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# The Effect of Occupational Health and Safety Management System (OHSMS) on Work Accidents and Productivity in the Bawela Stadium Project, Sorong City

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**ABSTRACT**

The high rate of work accidents in Indonesian construction projects indicates suboptimal implementation of keselamatan kerja despite regulatory requirements. The Occupational Safety and Health Management System (OHSMS) serves as a critical instrument for creating safe work environments, enhancing productivity, and mitigating accident risks. This study examines OHSMS implementation, work accident rates, and labor productivity in the Bawela Stadium Construction Project in Sorong City, while analyzing direct and indirect relationships among these variables. A quantitative approach with verifiable methods was employed, utilizing a sample of 100 construction workers selected through simple random sampling. Data were collected via Likert scale questionnaires and analyzed using Structural Equation Modeling–Partial Least Square (SEM-PLS). Results revealed that OHSMS implementation scored 3.40 ("adequate" category), work accident rates scored 2.46 ("adequate" category), and labor productivity scored 3.39 ("adequate" category). OHSMS implementation demonstrated significant negative effects on work accident rates ($\beta = -0.656$, $p = 0.000$) and significant positive effects on labor productivity ($\beta = 0.863$, $p = 0.000$). Work accident rates exhibited negative influence on productivity ($\beta = -0.142$, $p = 0.000$). Indirectly, OHSMS affects productivity through accident rate reduction ($\beta = 0.093$, $p = 0.001$). This study uniquely contributes by providing empirical evidence of OHSMS effectiveness in large-scale stadium construction contexts, where complex operations and high-risk activities demand robust safety systems. Findings underscore the importance of strengthening occupational safety through leadership commitment, systematic planning, and pengembangan budaya K3 (Keselamatan dan Kesehatan Kerja) to ensure construction project success.

**Keywords:** SMK3, Work Accidents, Productivity, Construction Projects, Bawela Stadium

## INTRODUCTION

Sustainable national development is part of the global commitment through the achievement of the Sustainable Development Goals (SDGs), which emphasize the importance of inclusive economic growth (Goal 8), decent and productive work, and protection of occupational health and safety (Goal 3). In this context, the construction sector plays an important role as the main driver of national infrastructure development that encourages economic growth and equitable development.

However, the progress of the construction sector in Indonesia is still overshadowed by serious challenges, especially related to occupational safety and health (Lestari et al., 2020). The high rate of work accidents is an obstacle to achieving optimal productivity and contradicts the principles of sustainable development (Jilcha & Kitaw, 2017). Data from the Ministry of Manpower until May 2024 recorded 162,327 cases of work accidents, with the construction sector as one of the largest contributors (Kemnakertrans, 2024). This reflects the weak implementation of effective occupational safety systems and directly hinders the achievement of SDGs Goals 3 and 8 simultaneously (Milea et al., 2025).

Furthermore, data from Social Security in 2012 stated that there were 103,000 cases of work accidents per year, with an average of nine deaths per day (Misuri et al., 2021). Until

2013, six workers died every day due to work accidents. Meanwhile, a report by the International Labour Organization (ILO) states that Indonesia records an average of 99,000 work accidents per year, of which 70% are fatal (Kasmir, 2017).

The main causes of the high number of work accidents include the negligence of companies prioritizing profits, weak government supervision, and the non-optimal implementation of *K3* (Occupational Safety and Health) regulations. In fact, according to Suardi, a healthy, productive, and quality workforce is highly dependent on the successful implementation of the *Sistem Manajemen Kesehatan dan Keselamatan Kerja (SMK3)* (Sinaga et al., 2025).

Technological developments in the construction industry drive efficiency but also increase potential hazards (Sidani et al., 2023). Therefore, systematic risk management is needed through the implementation of *SMK3* (Heronasia & Zuraida, 2025). This system includes organizational structure, planning, implementation, responsibility, and evaluation of all work processes to ensure labor safety and sustainability of the production process (Director General of PPK and *K3*, Ministry of Manpower, 2017).

Based on the Regulation of the Minister of Public Works and Public Housing (PUPR) No. 10 of 2021 concerning Construction Safety Management System (SMKK) Guidelines, every construction service provider is required to implement a safety management system as part of efforts to prevent work accidents. This provision aligns with Government Regulation (PP) No. 50 of 2012, which requires the implementation of *SMK3* for companies with a number of employees ≥100 people or those with a high level of potential danger (Wulandari et al., 2024). However, until the fourth quarter of 2023, data from the Ministry of Manpower's Satudata shows that only 1,744 companies in Indonesia have officially implemented *SMK3*. This number is very small compared to the total number of existing companies, indicating that awareness and implementation of *SMK3* and *SMKK* in the field is still very low (Rossanika & Amrina, 2024).

Especially in the construction sector, the rate of work accidents is very high due to the characteristics of physically demanding work and the use of heavy equipment (Yilmaz & Çelebi, 2015). Workers in this sector account for 7–8% of the total Indonesian workforce and represent the sector with the highest rate of work accidents (Wirahadikusumah, Reini D., 2011). Therefore, the implementation of *SMK3* is a must in every construction project.

The Bawela Stadium Construction Project is a large-scale construction project with a high level of complexity involving many laborers and heavy equipment. Based on the results of the pre-survey of 10 respondents, the implementation of *SMK3* is still in the sufficient category with an average score of 3.12, where leadership and worker participation aspects received the lowest score (2.7), while safety planning received the highest score (3.5). In terms of work accident rate, the average score was 2.8, with minor accidents having the highest frequency (3.1), indicating weak risk prevention measures. Meanwhile, work productivity has an average score of 2.97, where efficiency (2.3) and work morale (2.5) are relatively low, although the increase in work results is quite good (3.8).

Although a number of previous studies, such as those by Munasih et al. (2015), Prima Billy Polla et al. (2015), and Zikrullah et al. (2019), have proven that the application of *SMK3* generally has a significant effect on increasing labor productivity and reducing the risk of work accidents, most studies have focused on the manufacturing sector or specific types of work such as ironing. Research highlighting the direct relationship between *SMK3* implementation and the rate of work accidents and productivity simultaneously in the context of large-scale construction projects, such as stadiums, is still very limited.

While previous studies by Munasih et al. (2015), Prima Billy Polla et al. (2015), and Zikrullah et al. (2019) proved *OHSMS* application significantly affects labor productivity increases and work accident risk reductions, most focused on manufacturing sectors or specific

work types such as ironing. Research highlighting direct relationships between *OHSMS* implementation and work accident rates and productivity simultaneously in large-scale construction project contexts, particularly stadiums, remains extremely limited. Furthermore, specific aspects including safety leadership, worker participation, and comprehensive system support in *OHSMS* implementation have not been studied in depth, especially using empirical data directly from project sites.

This study addresses this critical gap by investigating *OHSMS* effectiveness in a large-scale stadium construction context where complex operations, diverse workforce demographics, and high-risk activities converge. Unlike previous research, this study employs comprehensive SEM-PLS analysis to examine both direct and indirect pathways through which *OHSMS* influences productivity via accident rate reduction. The stadium construction setting provides unique insights given its scale, public visibility, and intensive labor requirements. This research contributes novel empirical evidence on *OHSMS* implementation effectiveness specifically in large-scale public infrastructure projects, offering practical recommendations grounded in field evidence.

This study investigates: (1) *OHSMS* implementation, work accident rates, and work productivity descriptions in the Bawela Stadium Construction Project; (2) *OHSMS* implementation effects on work accident rates; (3) *OHSMS* implementation effects on work productivity; (4) work accident rate effects on work productivity; and (5) indirect *OHSMS* implementation effects on work productivity through work accident rate reduction. Findings aim to strengthen occupational safety systems through leadership enhancement, systematic planning, and OSH culture development supporting construction project success.

In addition, specific aspects such as safety leadership, worker participation, and comprehensive system support in the implementation of *SMK3* have often not been studied in depth, especially using empirical data directly from the project site. This creates an important research gap to be filled in order to provide practical recommendations based on field evidence.

Based on the description above, the researcher is interested in further research on *"The Effect of the Implementation of the K3 Management System on the Rate of Work Accidents and Its Impact on Work Productivity in the Bawela Stadium Construction Project"*. This study aims to find out the extent to which the application of *SMK3* can reduce the rate of work accidents and how it impacts increasing work productivity in large-scale construction projects.

## RESEARCH METHOD

This research used a quantitative approach with descriptive and verifiable methods. The research was conducted on the Bawela Stadium Construction project, focusing on the application of the K3 Management System (X) as an independent variable, the rate of work accidents (Y) as an intervening variable, and work productivity (Z) as a dependent variable. Primary data were obtained through a questionnaire distributed to 100 respondents who were randomly selected from a total population of 120 workers using the Slovin formula.

The research instrument was a Likert scale with five levels of assessment. Questionnaire items were developed based on established theoretical frameworks: OHSMS indicators adapted from Permen PUPR No. 10 of 2021 and Construction Safety Plan guidelines for Bawela Stadium; work accident rate items derived from Tarwaka (2016) and Suma'mur classifications; and productivity indicators based on Sutrisno (2023) framework. Prior to main data collection, a pilot test was conducted with 30 construction workers from similar projects to ensure instrument clarity and validity. Pilot test results informed minor wording adjustments to enhance respondent comprehension.

Ethical considerations were rigorously observed throughout this research. Informed consent was obtained from all participants, who were briefed on research purposes, voluntary participation nature, and confidentiality assurances. Respondents received clear information

that participation would not affect their employment status. All collected data were anonymized and stored securely, accessible only to researchers. The project management granted formal approval for research conduct, ensuring no disruption to construction activities.

The research instrument uses a Likert scale with five levels of assessment. The data was analyzed using two methods, namely descriptive analysis to describe variable conditions, and verifiable analysis using SEM-PLS (Partial Least Square) with SmartPLS 3.0 software to test the validity, reliability, and relationship between variables. The research model was evaluated through an outer model to test validity and reliability, as well as an inner model to test the causal relationship between variables using R-square and Q-square.

## RESULTS AND DISCUSSION

### Respondent Characteristics

Based on data from 100 respondents who were construction workers at the Bawela Stadium Construction Project in Sorong City, the identities of the respondents were obtained which included gender, age, education level, and length of work experience.

**Table 1 Characteristics of Respondents**

| Respondent Profile | Criteria | Frequency | Percentage |
|---|---|---|---|
| Gender | Man | 96 | 96% |
| | Woman | 4 | 4% |
| Age | 20 – 25 Years | 25 | 25% |
| | 26 – 30 Years | 38 | 38% |
| | 31 – 35 Years | 12 | 12% |
| | 36 – 40 Years | 7 | 7% |
| | 41 – 50 Years | 12 | 12% |
| | >50 Years | 6 | 6% |
| Final Education | High School/Vocational School | 75 | 75% |
| | S1 | 20 | 20% |
| | S2 | 5 | 5% |
| | S3 | 0 | 0% |
| Long Time Working | < 1 year | 13 | 13% |
| | 1-3 Years | 25 | 25% |
| | 3 – 5 years | 25 | 25% |
| | >5 years | 37 | 37% |

Based on the results of a study of 100 respondents at the Bawela Stadium Construction Project in Sorong City, the majority of workers are male (96%) and dominated by the productive age group, especially 26-30 years old (38%). In terms of education, most of them have a high school/vocational school background (75%), while S1 and S2 graduates are 20% and 5%, respectively, without respondents with a S3 level. Based on work experience, the majority of respondents have more than 5 years of experience (37%), indicating the involvement of an experienced workforce in this project.

### Descriptive Analysis

The data described in this section are the results of respondents' responses to independent variables, namely the Occupational Safety and Health Management System (SMK3), as well as two dependent variables, namely Work Accidents and Labor Productivity in the Bawela Stadium Construction Project, Sorong City. The data was obtained through the distribution of questionnaires to 100 construction workers directly involved in the project. Data processing was carried out using a percentage calculation of the total average score of respondents' answers for each statement indicator. The results of the descriptive analysis of the three research variables are described as follows.

**Table 2 Overview of the Occupational Safety and Health Management System (SMK3) in the Bawela Stadium Construction Project in Sorong City**

| No | SMK3 Dimensions | Average Score | Category |
|---|---|---|---|
| **1** | Leadership & Employee Participation | 3.39 | Enough |
| **2** | Construction Safety Planning | 3.39 | Enough |
| **3** | Construction Safety Support | 3.41 | Good |
| **4** | Construction Safety Operations | 3.42 | Good |
| **5** | Construction Safety Performance Evaluation | 3.42 | Good |
| **6** | Human resource behavior towards K3 | 3.40 | Enough |
| **7** | Implementation of Job Safety Analysis (JSA) | 3.37 | Enough |
| **Total** | **Sum** | **3.40** | **Enough** |

Source: Researcher Data Processing, 2025

The implementation of the Occupational Safety and Health Management System (SMK3) in the Bawela Stadium Project is generally in the "Sufficient" category with a score of 3.40. Several dimensions have reached the "Good" category, namely Safety Support (3.41), Safety Operations (3.42), and Safety Performance Evaluation (3.42), with the highest indicator on routine supervision of 3.53. Meanwhile, the dimensions that are still in the "Sufficient" category include Leadership and Worker Participation (3.39), Safety Planning (3.39), HR Behavior towards K3 (3.40), and JSA Implementation (3.37). To improve the implementation of SMK3, improvements are needed in compliance with the use of PPE, the implementation of risk control hierarchies, planning consistency, individual behavior towards K3, as well as documentation and socialization of JSA

**Table 3 Overview of the Work Accident Rate in the Bawela Stadium Construction Project in Sorong City**

| No | Dimension | Average Score | Category |
|---|---|---|---|
| **1** | Minor Accidents | 2.45 | Enough |
| **2** | Medium Accidents | 2.46 | Enough |
| **3** | Serious Accidents | 2.45 | Enough |
| **Total** | **Sum** | **2.46** | **Enough** |

Source: Researcher Data Processing, 2025

The category of work accident rates is generally in the "Sufficient" category with a total score of 2.46. Minor accidents have a score of 2.45 and still often occur due to lack of vigilance and not optimal hazard identification. Moderate accidents were also at a score of 2.46, indicating that the risk control system and JSA documentation were not optimal, and that the understanding of the risk matrix and control hierarchy was still limited. Meanwhile, serious accidents with a score of 2.45 are rare, but repeated minor accidents are still common, and the post-incident recovery process has not been fast and effective.

**Table 4 Overview of Work Productivity in the Bawela Stadium Construction Project in Sorong City**

| No | SMK3 Dimensions | Average Score | Category |
|---|---|---|---|
| **1** | Ability | 3.37 | Enough |
| **2** | Improved Work Outcomes | 3.38 | Enough |
| **3** | Work Spirit | 3.39 | Enough |
| **4** | Self-Development | 3.42 | Good |
| **5** | Quality | 3.40 | Good |
| **6** | Efficiency | 3.39 | Enough |
| **Total** | **Sum** | **3.39** | **Enough** |

Source: Researcher Data Processing, 2025

The work productivity category is generally in the "Sufficient" category with a total score of 3.39. The dimensions that are classified as "Good" are Self-Development (3.42) and Quality (3.40), which reflect learning initiative, openness to training, and attention to the quality of work. Meanwhile, the dimensions of Ability, Improvement of Work Results, Work Morale, and Efficiency are still in the "Sufficient" category, so it requires an increase in work speed, consistency of results, time utilization, and team coordination. To improve overall productivity, technical training, periodic performance evaluations, and strengthening communication and coordination across teams are recommended.

**Verifiable Analysis**

This study uses the Structural Equation Modeling (SEM) method with a Partial Least Square (PLS) approach through SmartPLS 3.0 software to analyze the influence of SMK3 on work accidents and labor productivity. The analysis was carried out through two stages, namely the measurement model (outer model) to identify the most dominant indicators in each latent variable, and the structural model (inner model) to test the influence of SMK3 on work accidents and productivity, both direct and indirect. The results of data processing are displayed in the form of a path diagram that describes the relationship between the research variables.

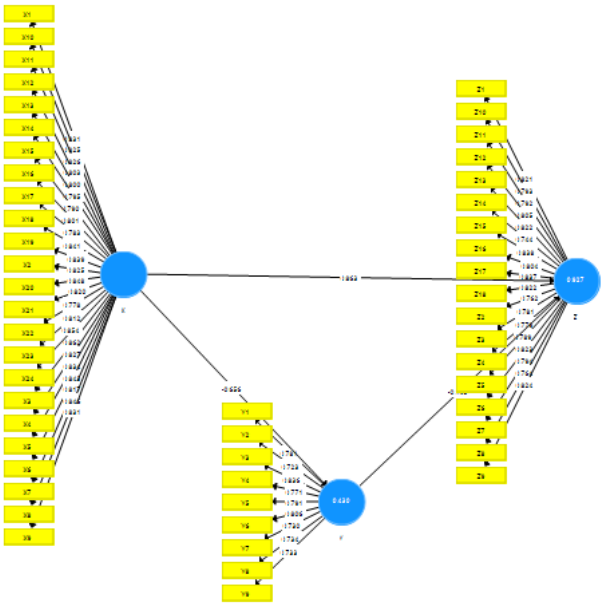

**Figure 1. Structural Modeling Standardization Coefficients**
Source: SmartPLS Data Processing 3.0, 2025

**Assessing the Outer Model**

***1. Convergent validity***

***a. Loading Factor***

The results of the convergent validity test using SmartPLS 3.0 showed that all indicators in the three research variables, namely SMK3 (X), work accidents (Y), and work productivity (Z), had a loading factor value above 0.70. This means that all indicators are declared valid and meet the convergent validity criteria, so that all statement items used in this study are feasible to proceed to the structural model analysis stage. Thus, the research instruments used can be relied upon to accurately measure each variable.

**b. *Average Variance Extracted* (AVE)**

The convergent validity results are based on the Average Variance Extracted (AVE) value. All latent variables in this study had an AVE value above 0.50, namely SMK3 of 0.676, work accidents of 0.590, and work productivity of 0.640. These values show that each construct has

a good convergent validity. Thus, the statements (indicators) used in forming each construct have been able to adequately explain their latent variables.

**2. Discriminatory Validity**

**a. Cross Loading**

The results of the cross loading test on SmartPLS 3.0 showed that each indicator had the highest loading value in its original construct compared to other constructs. For example, the X1 indicator has a loading of 0.831 on the SMK3 variable (X), higher than the loading for work accidents (Y) and work productivity (Z), which are -0.553 and 0.805. A similar pattern is seen in the indicators of the Y and Z variables, which also show the highest values in their respective constructs. This proves that all indicators in this study have good discriminant validity, so that the measurement model is declared feasible and able to accurately represent the constructed being studied.

**b. AVE Roots and Correlation between Latent Constructs (Fornel-Locker)**

The results of the discriminant validity test using the Fornell-Larcker criterion showed that the square root of AVE (√AVE) for each construct was greater than the correlation value between other constructs. For example, the SMK3 variable (X) has an √AVE of 0.822, higher than its highest correlation of 0.757 with the Productivity variable (Z). This also applies to the variables Work Accident (Y) with √AVE 0.768, and Productivity (Z) with √AVE 0.800. Thus, it can be concluded that all constructs have good discriminant validity, so the measurement model is feasible to use in subsequent analysis**.**

**3. Reliability Analysis**

The results of the reliability test showed that all research variables had Cronbach's Alpha and Composite Reliability values above 0.7, namely the SMK3 (X) variable with Cronbach's Alpha 0.979 and Composite Reliability 0.980, the Work Accident variable (Y) with 0.913 and 0.928, and the Productivity variable (Z) with 0.967 and 0.970. This shows that all constructs and dimensions in this study are reliable and meet the internal consistency criteria, so they can be used for further analysis.

**Structural Model (*Inner Model*)**

**1. *Goodness of Fit (R-Square)***

The results of the R-Square analysis showed that the Work Accident (Y) construct had a value of 0.430, which was included in the moderate category, while the Productivity (Z) construct had a value of 0.927, which was included in the strong category. This shows that exogenous variables are able to explain endogenous variables well, where the influence on productivity is very strong, while the influence on work accidents is at a moderate level.

**2. *Q-Square***

The results of the Q-Square calculation showed a value of 0.958, which means that the model has excellent predictive relevance because the value is greater than zero. This indicates that independent variables are able to predict dependent variables with a high degree of accuracy, with an error of only 4.2%. Thus, the model formed is declared robust and feasible for hypothesis testing.

**Hypothesis Testing**

Hypothesis testing was carried out by analyzing the path coefficient, t-value, and p-value. With a confidence level of 95% ($\alpha = 0.05$) and a two-tailed method, the limit of the t-table value is set at 1.984.

Decision-making criteria:

- If the t-statistic > 1.984, then H0 is rejected and H1 is accepted (significant influence).
- If the t-statistic < 1.984, then H0 is accepted and H1 is rejected (the effect is insignificant).

**The Effect of the Implementation of the Occupational Safety and Health Management System (SMK3)**

**On the Rate of Work Accidents in the Bawela Stadium Construction Project**

Hypothesis:
H0: There was no positive effect of the implementation of the Occupational Safety and Health Management System (SMK3) on work productivity in the Babela Stadium Construction Project.
H1: There is a positive influence of the implementation of the Occupational Safety and Health Management System (SMK3) on work productivity in the Bawela Stadium Construction Project.

**Table 5 Hypothesis Testing Results of the Influence of SMK3 on the Rate of Work Accidents**

| Line | *Original Sample* (O) | *T-Statistics* | *P-value* | Conclusion |
|---|---|---|---|---|
| **X1 -> Y** | -0.656 | 12.075 | **0.000** | H0 rejected |

Source: Researcher Data Processing, 2025

The results of the hypothesis test showed that the implementation of the Occupational Safety and Health Management System (SMK3) had a significant and negative effect on the rate of work accidents in the Bawela Stadium construction project. The original sample (O) value of -0.656 indicates that the better the implementation of SMK3, the lower the rate of work accidents. This is reinforced by a t-statistic value of 12.075 which is larger than the t-table of 1.984, as well as a p-value of 0.000 which is smaller than 0.05. Thus, $H_0$ was rejected and $H_1$ was accepted, so that SMK3 proved to be effective in reducing work accidents.

**The Effect of the Implementation of the Occupational Safety and Health Management System (SMK3) on Work Productivity in the Bawela Stadium Construction Project**

Hypothesis:
H0: There was no positive effect of the implementation of the Occupational Safety and Health Management System (SMK3) on work productivity in the Babela Stadium Construction Project.
H1: There is a positive influence of the implementation of the Occupational Safety and Health Management System (SMK3) on work productivity in the Bawela Stadium Construction Project.

**Table 6 Hypothesis Test Results of the Influence of SMK3 on Work Productivity**

| Line | *Original Sample* (O) | *T-Statistics* | *P-value* | Conclusion |
|---|---|---|---|---|
| **X -> Z** | 0.863 | 27.207 | **0.000** | H0 rejected |

Source: Researcher Data Processing, 2025

The results of the hypothesis test show that the implementation of the Occupational Safety and Health Management System (SMK3) has a positive and significant influence on the labor productivity of the workforce in the Bawela Stadium construction project. The original sample value (O) of 0.863 shows that the better the implementation of SMK3, the higher the labor productivity. This is reinforced by a t-statistic value of 27.207 which is much larger than the t-table of 1.984, as well as a p-value of 0.000 which is smaller than 0.05. Thus, $H_0$ was rejected and $H_1$ was accepted, so that the implementation of SMK3 was proven to significantly increase work productivity.

**The Effect of the Rate of Work Accidents on Work Productivity in the Bawela Stadium Construction Project**

Hypothesis:
H0: There is no effect of the level of work accidents on work productivity in the Bawela Stadium Construction Project.

H1: There is an effect of the rate of work accidents on work productivity in the Bawela Stadium Construction Project.

**Table 7 Hypothesis Test Results of the Effect of Work Accident Rates on Work Productivity**

| Line | *Original Sample* (O) | *T-Statistics* | *P-value* | Conclusion |
|---|---|---|---|---|
| **Y -> Z** | -0.142 | 3,623 | **0.000** | H0 rejected |

Source: Researcher Data Processing, 2025

The results of the hypothesis test show that the rate of work accidents has a negative and significant influence on the labor productivity of the workforce in the Bawela Stadium construction project. The original sample value (O) of -0.142 shows that the higher the rate of work accidents, the lower the labor productivity. This is reinforced by a t-statistic value of 3.623 which is greater than the t-table of 1.984 and a p-value of 0.000 which is smaller than 0.05. Thus, $H_0$ is rejected and $H_1$ is accepted, so it is proven that work accidents have a negative impact on productivity.

**The Effect of the Implementation of SMK3 on Increasing Work Productivity in the Bawela Stadium Construction Project through Reducing the Rate of Work Accidents**

Hypothesis:

H0: There is no effect of the implementation of SMK3 on increasing work productivity in the Bawela Stadium Construction Project through a reduction in the rate of work accidents

H1: There is an effect of the implementation of SMK3 on increasing work productivity in the Bawela Stadium Construction Project through a reduction in the rate of work accidents

**Table 8 Hypothesis Test Results of the Effect of the Implementation of SMK3 on Increasing Work Productivity through Reducing the Rate of Work Accidents**

| Line | *Original Sample* (O) | *T-Statistics* | *P-value* | Conclusion |
|---|---|---|---|---|
| **X-> Y -> Z** | 0,093 | 3,435 | **0.001** | H0 rejected |

Source: Researcher Data Processing, 2025

The test results showed that the implementation of SMK3 had an indirect positive effect on work productivity through a reduction in the rate of work accidents in the Bawela Stadium construction project. The original sample value (O) of 0.093 shows that the better the implementation of SMK3, the lower the rate of work accidents, so that productivity increases. This is supported by a t-statistic value of 3.435 which is larger than the t-table of 1.984 and a p-value of 0.001 which is smaller than 0.05. Thus, $H_0$ was rejected and $H_1$ was accepted, so that the mediation proved significant.

**Discussion**

***The Effect of OHSMS on Work Accident Rates***

The study demonstrates OHSMS implementation significantly reduces work accident rates ($\beta = -0.656$, $t = 12.075$, $p = 0.000$), confirming $H_1$ acceptance. This finding strongly aligns with previous research by Hartono et al. (2018) who found similar negative correlations in Tangerang building construction projects, and Suwardana et al. (2020) who demonstrated OHSMS effectiveness in reducing accidents at Sahid Kuta Lifestyle Resort construction. The substantial negative coefficient indicates comprehensive OHSMS implementation—encompassing safety leadership, systematic planning, operational controls, and performance evaluation—creates protective mechanisms substantially reducing accident occurrence.

These findings carry important implications for construction project management. The 65.6% accident rate reduction per unit OHSMS improvement suggests systematic safety

investments yield tangible risk mitigation benefits. Compared to manufacturing sector studies by Munasih et al. (2015) showing similar patterns, construction contexts demonstrate even stronger effects, likely attributable to higher baseline risks in construction environments. The Bawela Stadium project results underscore that despite "adequate" current implementation levels (score 3.40), substantial improvement potential exists, particularly in leadership participation (score 3.39) and JSA implementation (score 3.37)—areas requiring prioritized attention.

***The Effect of OHSMS on Work Productivity***

OHSMS implementation demonstrates significant positive effects on work productivity ($\beta = 0.863$, $t = 27.207$, $p = 0.000$), representing one of the strongest relationships identified in this study. This finding corroborates Zikrullah et al. (2019) and Yunus (2019) who established positive OHSMS-productivity relationships, yet the magnitude observed in Bawela Stadium project (86.3% productivity increase per unit OHSMS improvement) substantially exceeds previous findings. This enhanced effect may reflect large-scale stadium construction's unique characteristics where safety system effectiveness directly influences complex coordination, resource efficiency, and workforce morale.

Theoretical explanations for this strong relationship encompass multiple mechanisms. First, comprehensive OHSMS implementation creates psychological safety, enabling workers to focus on task performance rather than hazard concerns (Widiana et al., 2023). Second, systematic safety planning reduces work interruptions from accidents or near-misses, maintaining productivity momentum. Third, safety culture development fostered through OHSMS enhances organizational commitment and work morale—productivity dimensions scoring relatively lower (3.39) in current assessment yet demonstrating substantial improvement potential. Compared to Riestiany findings in cement manufacturing showing 45% productivity improvement, construction contexts demonstrate nearly double the effect magnitude, suggesting sector-specific factors amplify OHSMS benefits.

***The Effect of Work Accidents on Productivity***

Work accident rates exhibit significant negative effects on productivity ($\beta = -0.142$, $t = 3.623$, $p = 0.000$), though the coefficient magnitude appears relatively modest compared to direct OHSMS effects. This finding aligns with Masrofah and Michael (2020) research demonstrating productivity declines from work accidents. The relationship's moderate strength suggests accidents impact productivity through multiple pathways: direct losses from injured worker absence, indirect effects from team disruption and morale reduction, and administrative burden from incident investigations and corrective actions.

Contextualizing this finding within stadium construction reveals important nuances. Minor accidents (score 2.45), occurring most frequently, create cumulative productivity drains through repeated work disruptions, even when individual incidents cause limited immediate impact. Moderate accidents (score 2.46) generate more substantial productivity losses through extended recovery periods and potential light-duty assignments. The 14.2% productivity reduction per unit accident rate increase, while seemingly modest, compounds significantly across large-scale projects with extended timelines. Compared to Umam et al. (2020) findings in steel structure work showing similar patterns, the Bawela Stadium results suggest accident-productivity relationships remain consistent across construction types, emphasizing universal importance of accident prevention.

***Indirect Effects: OHSMS-Productivity via Accident Reduction***

The mediation analysis reveals OHSMS indirectly enhances productivity through accident rate reduction ($\beta = 0.093$, $t = 3.435$, $p = 0.001$), confirming the hypothesized pathway. While this indirect effect appears modest compared to direct effects (0.863), it represents a theoretically important mechanism demonstrating OHSMS's comprehensive influence. This finding extends previous research by explicitly quantifying the mediation pathway rarely

examined in construction contexts. The total OHSMS effect on productivity (direct 0.863 + indirect 0.093 = 0.956) underscores safety management's multifaceted benefits.

This mediation finding holds practical significance for justifying OHSMS investments. Construction managers can leverage both direct productivity benefits and indirect accident cost savings when developing safety business cases. The dual pathway also suggests OHSMS optimization strategies should address both direct productivity mechanisms (work organization, morale, efficiency) and accident prevention mechanisms (hazard identification, risk controls, safety behaviors). Comparing with Supriyan and Ayomi (2022) research in Project X, the Bawela Stadium findings demonstrate stronger mediation effects, potentially reflecting more comprehensive OHSMS implementation or larger-scale project complexities amplifying accident prevention benefits.

***Integrated Interpretation and Implications***

Collectively, these findings establish OHSMS as a critical determinant of construction project success through dual mechanisms: directly enhancing productivity and indirectly mitigating accident-related losses. The $R^2$ values (43.0% for accidents, 92.7% for productivity) indicate OHSMS explains substantial outcome variance, with exceptionally strong productivity prediction. The $Q^2$ value (95.8%) confirms excellent model predictive relevance, suggesting findings generalize to similar large-scale construction contexts.

Several implementation priorities emerge from this research. First, leadership commitment and worker participation—currently scoring lowest (3.39)—require immediate attention through enhanced management engagement, participatory safety committees, and worker empowerment in hazard identification. Second, JSA implementation (score 3.37) needs strengthening through systematic documentation, comprehensive hazard analysis training, and consistent application across all high-risk tasks. Third, addressing minor accident frequency (score 2.45) through improved hazard recognition, preventive controls, and near-miss reporting can yield compounding productivity benefits. Fourth, efficiency enhancement (score 3.39) through integrated safety-productivity planning can maximize OHSMS's direct effects.

These findings contribute to construction safety literature by providing robust empirical evidence from large-scale stadium construction—a context previously underrepresented in OSH research. The study's comprehensive SEM-PLS analysis, examining simultaneous direct and indirect relationships, advances methodological rigor beyond previous descriptive or simple correlation studies. Practically, results inform evidence-based OHSMS optimization strategies for major infrastructure projects, where safety performance and productivity excellence constitute critical success factors. The Indonesian context adds valuable perspectives for developing economies where construction sector growth and safety system maturation occur simultaneously.

## CONCLUSION

This study provides strong empirical evidence that implementing an Occupational Health and Safety Management System (*OHSMS*) is critical to the success of the Bawela Stadium construction project, as it directly improves labor productivity and indirectly enhances it by significantly reducing work accident rates. The findings highlight that effective *OHSMS* relies on leadership commitment, structured planning, and continuous evaluation to create a safer and more productive workplace, positioning *OHSMS* as a strategic investment rather than a regulatory burden. Given these insights, future research should explore the longitudinal impacts of *OHSMS* implementation across different phases of large-scale construction projects and examine specific interventions that optimize both safety outcomes and productivity metrics in diverse construction settings. Such work could provide practical guidance for tailoring *OHSMS* frameworks to varied project complexities and workforce demographics, advancing safer and more efficient construction practices globally.

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