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Analysis of the Impact of Overtime on Work Productivity and Occupational Safety and Health in the Lembean–Marawas Road Project in North Minahasa Regency

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Abstract
This study aimed to analyze the effects of work motivation (X1), occupational health (X2), and occupational safety (X3) on worker productivity (Y) during overtime implementation in the Lembean–Marawas Road Preservation Project, North Minahasa Regency, and to evaluate the effectiveness of overtime work on workers' physical productivity. The study employed a quantitative approach, with data collected through questionnaires distributed to 24 respondents and analyzed using IBM SPSS Statistics and Jamovi for validation and comparative testing. The F-test results indicated that work motivation, occupational health, and occupational safety simultaneously had a significant effect on worker productivity (F-count = 6.224; Sig. = 0.004), explaining 48.3% of the variance in productivity ($R^2 = 0.483$). Among the independent variables, work motivation had the strongest influence, with the highest regression coefficient (0.482). The physical productivity analysis showed that overtime was effective for stone masonry work (E = 1.0675) but ineffective for BJTP-280 plain reinforcement steel work (E = 0.4155), indicating that overtime effectiveness varied depending on the type of construction activity. The results obtained from SPSS and Jamovi produced consistent values, confirming the reliability of the statistical analysis.

INTRODUCTION

Labor productivity in road construction significantly influences project completion time and the quality of construction outcomes, both of which are typically defined within contractual agreements between construction service providers and project owners. Several factors commonly encountered during project execution can delay the completion of work activities, including equipment failures, adverse weather conditions, and environmental or community-related constraints (Associated General Contractors of America, 2003). To mitigate delays, construction contractors often implement overtime work to achieve scheduled completion targets. Overtime refers to working hours that exceed the normal working schedule established by company regulations or employment agreements. However, its implementation requires careful management to maintain worker welfare, comply with occupational safety regulations and labor requirements, and ensure efficient use of project resources (Simamora, 2006; Thomas, 1992). According to the Regulation of the Minister of Manpower and Transmigration No. KEP.102/MEN/VI/2004, overtime is limited to a maximum of 3 hours per day or 14 hours per week. Workers undertaking overtime of 3 hours or more are also required to receive adequate food and beverages with a minimum nutritional value of 1,400 calories. Thomas and Raynar (1997) reported that overtime could be implemented for three to four weeks without substantial efficiency losses; however, longer durations may result in excessive fatigue and significant reductions in work efficiency.

The Lembean–Marawas Road Preservation Work Package is a program implemented by the Public Works and Spatial Planning Office of North Minahasa Regency and funded through the Special Allocation Fund (DAK) for the 2023 fiscal year, covering a total road length of 13.253 km. The road serves as an important connection between North Minahasa Regency and Minahasa Regency (Tondano) and supports economic activities, particularly food production centers. During project implementation, the contractor applied overtime work to several activities to achieve the contractual completion target. Although overtime is intended to accelerate project schedules, it may negatively affect workers' health and increase the risk of occupational injuries (Dembe et al., 2005). Extended working hours may also contribute to fatigue, reduced work motivation, and declining work quality (Becker et al., 2004). When overtime is applied for more than four consecutive weeks, worker fatigue may increase and work efficiency may decline significantly (Astrawan et al., 2019). Nevertheless, Sumarningsih (2014) found that overtime can improve construction worker productivity depending on the type of work and the conditions of its implementation.

Productivity, expressed as the relationship between output and input, represents the efficiency level in producing goods or services (Sinungan, 2009). In construction projects, productivity is generally measured as the volume of completed work per unit of labor time and can be calculated using the formula $P = V \div (n \times J)$, where P represents worker productivity, V represents work volume, n represents the number of workers, and J represents total working hours (Dipohosodo, 1996; Ervianto, 2008). Construction productivity is influenced by several factors, including work methods and technology, field management, work environment, and human factors such as motivation, health, and occupational safety (Ervianto, 2005). Work motivation refers to internal and external factors that encourage workers to perform effectively in achieving organizational goals (Sutrisno, 2017). During overtime implementation, motivation becomes particularly important in maintaining worker commitment despite extended working hours. Occupational Safety and Health (Kesehatan dan Keselamatan Kerja [K3]), regulated under Kepmenaker No. 463/MEN/1993, aims to protect workers and support safe and productive operations. Its implementation is influenced by workload, work capacity, and workplace conditions (Budiono et al., 2003). Occupational health focuses on maintaining workers' physical, mental, and social well-being, which becomes increasingly important during overtime because extended working hours may affect worker endurance and performance. Meanwhile, occupational safety involves the implementation of Personal Protective Equipment (PPE), safe work procedures, and effective supervision to reduce workplace risks (Pujiastuti, 2008).

Previous studies have investigated related variables in various construction contexts. Rochmanu Ade (2018) examined the effects of motivation, fatigue, health, and work stress on worker performance during overtime and found that work stress was the dominant factor affecting performance during afternoon and weekend overtime periods. Sinaga et al. (2022) analyzed the influence of K3 implementation on construction project success and found that occupational safety significantly contributed to project success (13.9%), whereas occupational health did not show a significant effect. Wijaya and Waty (2023) examined the effects of work environment, K3 implementation, and labor factors on construction productivity and identified work area conditions and labor factors as significant determinants. Syamsuri (2024) evaluated overtime effectiveness in relation to productivity, safety, and occupational health and found that overtime was most effective in floor plate formwork activities ($E = 1.04 > 1$), while health variables significantly influenced productivity ($R^2 = 0.252$). Bustamin et al. (2023) investigated the effect of K3 implementation on construction worker performance and identified movement space suitability (11.3%), workplace cleanliness (11.1%), and PPE availability (10.8%) as the most influential safety factors. This study differs from previous research by integrating work motivation, occupational health, and occupational safety as simultaneous predictors of worker productivity, focusing specifically on overtime implementation in a road preservation project, applying SPSS and JAMOVI for analytical cross-validation, and evaluating the physical productivity effectiveness of overtime work.

Based on this background, this study aims to evaluate the effectiveness of overtime implementation on labor productivity and analyze the effects of work motivation, occupational health, and occupational safety on worker productivity during overtime work using SPSS and JAMOVI to validate the consistency of analytical results. The research questions addressed in this study are: (1) To what extent do work motivation, occupational health, and occupational safety influence worker productivity during overtime work? (2) Which factor has the most dominant influence on worker productivity during overtime implementation? (3) Is overtime implementation effective in maintaining or improving workers' physical productivity compared with normal working hours?

The objectives of this study are: (1) to determine the effects of work motivation, occupational health, and occupational safety on worker productivity during overtime work; (2) to identify the most dominant factor influencing worker productivity during overtime implementation; and (3) to evaluate the effectiveness of overtime work on physical productivity by comparing productivity levels during overtime and normal working hours.

Theoretically, this study contributes to construction management research by integrating work motivation, occupational health, and occupational safety into a comprehensive analytical framework for evaluating overtime work in road construction projects. It also provides empirical evidence regarding differences in overtime effectiveness across various construction activities. Practically, the findings provide recommendations for construction service providers, project managers, and policymakers in developing overtime management strategies that consider worker motivation, health, safety, competency development, and supportive working environments to maintain productivity during extended working periods.

The study was guided by four hypotheses:

H1: Work motivation has a significant effect on worker productivity during overtime implementation.

H2: Occupational health has a significant effect on worker productivity during overtime implementation.

H3: Occupational safety has a significant effect on worker productivity during overtime implementation.

H4: Work motivation, occupational health, and occupational safety simultaneously have a significant effect on worker productivity during overtime implementation.

METHOD

Types and Research Approaches

This study employed a quantitative approach to test the research hypotheses through numerical data collection and statistical analysis. Data were collected through questionnaires distributed to respondents and analyzed using IBM SPSS Statistics and JAMOVI to validate the consistency of the results. In addition, descriptive-comparative analysis was conducted to evaluate worker productivity and the effectiveness of overtime implementation based on project reports and field observations.

Research Location and Time

The location of the research was carried out at the Lembean – Marawas Road Preservation Project in Kauditan District, North Minahasa Regency, North Sulawesi, with the initial coordinate point

Research Variables and Operational Definitions

In this research, there are two types of variables, namely independent variables and dependent variables. The independent variable consists of work motivation (X1), occupational health (X2), and occupational safety (X3), while the bound variable is worker productivity (Y). The operational definition of each variable is presented in Table 1.

Table 1. Research Variables and Indicators

Code	Variable	Questionnaire Statement Indicators
X1	Work Motivation	The overtime pay I received encouraged me to work harder during overtime. Providing additional incentives makes me excited about completing overtime work. Recognition or praise from the foreman/supervisor for the work results makes me motivated. I feel responsible for completing work targets even during overtime. I am encouraged to show good results during overtime.
X2	Occupational Health	My body condition remains healthy to carry out work during overtime. The project work environment during overtime is quite clean and does not interfere with health. Lighting and air circulation in the work area during overtime are in adequate condition. Adequate rest facilities are available for workers during overtime. There is enough food consumption/intake to maintain stamina during overtime.
X3	Occupational Safety	Personal Protective Equipment (PPE) is available and I use it when working overtime. Safe work procedures (SOPs) are still applied during the implementation of overtime work. Safety supervision and K3 signs continue to function properly during overtime. Work equipment and work areas are safe to use during overtime. I obtained a safety briefing before performing overtime work.
Y	Worker Productivity	The volume of work I complete while working overtime is in accordance with the set target. The quality of my work results during overtime is still good and according to standards. I was able to complete overtime work on time. I work efficiently in utilizing time and energy during overtime. The work target that was charged to me during overtime hours could be achieved.

Source: Researcher's adaptation from various literature

Population and Sample

The population in this study is all workers involved in the Lembean – Marawas Road Preservation Project, North Minahasa Regency. The sampling technique used is purposive sampling, which is sampling based on certain criteria and objectives that have been set beforehand. The respondent criteria are workers who are directly involved in the implementation of work during normal working hours or additional working hours. Based on these criteria, a sample of 24 workers was obtained who filled out the questionnaire completely and was declared valid.

Data collection techniques

This study uses primary data and secondary data. Primary data were collected through: (1) Questionnaire using the Likert Scale with five levels of answers; (2) Direct interviews from sources; (3) Literature study from books, journals, regulations, and previous research; (4) Documentation in the form of photos and project documents. Secondary data is in the form of project reports that contain the volume of work, the number of workers, the number of working days, and the hours worked per day, which are the basis for calculating physical productivity and the effectiveness of the implementation of overtime working hours. The Likert scale used is presented in Table 2.

Table 2. Likert Scale

Value	Criteria	Explanation
5	Strongly Agree (SS)	The respondent strongly agreed because the statement was very in accordance with the perceived circumstances.
4	Agree (S)	The respondent considers the statement to be in accordance with the perceived circumstances.
3	Disagree (KS)	Respondents could not determine with certainty the perceived situation.
2	Disagree (TS)	The respondent considered the statement not to be in accordance with the perceived circumstances.
1	Strongly Disagree (STS)	The respondent strongly disagrees because the statement is very inconsistent with the perceived circumstances.

Source: Sugiyono (2017)

Stages of Research

This research began with the determination of the research object, literature study, formulation of problems and hypotheses, preparation of instruments, data collection through questionnaires and observations, then data processing through two tracks, namely statistical analysis of questionnaires (validity test, reliability, classical assumptions, and multiple linear regression using SPSS and JAMOVI) as well as analysis of productivity and effectiveness of project report data. The research flow chart is presented in Figure 3.

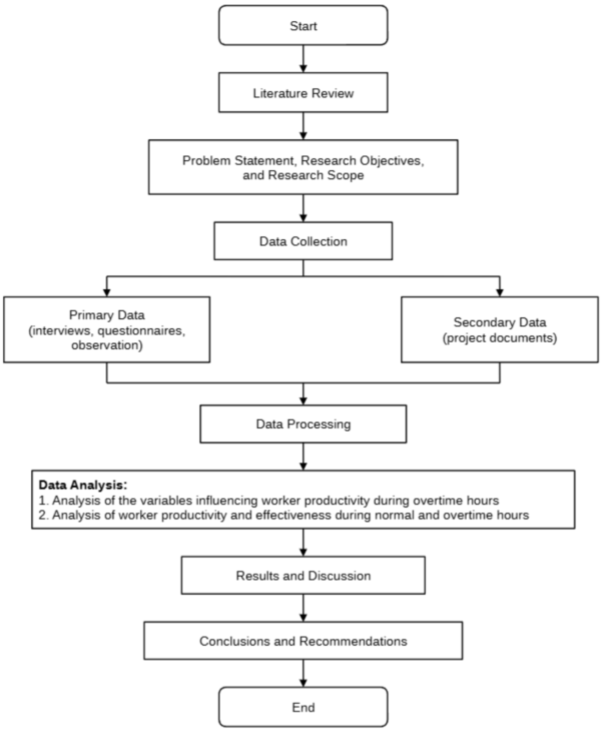

Figure 1. Research Flow Diagram

Data Analysis Methods

Data analysis is carried out through several stages. The validity test was performed by Pearson's product moment correlation (rxy), where the item is declared valid if r-counts > r-table (0.4044 for n = 24, significance level 5%). The reliability test uses Cronbach's Alpha, where the instrument is reliable if the alpha value > 0.600. The classical assumption test included the Shapiro-Wilk normality test ($p > 0.05$), the multicollinearity test with a Tolerance value of > 0.10 and VIF < 10, and the heteroscedasticity test with the Glejser test ($p > 0.05$). Multiple linear regression analysis using the equation:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e \text{ ... } (3)$$

where Y = worker productivity; a = constant; b_1–b_3 = regression coefficient; X_1 = work motivation; X_2 = occupational health; X_3 = job safety; e = error. The hypothesis test is carried out through the t-test (partial), the F test (simultaneous), and the determination coefficient (R^2). The interpretation of the relationship level based on the value of the correlation coefficient is presented in Table 3.

Table 3. Interpretation of the Correlation Coefficient of R Value

Interval Coefficient	Relationship Level
0,80 – 1,000	Very powerful
0,60 – 0,799	Strong
0,40 – 0,599	Quite powerful
0,20 – 0,399	Low
0,00 – 0,199	Very low

Source: Sugiyono (2017)

The physical productivity analysis is calculated by dividing the volume of work by the total person-hours (Equation 1). The effectiveness of implementing overtime hours is assessed by comparing productivity during overtime to productivity at normal hours:

$$E = P\_lembur \div P\_normal \ ... \ (4)$$

Assessment criteria: $E \geq 1$ (effective overtime) or $E < 1$ (less effective overtime).

RESULTS AND DISCUSSION

Overview

This study aims to analyze the influence of work motivation factors, occupational health, and occupational safety on worker productivity during the implementation of overtime working hours in the Lembean – Marawas Road Preservation Project, North Minahasa Regency. From the results of observations in the field and the distribution of questionnaires, valid and complete data were obtained for 24 respondents. The questionnaire results were processed with IBM SPSS Statistics and JAMOVI as a cross-test.

Characteristics of Respondents

The distribution of respondents by age group is presented in Table 4.

Table 4. Characteristics of Respondents by Age

Age Range	Number (people)	Percentage (%)
21 – 30 years old	6	25,00%
31 – 40 years old	7	29,17%
41 – 50 years old	10	41,67%
51 – 60 years old	1	4,17%
Total	24	100,00%

Source: Questionnaire data processing, 2026

Based on Table 4, the majority of workers are in the age range of 41–50 years (41.67%), which indicates that most workers are in productive age.

The distribution of respondents based on length of work experience is presented in Table 5.

Table 5. Respondent Characteristics Based on Length of Work Experience

Work Experience	Number (people)	Percentage (%)
1 – 5 years	6	25,00%
5 – 10 years	3	12,50%
More than 10 years	15	62,50%
Total	24	100,00%

Source: Questionnaire data processing, 2026

Based on Table 5, the majority of workers have more than 10 years of work experience (62.50%), which shows that most workers are experienced and master their field of work.

The distribution of respondents by last education is presented in Table 6.

Table 6. Characteristics of Respondents Based on Recent Education

Final Education	Number (people)	Percentage (%)
SD	2	8,33%
Junior High School	7	29,17%

Final Education	Number (people)	Percentage (%)
High School/Vocational School	9	37,50%
S1/Diploma IV	6	25,00%
Total	24	100,00%

Source: Questionnaire data processing, 2026

Based on Table 6, the majority of workers have a high school/vocational education (37.50%), which shows that most workers already have adequate formal education for field work.

Descriptive Analysis of Research Variables

Descriptive analysis was used to describe respondents' responses to each research variable. The mean values and standard deviations of each variable are presented in Table 7.

Table 7. Descriptive Statistics of Research Variables

Variable	N	Minimum	Maximum	Red	Std. Deviation
Motivation (X1)	24	4,000	5,000	4,458	0,470
Health (X2)	24	3,200	5,000	3,942	0,326
Security (X3)	24	3,200	5,000	4,250	0,487
Productivity (Y)	24	4,000	5,000	4,425	0,473
Valid N (listwise)	24				

Source: SPSS data processing, 2026

Based on Table 7, all variables have an average value above 3.9 out of a maximum scale of 5. The work motivation variable had the highest average score (4.458), while the occupational health variable had the lowest average score (3.942). This shows that in general, respondents give a positive response to each variable.

Instrument Validity and Reliability Test

The validity test was carried out by calculating the Pearson product moment correlation between the score of each item and the total score. The value of the r-table with n = 24 and the significance level of 5% is 0.4044. The results of the validity test are presented in Table 8.

Table 8. Variable Validity Test Results

Variable	Item	r-count	r-table	Remarks
Work Motivation (X1)	X1.1	0,917	0,4044	Valid
	X1.2	0,924	0,4044	Valid
	X1.3	0,912	0,4044	Valid
	X1.4	0,958	0,4044	Valid
	X1.5	0,938	0,4044	Valid
Occupational Health (X2)	X2.1	0,933	0,4044	Valid
	X2.2	0,872	0,4044	Valid
	X2.3	0,692	0,4044	Valid
	X2.4	0,934	0,4044	Valid
	X2.5	0,623	0,4044	Valid
Occupational Safety (X3)	X3.1	0,949	0,4044	Valid
	X3.2	0,990	0,4044	Valid
	X3.3	0,938	0,4044	Valid
	X3.4	0,932	0,4044	Valid
	X3.5	0,938	0,4044	Valid
Worker Productivity (Y)	Y1	0,926	0,4044	Valid

Variable	Item	r-count	r-table	Remarks
	Y2	0,962	0,4044	Valid
	Y3	0,977	0,4044	Valid
	Y4	0,977	0,4044	Valid
	Y5	0,853	0,4044	Valid

n = 24 ; r-*table at* 5% *significance level* = 0.4044

Source: SPSS data processing, 2026

Based on Table 8, all statement items from each variable have a value of r-count > r-table (0.4044), so that all statement items are declared valid and can be used for further analysis. The reliability test was carried out by calculating Cronbach's Alpha value. The results of the reliability test are presented in Table 9.

Table 9. Reliability Test Results

Variable	Cronbach's Alpha	Number of Items	Remarks
Work Motivation (X1)	0,961	5	Reliable (Excellent)
Occupational Health (X2)	0,860	5	Reliable (Excellent)
Occupational Safety (X3)	0,972	5	Reliable (Excellent)
Worker Productivity (Y)	0,966	5	Reliable (Excellent)

Source: SPSS data processing, 2026

Based on Table 9, all variables have a Cronbach's Alpha value of > 0.600, so that all research instruments are declared reliable in the very good category.

Classical Assumption Test

The normality test was performed using the Shapiro-Wilk method considering that the number of samples was relatively small (n = 24). The results are presented in Table 10.

Table 10. Shapiro-Wilk Normality Test Results

W Stats	Significance (p-value)	Remarks
0,949	0,254	Normally Distributed

Source: SPSS and Jamovi data processing, 2026

Based on Table 10, the significance value of the Shapiro-Wilk test is 0.254 > 0.05, so that the residual regression model is declared to be normally distributed.

The multicollinearity test was carried out by looking at the values of Tolerance and Variance Inflation Factor (VIF). The results are presented in Table 11.

Table 11. Multicollinearity Test Results

Variable	Tolerance	VIVID	Remarks
Work Motivation (X1)	0,480	2,083	Multicollinearity-free
Occupational Health (X2)	0,906	1,103	Multicollinearity-free
Occupational Safety (X3)	0,481	2,080	Multicollinearity-free

Source: SPSS data processing, 2026

Based on Table 11, all free variables have a Tolerance value of > 0.10 and a VIF value of < 10, so that the regression model is declared free from multicollinearity problems.

The heteroscedasticity test was carried out with the Glejser test. The test results are presented in Table 12.

Table 12. Results of Heteroscedasticity Test (Glejser Test)

Variable	Sig.	Remarks
Work Motivation (X1)	0,134	Heteroscedasticity Free
Occupational Health (X2)	0,548	Heteroscedasticity Free
Occupational Safety (X3)	0,285	Heteroscedasticity Free

Source: SPSS data processing, 2026

Based on Table 12, the significance value of all independent variables > 0.05, so it can be concluded that there are no symptoms of heteroscedasticity and residual variance is homogeneous (homoskedasticity).

Multiple Linear Regression Analysis

Multiple linear regression analysis was used to determine the magnitude of the influence of the variables work motivation (X1), occupational health (X2), and occupational safety (X3) on worker productivity (Y). The results of regression analysis are presented in Table 13.

Table 13. Multiple Linear Regression Analysis Results

Variable	Coefficient (B)	Std. Error	t-count	Sig.
(Constant)	0,716	1,048	0,683	0,503
Work Motivation (X1)	0,482	0,234	2,065	0,052
Occupational Health (X2)	0,171	0,245	0,698	0,493
Occupational Safety (X3)	0,208	0,225	0,923	0,367

Source: SPSS data processing, 2026

Based on Table 13, a multiple linear regression equation is obtained:

$$Y = 0{,}716 + 0.482\ X_1 + 0.171\ X_2 + 0.208\ X_3 \ ... \ (5)$$

The equation shows that the value of the constant is 0,716 and that all the coefficients of the free variables are positive. This means that any increase in each independent variable tends to increase worker productivity. The largest regression coefficient is the work motivation variable (0.482), which shows that work motivation contributes the most to worker productivity during the implementation of overtime hours.

Hypothesis testing

1. T test (Partial test)

The t-test is used to determine the influence of each partially independent variable on the bound variable. With n = 24 and df = 20, the t-table value is 2.086.

The work motivation variable (X1) obtained a t-count value of 2.065 with a significance of 0.052. The significance value is slightly greater than 0.05 so that work motivation has not had a partial significant effect at the level of 5%, but it is close to significant and is the most dominant variable (the highest beta coefficient is 0.479). The occupational health variable (X2) obtained a t-count of 0.698 with a significance of 0.493, and the occupational safety variable (X3) obtained a t-count of 0.923 with a significance of 0.367. The two significance values > 0.05, so that partially occupational health and occupational safety did not have a significant effect. This needs to be interpreted by considering the relatively small number of samples (n = 24), where the statistical power of the test tends to be low.

2. F Test (Simultaneous Test)

The F test is used to determine the effect of all independent variables together on the bound variables. The results of the F test are presented in Table 14.

Table 14. F Test Results (ANOVA)

Models	F-count	F-Table	Sig.	Remarks
Regression	6,224	3,098	0,004	Significant

Source: SPSS data processing, 2026

Based on Table 14, the value of F-calculated (6.224) > F-table (3.098) with a significance of 0.004 < 0.05. Thus, H4 is accepted, which means that work motivation, occupational health, and occupational safety simultaneously have a significant effect on worker productivity during the implementation of overtime working hours.

3. Coefficient of Determination (R^2)

The results of the determination coefficient are presented in Table 16.

Table 15. Result of Coefficient of Determination (R^2)

R	R Square (R^2)	Adjusted R Square
0,695	0,483	0,405

Source: SPSS data processing, 2026

Based on Table 15, the value of the correlation coefficient (R) of 0.695 is included in the category of strong relationships. An R^2 value of 0.483 indicates that the three variables together are able to explain 48.3% of the variation in worker productivity, while the remaining 51.7% is explained by other variables that were not studied.

Comparison of SPSS and Jamovi Results

To ensure the accuracy and consistency of the results, all tests were processed using two software, namely IBM SPSS Statistics and Jamovi. A comparison of the results of the two is presented in Table 16.

Table 16. Comparison of SPSS and Jamovi Data Processing Results

Testing / Parameters	SPSS Results	Jamovi results	Ket.
Validity (r-count range)	0,623 – 0,990	0,623 – 0,990	Identical
Reliability (Cronbach's α)	0,860 – 0,972	0,860 – 0,972	Identical
Normality (Shapiro-Wilk, p)	0,254	0,254	Identical
Multicollinearity (highest CIF)	2,083	2,083	Identical
Heteroscedasticity (Glejser, p)	0,134 – 0,548	0,134 – 0,548	Identical
F test (F-count; Sig.)	6,224; 0,004	6,224; 0,004	Identical
Coefficient of determination (R^2)	0,483	0,483	Identical

Source: SPSS and Jamovi data processing, 2026

Based on Table 16, all the values of the data processing results in SPSS and Jamovi show identical numbers. This proves that the results of the research analysis are consistent and not affected by software differences.

Analysis of the Effectiveness of Overtime Working Hours on Physical Productivity

1. Productivity in Normal Hours

Based on the daily report in December on the Lembean – Marawas Road Preservation Work, the following normal productivity calculation data was obtained. BJTP-280 Plain Rebar Steel Workmanship: Volume = 2,720.46 kg; Duration = 3 days; Hours/day = 8 hours; Number of employees = 12 people. Normal productivity = 9.4460 kg/person-hour. Masonry Work: Volume = 49.96 m³; Duration = 5 days; Hours/day = 8 hours; Number of employees = 12 people. Normal productivity = 0.1041 m³/person-hour. The recapitulation is presented in Table 17.

Table 17. Recap of Productivity Calculations in Normal Hours

Job Items	Volume of Work Results	Volume of Work Per Day	Volume Per Workforce	Normal Productivity
BJTP-280 Plain Reinforcement Steel	2,720.46 kg	906.82 kg/day	75.5683 kg/org/day	9.4460 kg/org-hour
Stone Pairs	49.96 m³	9,992 m³/day	0.8327 m³/org/day	0.1041 m³/org-hour

Source: Project daily reports and field observation, 2026

2. Overtime Productivity

Overtime productivity is calculated from the actual volume achieved during the implementation of overtime work. BJTP-280 Plain Rebar Steel Work: Volume = 423.93 kg; Duration = 3 days; Hours/day = 3 hours; Number of employees = 12 people. Overtime productivity = 3.9253 kg/person-hour. Masonry Work: Volume = 20 m³; Duration = 5 days; Hours/day = 3 hours; Number of employees = 12 people. Overtime productivity = 0.1111 m³/person-hour. The recapitulation is presented in Table 18.

Table 18. Recapitulation of Productivity Calculation in Overtime

Job Items	Total Volume of Work Results	Volume of Work Per Day	Volume Per Workforce	Overtime Productivity
BJTP-280 Plain Reinforcement Steel	423.93 kg	141.31 kg/day	11.7758 kg/org/day	3.9253 kg/org-hour
Stone Pairs	20 m³	4 m³/day	0.3333 m³/org/day	0.1111 m³/org-hour

Source: Project daily reports and field observation, 2026

3. Results of Effectiveness Calculations

By comparing overtime productivity to normal productivity, the effectiveness value (E) was obtained as follows: BJTP-280 Plain Rebar Steel Work: $E = 3.9253 \div 9.4460 = 0.4155 < 1$ (Ineffective). Stone Pair Work: $E = 0.1111 \div 0.1041 = 1.0675 \geq 1$ (Effective). A recapitulation of effectiveness is presented in Table 19.

Table 19. Physical Productivity Effectiveness Recapitulation

Job Type	Normal Productivity	Overtime Productivity	Effectiveness (E)	Remarks
BJTP-280 Plain Reinforcement Steel	9.4460 kg/org-hour	3.9253 kg/org-hour	0,4155	Ineffective

Job Type	Normal Productivity	Overtime Productivity	Effectiveness (E)	Remarks
Stone Pairs	0.1041 m³/org-hour	0.1111 m³/org-hour	1,0675	Effective

Source: Analysis results, 2026

The results of the study answer the three problem formulations as follows. First, related to the magnitude of the influence of motivation, health, and occupational safety on productivity, simultaneously the three variables had a significant effect on worker productivity (significant F test, $p = 0.004$) with a contribution of 48.3% ($R^2 = 0.483$). Partially, the three variables have not had a significant effect at the level of 5%, but all regression coefficients have positive values so that increased motivation, health, and occupational safety tend to be followed by increased productivity.

Second, related to the most dominant factor, work motivation was the most dominant variable with the largest regression coefficient (0.482), the highest beta value (0.479), and the highest t-count (2.065). The insignificance of the partial influence can be explained by the limitation of the sample ($n = 24$) which causes the power of statistical tests to detect partial effects to be limited, as well as the respondents' answers that tend to be centered on high scores so that the variation in data between respondents is relatively small.

Third, related to the effectiveness of the implementation of overtime working hours on physical productivity, the results of the analysis show that overtime is not always effective and its effectiveness depends on the type of work. Overtime was effective on Stone Pair work ($E = 1.0675$) but not effective on BJTP-280 Plain Rebar Steel work ($E = 0.4155$) which experienced a significant decrease in productivity. This indicates that the application of overtime working hours needs to consider the characteristics and level of fatigue in each type of work.

Data processing with SPSS and Jamovi resulted in consistent and identical coefficient, t-calculus, F-calculus, and determination coefficient values, which strengthened the validity of the research results. Overall, construction service providers need to pay attention to the aspects of motivation, health, and work safety in an integrated manner in the implementation of overtime work.

CONCLUSION

Based on the results of this study on the impact of overtime implementation on work productivity and K3 (Keselamatan dan Kesehatan Kerja; Occupational Safety and Health) in the Lembean–Marawas Road Preservation Project, it was concluded that work motivation, occupational health, and occupational safety simultaneously had a significant effect on worker productivity during overtime implementation (F-count = 6.224 > F-table = 3.098; Sig. = 0.004; $R^2 = 0.483$ or 48.3%). The regression equation was $Y = 0.716 + 0.482X_1 + 0.171X_2 + 0.208X_3$, with all regression coefficients showing positive relationships. However, none of the three variables had a statistically significant partial effect at the 5% significance level. Work motivation was identified as the most dominant factor based on the highest beta coefficient (0.479) and the largest t-value (2.065), although its effect was still close to the significance threshold.

The physical effectiveness analysis showed different results depending on the type of work activity. Overtime was effective for stone masonry work (stone pair) with an effectiveness value of $E = 1.0675 \geq 1$, but it was ineffective for BJTP-280 plain reinforcement steel work with E = 0.4155 < 1. These findings indicate that overtime implementation is not universally effective and should consider the characteristics, workload, and fatigue level associated with each type of construction activity. The statistical processing results from IBM SPSS Statistics and Jamovi produced identical values, confirming the consistency of the analytical results.

Based on these findings, construction service providers are advised to consider work motivation, occupational health, and occupational safety aspects comprehensively when implementing overtime, with particular attention to improving worker motivation as the most influential factor. Contractors should also evaluate the characteristics and fatigue risks of each work activity before applying overtime to ensure that extended working hours contribute to actual productivity improvements. Future research is recommended to involve larger sample sizes, broader research locations, and additional variables such as work fatigue, work stress, and work environment conditions to strengthen statistical analysis and improve the generalizability of findings.

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