a reference to improve work productivity in the future.

Flowchart

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                    ┌─────────────┐
                    │    START    │
                    └──────┬──────┘
                           ↓
                  ┌──────────────────┐
                  │ LITERATURE STUDY │
                  └────────┬─────────┘
                           ↓
                ┌──────────────────────┐
                │ PROBLEM FORMULATION  │
                └──────────┬───────────┘
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                ┌──────────────────────┐
                │ PRELIMINARY SURVEY   │
                └──────────┬───────────┘
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                ┌──────────────────────┐
                │  DATA COLLECTION     │
                └──────────────────────┘
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PRIMARY DATA	DATA PROCESSED	SECONDARY
1. Interview	By	1. Article
2. Questionnaire	1. Microsof Excel	2. Jurnal
3 Documentation.	2 Software SPSS 26.00	3 Website

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                ┌──────────────────────────────────┐
                │ DATA RECAPITULATION AND ANALYSIS │
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DISCUSSION
Analyzing the effect of SMK3 implementation
In workers using factors:
1. Planning
2. Organization
3. Implementation
4. Surveillance

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                │ CONCLUSIONS AND SUGGESTIONS  │
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                        │    FINISH    │
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RESULTS AND DISCUSSION

Results

1. Respondent Presentation

In this study, the respondents consisted of 35 workers at the Majalengka Cikeruh Bridge Construction Project, grouped by company, gender, and position. Based on the company, the majority of respondents came from the main contractor as many as 28 people (80%), while there were 6 people (18.14%) from subcontractors and only 1 person (2.86%) from supervisory consultants. In terms of gender, all respondents were male (100%), with no female participation. Based on position, 19 respondents were daily workers (52.29%), followed by 4 quantity surveyors (11.43%), 2 HSE and crew operators (5.71%), and 1 field manager, construction management, QC, SCM, engineer, SEM, commercial staff, and crew helper (2.86%). Thus, the majority of respondents came from main contracting companies, were male, and worked as day laborers.

2. Research Instrument Test

Validity Test

Validity test is one of the testing methods to verify the accuracy and feasibility of the questions in the questionnaire in measuring research variables. Determination of validity based on the comparison of the value of r count with r table, with the provisions:

- r count > r table = feasible
- r count < r table = not feasible

The following are the results of the validity test of the research conducted:

Table 1 Validity Test

No.	Variable	Item	Rcount	Rtable	Description
1.	Planning (X1)	P1	0,764	0,3338	feasible
		P2	0,667	0,3338	feasible
		P3	0,637	0,3338	feasible
		P4	0,766	0,3338	feasible
		P5	0,743	0,3338	feasible
2.	Organization (X2)	P1	0,654	0,3338	feasible
		P2	0,738	0,3338	feasible
		P3	0,746	0,3338	feasible
		P4	0,687	0,3338	feasible
		P5	0,784	0,3338	feasible
3.	Actuating (X3)	P1	0,784	0,3338	feasible
		P2	0,657	0,3338	feasible
		P3	0,728	0,3338	feasible
		P4	0,634	0,3338	feasible
		P5	0,547	0,3338	feasible
4.	Controlling (X4)	P1	0,722	0,3338	feasible
		P2	0,743	0,3338	feasible
		P3	0,639	0,3338	feasible
		P4	0,587	0,3338	feasible
		P5	0,732	0,3338	feasible
5.	Worker productivity (Y)	P1	0,764	0,3338	feasible
		P2	0,666	0,3338	feasible
		P3	0,637	0,3338	Feasible
		P4	0,766	0,3338	Feasible
		P5	0,654	0,3338	Feasible

Source: Data processed (2024)

The results of the analysis using IBM SPSS Version 26.0 showed that all data met the validity criteria, where the calculated R value for each component of the four variables tested proved to be higher than the R table value.

Reliability Test

To evaluate the consistency of the research instrument in the form of a questionnaire, a Reliability Test was conducted. This test aims to ensure that the instrument can produce consistent data even though it is used at different times under the same conditions. Reliability evaluation uses the Cronbach's Alpha method, whose coefficient value illustrates the level of reliability and internal consistency of the research instrument used. An instrument is said to be reabel if it has Cronbach Alpha> 0.7. The following are the results of the reliability test of the research conducted:

Table 2 Relibility

No.	Variable	Cronbach's Alpha	Description
1.	Planning (X1)	0,867	Realible
2.	Organization (X2)	0,923	Realible
3.	Actuating (X3)	0,858	Realible
4.	Controlling (X4)	0,920	Realible
5.	Worker productivity (Y)	0,867	Realible

Source: Data processed (2024)

All items evaluated can be categorized as reliable based on table 2 above, indicated by the acquisition value of the Cronbach's Alpha score which is above the minimum value of 0.7 for each component.

3. Questionnaire Analysis

In this study, questionnaire analysis was conducted to determine the effect of variables on worker productivity. The method is by:

a. Average value (mean)

$$\bar{x} = \Sigma Xi / \Sigma Fi$$

Where :

$\bar{x}$ = Average factor

Σxi = Total of all values

Σfi = Total amount of data

b. Relative Importance (IKR)

$$IKR = \frac{\bar{x}}{M}$$

Where :

IKR = Relative Importance Index

$\bar{x}$ = Mean value

M = 2 (multiplier of factors that have influence)

Here are the results:

Tabel 3 Analisis Kuesioner

Variable	Total average value	IKR	Description
Planning (X1)	1,985	1	Influence
Organization (X2)	2.00	1	Influence
Actuating (X3)	1,78	0,98	Influence
Controlling (X4)	1,942	0,98	Influence
Worker productivity (Y)	1,985	0,98	Influence

Source: Data processed (2024)

Data analysis shows that the implementation of SMK3 which includes aspects of planning, organization, implementation, and supervision has a significant positive impact on increasing the productivity of workers in the Cikeruh Majalengka Bridge construction project.

Discussin

a. The Effect of Planning (X1) on Worker Productivity (Y)

The results of the analysis show that the planning variable has an average value of **1.98**, which means that it has a positive effect on worker productivity. Good planning is very important to improve worker performance in the Cikeruh Bridge project, so companies need to ensure that planning is carried out carefully to achieve targets.

b. Effect of Organization (X2) on Worker Productivity (Y)

The organization variable obtained an average value of 2.0, indicating a strong influence on productivity. An organized organizational structure helps improve efficiency and ensures work goes according to the rules, which is important for project success.

c. Effect of Actuating (X3) on Worker Productivity (Y)

On the implementation variable, the average value of **1.78** indicates a positive influence. Proper implementation is instrumental in maintaining productivity and safety during project implementation, so companies need to focus on safe procedures.

d. Effect of Controlling (X4) on Worker Productivity (Y)

The supervision variable has an average value of 1.94, which also shows a significant effect on productivity. Strict supervision ensures the project runs according to operational standards, so companies need to continue to monitor performance to maintain quality.

e. Effect of Planning (X1), Organization (X2), Actuating (X3) and Controlling (X4) on Worker Productivity (Y)

In general, the variables of planning (1.98), organization (2.0), implementation (1.78), and supervision (1.94) yielded an average value of 1.92, indicating a positive influence on worker productivity. Effective implementation of these four factors ensured the project ran smoothly, achieved the desired targets, and increased worker productivity and safety at the Cikeruh Bridge project.

CONCLUSION

SMK3 factors that have been analyzed to find their influence there are 4 factor to Worker Produktivity , namely, Planning, Organization, Actuating and Controlling. The planning factor focuses on how the workers during the implementation of the Cikeruh Majalengka bridge project. Then the Organizational factor focuses on this research, namely the Main Contractor organization, considering that the Main Contractor has the full responsibility for the Cikeruh Bridge construction project. And the Actuating factor that is focused on is the part of the bridge work carried out by the workers. And the Controlling factor is an activity to control the course of work so that it is in accordance with planning. What is focused on this supervision is whether the productivity of workers is running according to existing regulations and supervising whether workers apply K3 during work.

A factor is said to be influential if $\Sigma\overline{x}$ (total average value) is in the interval class $1.6 \geq x \leq 2.00$. From the results of data processing, the Planning factor received a value of $\Sigma\overline{x}=1.98$, the Organization factor received a value of $\Sigma\overline{x}=2.00$, the Actuating factor received a value of $\Sigma\overline{x}=1.78$, and the Controlling factor received a value of $\Sigma\overline{x}=1.94$. It can be concluded that all factors are said to have an influence on worker productivity in the construction of the Majalengka Cikeruh Bridge because they are in the interval $1.6 \geq x \leq 2.00$.

Based on the aspects and outputs obtained from $\Sigma\overline{x}$ (total average value), the role of SMK3 has a positive and significant effect on Worker Productivity, because the output obtained is in accordance with the input provided in the planning, organization, actuating and

controlling sections. It can be concluded that SMK3 has a positive effect on Worker Productivity, considering that the results obtained from the research show that workers work effectively and efficiently so that Worker Productivity on the Majalengka Cikeruh Bridge Construction Project runs in accordance with existing provisions so that the results achieved are more optimal.

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