# Integrating Kaizen Culture and Occupational Safety and Health in Enhancing Employee Productivity: A Study in the Precision Manufacturing Industry

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The precision component manufacturing industry faces a dual challenge in enhancing productivity while maintaining occupational safety, given that production processes involve machinery and high-risk activities. This study aims to analyze the effect of implementing kaizen culture and Occupational Safety and Health (OSH) on employee productivity, both partially and simultaneously, within the F-Line Department of PT XYZ Indonesia, a manufacturer of spinnerettes for the synthetic fiber industry. A quantitative approach with an explanatory design was applied to 64 respondents selected through saturated sampling technique. Data were collected using a five-point Likert-scale questionnaire, transformed into interval scale data using the Method of Successive Interval (MSI), and subsequently analyzed using multiple linear regression with the assistance of SPSS version 25.0, following validity, reliability, and classical assumption tests—including normality, multicollinearity, and heteroscedasticity. The results indicate that kaizen culture has a positive and significant effect on employee productivity (t = 6.456; p = 0.000), as does OSH (t = 4.642; p = 0.000). Simultaneous testing reveals that both variables significantly affect employee productivity (F = 214.236; p = 0.000), with a coefficient of determination ($R^2$) of 0.875, indicating that 87.5% of the variation in employee productivity is explained by these two variables. Kaizen culture demonstrates a relatively more dominant contribution than OSH. These findings suggest that kaizen culture and OSH are complementary in supporting operational performance. Accordingly, precision manufacturing companies are advised to integrate both programs synergistically—rather than as standalone initiatives—to optimize employee productivity while continuously mitigating the risk of workplace accidents.

**Keywords:** Kaizen Culture, Occupational Safety and Health (OSH), Employee Productivity, Multiple Linear Regression, Precision Manufacturing Industry



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## 1. Introduction

Competition within the global manufacturing industry requires companies to continuously enhance productivity, process efficiency, and product quality in order to sustain competitive advantage amid increasingly complex market dynamics [1]. Labor productivity serves as a key indicator of organizational success in utilizing resources effectively and efficiently, while also determining the competitiveness of manufacturing companies in the international market [2]. This challenge becomes even more pronounced in process-intensive manufacturing sectors, where companies are confronted with the dual demand of increasing production output while maintaining workforce safety amid the complexity of machinery, materials, and operational processes. Consequently, the issue of sustainable productivity improvement has become a global concern among manufacturing industry players across various countries, including Indonesia.

As one of Southeast Asia's major manufacturing economies, Indonesia faces escalating productivity and occupational safety pressures that underscore the urgency of this study. Indonesia's manufacturing sector contributed approximately 18.98% of GDP in 2024 and attracted USD 35.1 billion in foreign direct investment, representing 58.5% of total national foreign inflows. Despite this economic significance, national labor productivity growth decelerated to −1.55% year-on-year in 2024, signaling structural challenges that extend beyond capital investment to encompass workforce performance and management practices at the operational level. Concurrently, occupational accident data recorded by BPJS Ketenagakerjaan reveal a persistent upward trend, from 221,740 cases in 2020, rising to 234,370 in 2021, 297,725 in 2022, 370,747 in 2023, and reaching 462,241 cases in 2024—an increase of approximately 20% per annum. The manufacturing sector accounted for an estimated 20% of total workplace accident cases, making it one of the three highest-risk sectors alongside construction and mining. This convergence of declining productivity growth and escalating occupational accident rates points to a systemic gap in operational management practices within Indonesia's manufacturing industry—a gap that warrants empirical investigation at the firm and department level.

Industrial areas such as Cikarang, West Java, serve as operational centers for numerous multinational manufacturing companies, including PT XYZ, a manufacturer of spinnerettes—precision components used as filament-forming tools in the chemical man-made fiber industry. The production characteristics, which demand high precision across 12 production lines with variations in material, hole count, and capillary diameter, position the F-Line Department as a work unit with significant process complexity and occupational risk. Internal company data from 2018–2022 reveal fluctuations in workplace accident cases, with a sharp increase in 2021 (11 cases, 14 injured victims) before declining in 2022 (4 cases, 4 victims). This fluctuating pattern indicates that occupational risk control within the F-Line Department has not been consistently effective, while preliminary observations also reveal that the implementation of a continuous improvement culture across the work area has not been uniformly applied across all production lines. Such conditions have the potential to disrupt the achievement of production targets and reduce employee productivity.

One managerial approach widely adopted by the manufacturing industry to address these issues is kaizen culture. Kaizen is a continuous improvement philosophy oriented toward the ongoing enhancement of processes through incremental changes involving all elements of the organization [3]–[5]. The implementation of kaizen, particularly through the 5S approach (Seiri, Seiton, Seiso, Seiketsu, Shitsuke), has been shown to reduce waste, improve workplace layout, and enhance production process efficiency [6] [7]. Consistency in applying 5S principles has been reported as a key determinant of kaizen's success in supporting the operational performance of industrial organizations [4]. However, empirical evidence from Indonesian manufacturing settings indicates that the sustainability of kaizen implementation remains a critical challenge. Without structured evaluation mechanisms, visual management, and periodic auditing, improvement efforts tend to stagnate at initial implementation stages rather than becoming embedded in organizational culture [7]. Kaizen is thus considered to play a vital role in fostering a more organized, efficient, and productive work environment.

In addition to work process improvement, Occupational Safety and Health (OSH) constitutes a crucial factor in supporting productivity within manufacturing industries that involve machinery, equipment, and high-risk machining processes. Effective OSH implementation not only serves to prevent workplace accidents but also fosters a sense of security that encourages improved worker performance [8]. The root causes of persistently high accident rates in Indonesia's manufacturing sector have been identified as weaknesses in the OSH management system, insufficient safety education, and the suboptimal functioning of Occupational Safety and Health Committees (P2K3), with only approximately 17,000 out of

900,000 companies registered with BPJS Ketenagakerjaan reported as having an active P2K3. Human factors have been identified as the primary cause of workplace accidents, contributing to approximately 66% of all cases. Furthermore, sound OSH culture implementation enhances safety awareness, reduces accident risk, and supports improved worker discipline and performance [9]. From a regulatory standpoint, the obligation to implement OSH is affirmed in Law No. 1 of 1970 on Occupational Safety and Law No. 13 of 2003, Articles 86–87, which mandate that every company implement an OSH program as a fundamental right of workers in order to realize a safe and productive work system.

A number of prior studies have examined the effects of kaizen culture and OSH on employee productivity, at both national and global levels. Studies by Atta-Ankomah et al. (2022) [10] on multi-sector manufacturing companies in Ghana and Sichinsambwe et al. (2023) [11] in Zambia found that kaizen culture has a positive and significant effect on employee productivity. Meanwhile, Amini and Hidayat (2023) [12], focusing on cosmetics and personal care manufacturing companies, and Ariskiya et al. (2024) [13], focusing on automotive component manufacturing companies in Indonesia, similarly found that kaizen culture exerts a positive and significant effect on employee productivity. In a related vein, Maharani et al. (2025) [14] found that OSH has a positive effect on employee productivity among transportation and logistics companies in Indonesia. Other studies, namely Sinollah and Zaki (2022) [15] on consumer goods manufacturing companies and Pagirik et al. (2025) [16] on consumer goods manufacturing companies in Indonesia, found that OSH has a positive and significant effect on employee productivity. Taken together, these findings consistently demonstrate that kaizen culture and OSH are important determinants of employee productivity across various manufacturing sectors.

Notwithstanding this body of evidence, three important gaps in the existing literature can be identified. First, prior studies have examined kaizen culture and OSH predominantly as separate, independent variables, without analyzing their simultaneous interaction within a unified model. Examining these two variables in isolation risks underestimating their combined managerial significance, particularly in industries where continuous improvement and occupational safety are inherently interdependent. Second, extant studies have concentrated on broad manufacturing sectors—automotive, consumer goods, cosmetics, and logistics—without specifically examining the precision component manufacturing industry characterized by high-risk machining processes, micron-level tolerance requirements, and complex multi-line production configurations, as found in spinnerette production for the synthetic fiber industry. Third, prior studies conducted in Indonesia have generally adopted a company-level unit of analysis, limiting the granularity of findings. This study addresses these gaps by examining the simultaneous effects of kaizen culture and OSH at the specific production-department level (the F-Line Department of PT XYZ), an industry and unit of analysis that have not previously been investigated in comparable studies. The novelty of this research therefore lies not merely in its geographic or organizational setting, but in the integration of both variables within a precision manufacturing environment distinguished by its unique process complexity, measurable occupational risk profile, and operational characteristics that differ fundamentally from those of the automotive, consumer goods, and logistics sectors examined in prior literature.

This study aims to address this gap by analyzing the effect of kaizen culture and Occupational Safety and Health (OSH) implementation, both partially and simultaneously, on the employee productivity of the F-Line Department at PT XYZ. This study offers several original contributions. First, it examines the simultaneous effect of two managerial variables—kaizen and OSH—which have predominantly been studied separately in prior literature. Second, it presents a research object within the precision component manufacturing industry (spinnerette), characterized by high-risk processes that are rarely examined as a unit of analysis in comparable studies. Third, it employs a quantitative approach involving data

transformation through the Method of Successive Interval (MSI) and multiple linear regression analysis, which satisfies classical assumption tests—normality, multicollinearity, and heteroscedasticity—as well as hypothesis testing (t-test and F-test) using SPSS version 25.0.

The findings of this study are expected to provide more comprehensive insights for the management of PT XYZ and similar manufacturing companies in formulating operational policies that integrate a culture of continuous improvement with occupational safety management. These data-driven recommendations may serve as a reference for designing more structured kaizen and OSH programs to support productivity enhancement, reduce workplace accidents, and strengthen the operational competitiveness of the company.

## 2. Literature Review and Hypotheses Development

### Employee Productivity

Productivity represents a measure of an organization's capacity to transform its available resources—labor, time, materials, and technology—into valuable output effectively and efficiently [12]. In the manufacturing industry, productivity is not merely assessed in terms of output quantity but also reflects the quality of work processes, the degree to which waste can be minimized, and the consistency in achieving operational targets. Tuti et al. (2020) [17] define productivity as the level of an employee's capacity to produce optimal work in accordance with company-established targets, which is influenced by work commitment, competence, and working conditions. Individual productivity is multidimensional in nature, determined by internal factors such as competence and motivation, as well as external factors such as the work system and organizational culture [18]. Two external factors particularly relevant to high-risk precision manufacturing industries are the culture of continuous improvement (kaizen) and the management of Occupational Safety and Health (OSH), which constitute the focus of this study.

### Kaizen Culture and Employee Productivity

Kaizen is a Japanese management philosophy that emphasizes continuous improvement through small yet consistent changes involving all members of the organization [4]. The implementation of kaizen is most commonly measured through the 5S approach (Seiri, Seiton, Seiso, Seiketsu, Shitsuke), which aims to create a clean, organized, safe, and efficient work area [6]. Theoretically, the kaizen mechanism enhances productivity through three primary pathways: (1) the elimination of waste through the 3M concept (Muda, Mura, Muri), which reduces non-value-added activities; (2) the standardization of work processes, which reduces variability in production outcomes; and (3) the active involvement of employees in the improvement cycle, which fosters a heightened sense of ownership over work processes [3].

A range of empirical studies reinforce these theoretical arguments. Atta-Ankomah et al. (2022) [10], through a difference-in-difference method applied to multi-sector manufacturing companies in Ghana, found that the implementation of kaizen practices significantly improved productivity by reducing waste and improving workflow efficiency. Amini and Hidayat (2023) [12], employing Structural Equation Modeling (SEM-PLS) on cosmetics and personal care manufacturing companies in Indonesia, found that consistency in 5S implementation constitutes a key determinant of kaizen's success in enhancing operational performance. Ariskiya et al. (2024) [13], through SEM-PLS analysis on automotive component manufacturing companies in Indonesia, reported that 5S kaizen practices positively and significantly enhance workplace efficiency, which directly correlates with employee productivity. In Zambia, Sichinsambwe et al. (2023) [11], using OLS regression on multi-sector manufacturing companies, demonstrated that the implementation of kaizen practices has a positive and significant effect on employee performance through a structured culture of continuous improvement.

Based on this theoretical foundation and empirical evidence, the more consistently kaizen culture is implemented—as reflected in 5S practices embedded within daily work routines—the higher the productivity generated by employees. Accordingly, the first hypothesis is formulated as follows:
$H_1$: Kaizen culture has a positive and significant effect on employee productivity.

### Occupational Safety and Health (OSH) and Employee Productivity

Occupational Safety and Health (OSH) refers to a set of policies and measures designed to prevent workplace accidents, protect worker health, and control risks within the work environment [8]. Theoretically, OSH influences productivity through a mechanism of reduced operational disruption: a safe working environment lowers absenteeism resulting from injury, reduces production downtime caused by workplace incidents, and enhances a sense of psychological safety that correlates with work motivation and concentration [9]. In manufacturing industries involving high-risk machining processes, such as spinnerette production, effective OSH constitutes an operational prerequisite rather than a mere matter of regulatory compliance.

A number of empirical studies substantiate this argument. Maharani et al. (2025) [14], through SEM-PLS analysis, found that OSH culture—together with the work environment and work culture—has a positive and significant effect on employee performance among cargo transportation, freight forwarding, and logistics service companies in Indonesia. Sinollah and Zaki (2022) [15], employing multiple linear regression, demonstrated that the effective implementation of OSH policies correlates positively and significantly with employee productivity among consumer goods manufacturing companies in Indonesia. Swastika et al. (2022) [19], through multiple linear regression analysis, found that the structured implementation of OSH culture enhances employee work discipline, which in turn directly impacts the achievement of production targets at traditional herbal medicine manufacturing companies in Indonesia. Pagirik et al. (2025) [16], using multiple linear regression on consumer goods manufacturing companies in Indonesia, concluded that effective OSH policies reduce the frequency of workplace accidents while simultaneously enhancing employee productivity.

Based on this theoretical foundation and empirical evidence, the more optimally OSH programs are implemented—encompassing working environment conditions, the use of personal protective equipment (PPE), procedural compliance, and risk control—the higher the employee productivity that can be achieved. Accordingly, the second hypothesis is formulated as follows:
$H_2$: Occupational Safety and Health (OSH) has a positive and significant effect on employee productivity.

## 3. Research Methods

### Research Design and Approach

This study employs a quantitative approach with an explanatory research design aimed at examining the causal relationship between independent and dependent variables through hypothesis testing based on numerical data [20]. This approach was selected because the study seeks to measure the magnitude of the effect of kaizen culture ($X_1$) and Occupational Safety and Health/OSH ($X_2$) implementation on employee productivity (Y), both partially and simultaneously, through inferential statistical analysis. The explanatory design was deemed most appropriate for this study, as it enables the direction and significance of inter-variable effects to be tested in a measurable manner, thereby allowing the findings to be generalized within the boundaries of the defined population.

### Research Object, Location, and Time

The object of this study is PT XYZ Indonesia, a manufacturing company producing spinnerettes—precision components used for filament formation in the chemical man-made fiber industry—located at EJIP Industrial Park Plot 8K-1, Sukaresmi, South Cikarang, Bekasi, West Java. The study focuses on the F-Line Department, a production unit comprising 12 lines with varying process characteristics, including material type, hole count, capillary diameter, and cycle time, making it a relevant setting for examining the interaction between process efficiency (kaizen) and occupational risk control (OSH) in relation to productivity. The study was conducted from June 2024 to June 2026, encompassing the stages of preliminary observation, instrument development, data collection, statistical analysis, and final report preparation.

### Population, Sample, and Sampling Technique

The population of this study comprises all employees of the F-Line Department at PT XYZ who are directly involved in the production process. Given the relatively limited population size and the fact that all population members are directly engaged with the variables under study, sampling was conducted using the census or total sampling method, whereby the entire population is treated as the unit of analysis [21]. The application of the census method in this study ensures that statistical inference is not distorted by sampling error, thereby allowing the results of hypothesis testing to fully reflect the condition of the population. The distribution of respondents by position is presented in Table 1.

**Table 1.** Distribution of Research Respondents

| No | Position | Number of Employees | Percentage (%) |
|---|---|---|---|
| 1 | Production Operator | 45 | 70.3 |
| 2 | Machine Setter | 8 | 12.5 |
| 3 | Technician/Maintenance | 5 | 7.8 |
| 4 | Production Leader | 4 | 6.3 |
| 5 | Production Supervisor | 2 | 3.1 |
| Total | | 64 | 100 |

### Operational Definitions and Variable Measurement

This study involves three main variables: two independent variables—kaizen culture ($X_1$) and Occupational Safety and Health/OSH ($X_2$)—and one dependent variable, employee productivity (Y). Kaizen culture is defined as the level of implementation of the continuous improvement philosophy through 5S practices in employees' daily work activities, measured using five indicators: Seiri (sorting), Seiton (setting in order), Seiso (shining), Seiketsu (standardizing), and Shitsuke (sustaining), adapted from Mazur et al. (2024) [6] and Sihombing and Purba (2025) [7]. Occupational Safety and Health (OSH) is defined as the level of effectiveness of risk management and the protection of employee safety and health, measured through six indicators: working environment conditions, use of personal protective equipment (PPE), compliance with safety procedures, OSH training and dissemination, safety facilities, and accident risk control, adapted from Sinollah and Zaki (2022) [15] and Swastika et al. (2022) [19]. Employee productivity is defined as the level of an employee's ability to generate work output effectively and efficiently in accordance with company targets, measured through six indicators: work capability, improvement in work output, work morale, self-development, work quality, and work efficiency, adapted from Amini and Hidayat (2023) [12] and Siregar and Hermawan (2024) [18]. A summary of the variable operationalization is presented in Table 2.

**Table 2.** Operational Definitions and Indicators of Research Variables

| Variable | Operational Definition | Indicators | Number of Items | Indicator Source |
|---|---|---|---|---|
| Kaizen Culture ($X_1$) | Level of implementation of the continuous improvement philosophy through 5S practices in daily work activities | Seiri; Seiton; Seiso; Seiketsu; Shitsuke | 5 | [6] [7] |
| Occupational Safety and Health/OSH ($X_2$) | Level of effectiveness of risk management and the protection of employee safety and health | Working environment conditions; Use of PPE; Procedural compliance; OSH training; Safety facilities; Risk control | 6 | [15] [19] |
| Employee Productivity (Y) | Level of an employee's ability to generate work output effectively and efficiently in accordance with company targets | Work capability; Improvement in work output; Work morale; Self-development; Work quality; Work efficiency | 6 | [12] [18] |

### Measurement Scale

All variables were measured using a five-point Likert-scale questionnaire, with responses ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Since Likert-scale data are ordinal in nature, they do not satisfy the interval-level assumption required for multiple linear regression analysis. Accordingly, raw ordinal scores were transformed into interval-scale data using the Method of Successive Interval (MSI) prior to statistical analysis [22].

MSI transforms ordinal responses into interval data by estimating the width of each scale category based on the underlying distribution of responses. The procedure follows five sequential steps. First, the frequency of each response category (1 through 5) is computed for each item. Second, the proportion of each category relative to the total number of respondents is calculated. Third, cumulative proportions are derived by summing the proportions progressively across categories. Fourth, each cumulative proportion is converted to its corresponding z-score (density value) using the standard normal distribution table. Fifth, the scale value (SV) for each category is computed as the difference between the ordinate of the lower boundary and the ordinate of the upper boundary, divided by the proportion of the category. The final interval score for each category is obtained by adding a constant to the scale value so that the lowest transformed score equals 1.000.

The resulting interval weights used in this study are presented in Table 3. These transformed values replace the original ordinal scores in all subsequent regression analyses, thereby satisfying the parametric assumptions of multiple linear regression.

**Table 3.** Measurement Scale: Likert-to-Interval Transformation (MSI)

| Likert Scale | Category | Ordinal Score | Interval Score (MSI) |
|---|---|---|---|
| 1 | Strongly Disagree (SD) | 1 | 1.000 |
| 2 | Disagree (D) | 2 | 1.832 |
| 3 | Neutral (N) | 3 | 2.964 |
| 4 | Agree (A) | 4 | 4.127 |
| 5 | Strongly Agree (SA) | 5 | 5.000 |

### Research Instrument Testing

Prior to data collection, the questionnaire instrument was tested through two standard procedures. Validity testing was conducted using Pearson Product Moment correlation, with an item deemed valid if the calculated r-value exceeded the table r-value at a 5% significance level. With degrees of freedom df = n − 2 = 64 − 2 = 62, the table r-value was determined to be 0.246. Reliability testing was conducted using Cronbach's Alpha coefficient, with the instrument deemed reliable if the resulting coefficient exceeded the threshold of 0.70 [23]. The combination of these two tests ensures that the instrument employed is capable of accurately and consistently measuring the intended constructs.

### Data Analysis Technique

All statistical analyses were processed using IBM SPSS Statistics version 25.0. Prior to hypothesis testing, the classical assumptions of regression were verified through three tests: (1) a normality test using Kolmogorov-Smirnov, with data deemed normally distributed if the Asymp. Sig. value exceeded 0.05; (2) a multicollinearity test using Tolerance and Variance Inflation Factor (VIF) values, with the criterion for freedom from multicollinearity being a Tolerance value greater than 0.10 and a VIF value below 10; and (3) a heteroscedasticity test using the Glejser test, with data deemed free from heteroscedasticity if the residual significance value exceeded 0.05. Satisfying these three classical assumptions is a prerequisite for ensuring that the regression coefficient estimates qualify as the Best Linear Unbiased Estimator (BLUE) [24]. Hypothesis testing was conducted through multiple linear regression analysis using the following equation model:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \varepsilon \quad (1)$$

where Y denotes employee productivity, α is the constant, $\beta_1$ and $\beta_2$ are the regression coefficients of the respective independent variables, $X_1$ is kaizen culture, $X_2$ is Occupational Safety and Health (OSH), and e is the error term. Partial hypothesis testing ($H_1$ and $H_2$) was conducted using the t-test, with the hypothesis accepted if the significance value was less than 0.05 and the calculated t-value exceeded the table t-value. Simultaneous hypothesis testing ($H_3$) was conducted using the F-test, with the hypothesis accepted if the significance value was less than 0.05 and the calculated F-value exceeded the table F-value. The proportion of variance in the dependent variable explained by the two independent variables was measured using the coefficient of determination ($R^2$).

## 4. Results and Discussion

### Validity Test Results

A validity test was conducted to determine the accuracy of the instrument in measuring the variables under study, using Pearson Product Moment correlation across 64 respondents. An item was deemed valid if the calculated r-value exceeded the table r-value and the significance value was below 0.05 [23]. With degrees of freedom (df) = n − 2 = 64 − 2 = 62, the table r-value was determined to be 0.246. The test results are presented in Table 4.

**Table 4.** Validity Test Results

| Variable | Item | r-value | Sig. | Remarks |
|---|---|---|---|---|
| Kaizen Culture ($X_1$) | $X_{1.1}$ (Seiri) | 0.879 | 0.000 | Valid |
| | $X_{1.2}$ (Seiton) | 0.927 | 0.000 | Valid |
| | $X_{1.3}$ (Seiso) | 0.925 | 0.000 | Valid |
| | $X_{1.4}$ (Seiketsu) | 0.923 | 0.000 | Valid |
| | $X_{1.5}$ (Shitsuke) | 0.906 | 0.000 | Valid |

| Variable | Item | r-value | Sig. | Remarks |
|---|---|---|---|---|
| Occupational Safety and Health/OSH ($X_2$) | $X_{2.1}$ (Working environment conditions) | 0.646 | 0.000 | Valid |
| | $X_{2.2}$ (Use of PPE) | 0.647 | 0.000 | Valid |
| | $X_{2.3}$ (Procedural compliance) | 0.886 | 0.000 | Valid |
| | $X_{2.4}$ (Training/dissemination) | 0.913 | 0.000 | Valid |
| | $X_{2.5}$ (OSH facilities) | 0.875 | 0.000 | Valid |
| | $X_{2.6}$ (Risk control) | 0.926 | 0.000 | Valid |
| Employee Productivity (Y) | $Y_1$ (Work capability) | 0.851 | 0.000 | Valid |
| | $Y_2$ (Improvement in output) | 0.953 | 0.000 | Valid |
| | $Y_3$ (Work morale) | 0.927 | 0.000 | Valid |
| | $Y_4$ (Self-development) | 0.901 | 0.000 | Valid |
| | $Y_5$ (Work quality) | 0.890 | 0.000 | Valid |
| | $Y_6$ (Work efficiency) | 0.890 | 0.000 | Valid |

Table 4 shows that all 17 items across the three variables yielded calculated r-values exceeding the table r-value (0.246), with a significance level of 0.000 ($p < 0.05$); accordingly, all items were deemed valid and suitable for use as research instruments. A notable pattern was observed within the OSH variable, whereby items $X_{2.1}$ and $X_{2.2}$ (working environment conditions and PPE use) exhibited relatively lower correlations (0.646–0.647) compared to the other items (0.875–0.926). This suggests that the administrative and behavioral dimensions of OSH—including training, compliance, and risk control—were perceived more homogeneously by respondents than the physical dimensions related to working environment conditions and PPE use.

### Reliability Test Results

A reliability test was conducted to assess the consistency of the research instrument using the Cronbach's Alpha method. An instrument was deemed reliable if its Cronbach's Alpha value exceeded 0.70 [23]. The test results are presented in Table 5.

**Table 5.** Reliability Test Results

| Variable | Cronbach's Alpha | N of Items | Remarks |
|---|---|---|---|
| Kaizen Culture ($X_1$) | 0.828 | 5 | Reliable |
| Occupational Safety and Health/OSH ($X_2$) | 0.803 | 6 | Reliable |
| Employee Productivity (Y) | 0.815 | 6 | Reliable |

Table 5 shows that all variables obtained Cronbach's Alpha values above the 0.70 threshold, namely 0.828 for kaizen culture, 0.803 for OSH, and 0.815 for employee productivity. Accordingly, all research instruments were deemed reliable and exhibited sound internal consistency, rendering them suitable for use as data collection tools.

### Classical Assumption Test Results

Classical assumption testing was conducted to ensure that the regression model satisfied the requirements of a sound estimator (Best Linear Unbiased Estimator), encompassing tests of normality, multicollinearity, and heteroscedasticity [24]. The test results are presented in Table 6.

**Table 6.** Classical Assumption Test Results

| Test Type | Indicator | Value | Criterion | Remarks |
|---|---|---|---|---|
| Normality | Kolmogorov-Smirnov (Asymp. Sig.) | 0.200 | > 0.05 | Data normally distributed |

| Test Type | Indicator | Value | Criterion | Remarks |
|---|---|---|---|---|
| Multicollinearity | Tolerance ($X_1$) | 0.267 | > 0.10 | Free of multicollinearity |
| | VIF ($X_1$) | 3.741 | < 10 | Free of multicollinearity |
| | Tolerance ($X_2$) | 0.267 | > 0.10 | Free of multicollinearity |
| | VIF ($X_2$) | 3.741 | < 10 | Free of multicollinearity |
| Heteroscedasticity | Sig. $X_1$ | 0.555 | > 0.05 | Homoscedastic |
| (Glejser) | Sig. $X_2$ | 0.879 | > 0.05 | Homoscedastic |

Table 6 shows that the Asymp. Sig. value obtained from the Kolmogorov-Smirnov test was 0.200 (> 0.05), indicating that the residual data were normally distributed. The Tolerance values for both independent variables were 0.267 (> 0.10), with a VIF of 3.741 (< 10), indicating that the model was free from multicollinearity. The Glejser test results yielded significance values of 0.555 for $X_1$ and 0.879 for $X_2$, both exceeding 0.05, indicating that the model did not exhibit heteroscedasticity. Accordingly, the regression model satisfied all classical assumptions and was deemed suitable for parameter estimation and hypothesis testing.

### Multiple Linear Regression Analysis Results

Multiple linear regression analysis was employed to determine the direction and magnitude of the effect of kaizen culture ($X_1$) and Occupational Safety and Health/OSH ($X_2$) on employee productivity (Y). The results of the data processing using SPSS version 25.0 are presented in Table 7.

**Table 7.** Multiple Linear Regression Analysis Results

| Model | B (Unstandardized) | Std. Error | Beta (Standardized) | t-value | Sig. |
|---|---|---|---|---|---|
| (Constant) | 2.033 | 1.058 | — | 1.921 | 0.059 |
| Kaizen Culture ($X_1$) | 0.592 | 0.092 | 0.564 | 6.456 | 0.000 |
| Occupational Safety and Health/OSH ($X_2$) | 0.416 | 0.090 | 0.406 | 4.642 | 0.000 |

Table 7 shows a constant value of 2.033, with regression coefficients of 0.592 for $X_1$ and 0.416 for $X_2$, yielding the following regression equation:

$$Y = 2.033 + 0.592X_1 + 0.416X_2 + \varepsilon \quad (2)$$

The constant value of 2.033 indicates that, in the absence of kaizen culture and OSH (i.e., when both equal zero), employee productivity stands at a baseline value of 2.033. The regression coefficient for $X_1$ of 0.592 indicates that each one-unit increase in kaizen culture raises employee productivity by 0.592 units, assuming $X_2$ remains constant. The regression coefficient for $X_2$ of 0.416 indicates that each one-unit increase in OSH raises employee productivity by 0.416 units, assuming $X_1$ remains constant. Based on the standardized beta coefficients, kaizen culture (0.564) exerts a more dominant effect on employee productivity than OSH (0.406).

### Hypothesis Testing Results

Hypothesis testing was conducted through the t-test to examine partial effects and the F-test to examine simultaneous effects. The results are presented in Tables 8 through 11.

**Table 8.** t-Test Results (Partial)

| Variable | t-value | t-table (df=61; α=0.05) | Sig. | Remarks |
|---|---|---|---|---|
| Kaizen Culture ($X_1$) | 6.456 | 2.000 | 0.000 | Significant |
| Occupational Safety and Health/OSH ($X_2$) | 4.642 | 2.000 | 0.000 | Significant |

Table 8 shows that the calculated t-values for both variables exceeded the table t-value (2.000), with a significance level of 0.000 (< 0.05). Accordingly, kaizen culture and OSH each exert a significant partial effect on employee productivity.

**Table 9.** F-Test Results (Simultaneous)

| Source of Variation | Sum of Squares | df | Mean Square | F-value | F-table (2; 61; 0.05) | Sig. |
|---|---|---|---|---|---|---|
| Regression | 1893.439 | 2 | 946.719 | 214.236 | 3.15 | 0.000 |
| Residual | 269.561 | 61 | 4.419 | | | |
| Total | 2163.000 | 63 | | | | |

Table 9 shows an F-value of 214.236, which substantially exceeds the table F-value (3.15), with a significance level of 0.000 (< 0.05). Accordingly, kaizen culture and OSH jointly exert a significant simultaneous effect on employee productivity.

**Table 10.** Coefficient of Determination Results

| R | R Square | Adjusted R Square | Std. Error of Estimate |
|---|---|---|---|
| 0.936 | 0.875 | 0.871 | 2.10215 |

Table 10 shows an R Square value of 0.875, indicating that 87.5% of the variation in employee productivity is explained by kaizen culture and OSH, while the remaining 12.5% is explained by other factors outside the research model.

**Table 11.** Summary of Research Hypotheses Testing

| Hypothesis | Statement | Test Statistic | Sig. | Decision |
|---|---|---|---|---|
| $H_1$ | Kaizen Culture → Employee Productivity (partial) | t = 6.456 | 0.000 | Accepted |
| $H_2$ | Occupational Safety and Health/OSH → Employee Productivity (partial) | t = 4.642 | 0.000 | Accepted |
| $H_3$ | Kaizen Culture & OSH → Employee Productivity (simultaneous) | F = 214.236 | 0.000 | Accepted |

Table 11 shows that all research hypotheses ($H_1$, $H_2$, $H_3$) were statistically supported. It can therefore be concluded that kaizen culture and OSH have a positive and significant effect on employee productivity, both partially and simultaneously.

## Discussion

The results indicate that kaizen culture has a positive and significant effect on employee productivity at PT XYZ, thereby supporting the acceptance of the first hypothesis ($H_1$). Beyond statistical significance (t = 6.456; p = 0.000), the unstandardized regression coefficient of 0.592 carries a concrete operational meaning, whereby each one-unit improvement in kaizen culture implementation is associated with a 0.592-unit increase in employee productivity, holding OSH constant. This magnitude is practically meaningful in a spinnerette production environment, where even marginal gains in process efficiency translate directly into measurable improvements in output quantity and dimensional accuracy. Spinnerette manufacturing demands tolerances at the micron level across multiple hole configurations and capillary diameters; under such conditions, even minor reductions in tool search time, workstation disorganization, or procedural inconsistency—all of which 5S directly targets—can yield disproportionately large gains in throughput and defect reduction. The dominant influence of kaizen ($\beta_1$ = 0.564) over OSH ($\beta_2$ = 0.406) is therefore not incidental but structurally explained by the nature of the production process itself. Unlike general manufacturing, spinnerette production is precision-driven, meaning that the quality and speed of output are almost entirely determined by how consistently and efficiently each production step is executed. Kaizen, through waste elimination, workflow standardization, and the discipline embedded in

daily 5S routines, directly addresses these execution-level determinants of productivity in a way that no safety intervention alone can replicate.

This finding is consistent with Atta-Ankomah et al. (2022) [10], who demonstrated that kaizen and 5S reduce non-productive activities and improve workflow efficiency in multi-sector manufacturing. It also aligns with Amini and Hidayat (2023) [12] and Ariskiya et al. (2024) [13], who reported that consistency in 5S implementation is a key determinant of productivity enhancement in Indonesian manufacturing companies, and with Sichinsambwe et al. (2023) [11], who found that structured continuous improvement cultures contribute to improved employee performance across manufacturing settings.

The results further indicate that OSH has a positive and significant effect on employee productivity ($t = 4.642$; $p = 0.000$), supporting the second hypothesis ($H_2$). The regression coefficient of 0.416 indicates that each one-unit improvement in OSH implementation is associated with a 0.416-unit increase in employee productivity. In practical terms, this effect operates primarily through the reduction of operational disruptions. A well-maintained OSH system reduces absenteeism from workplace injuries, minimizes unplanned production stoppages, and sustains the psychological safety that enables employees to maintain concentration and procedural compliance throughout high-risk machining tasks. In the F-Line Department, where processes involve high-speed rotating equipment and precision cutting tools, an unaddressed safety incident does not merely injure a worker—it halts an entire production line, disrupts scheduling across multiple shift cycles, and generates rework or scrap that compounds output losses. The effect of OSH on productivity is therefore best understood not as a direct performance driver, but as an operational continuity mechanism whose value is most visible when it is absent.

This finding reinforces Sinollah and Zaki (2022) [15], Swastika et al. (2022) [19], Maharani et al. (2025) [14], and Pagirik et al. (2025) [16], all of whom demonstrated that effective OSH implementation positively and significantly influences employee productivity across various Indonesian industrial sectors.

The simultaneous effect of kaizen culture and OSH on employee productivity ($F = 214.236$; $p = 0.000$) confirms that these two variables function as a complementary managerial system rather than independent interventions. This relationship has a clear operational logic in precision manufacturing. Kaizen optimizes how work is performed, while OSH ensures that the conditions under which work is performed remain safe and stable. Neither variable alone is sufficient—an efficiently organized but unsafe workplace generates accidents that disrupt productivity gains, while a safe but inefficiently organized workplace fails to reach its output potential. The interaction of these two variables within a single model, yielding an $R^2$ of 0.875, reflects the degree to which productivity in a highly process-dependent environment such as spinnerette production is systematically determined by management practices rather than by random or individual-level variation.

The $R^2$ value of 0.875 warrants critical examination. While this figure indicates that 87.5% of the variance in employee productivity is explained by kaizen culture and OSH, such a high coefficient of determination in a perception-based cross-sectional study may also reflect methodological characteristics that inflate explanatory power. All three variables—kaizen culture, OSH, and employee productivity—were measured through self-report questionnaires administered to the same respondents at a single point in time, creating the conditions for common method bias, whereby shared response tendencies such as acquiescence bias or social desirability artificially strengthen observed correlations between variables. Furthermore, the relatively small and homogeneous sample ($n = 64$, single department, single company) reduces within-sample variability, which can produce regression coefficients with inflated goodness-of-fit statistics. The remaining 12.5% of unexplained variance points to relevant factors outside the model, including work motivation, supervisory leadership quality, compensation structure, workforce fatigue, and

equipment reliability—all of which have been documented in the broader productivity literature as significant determinants of manufacturing employee performance. Future research should incorporate these variables, adopt objective productivity measures such as actual output rates or defect counts, and apply procedural remedies for common method bias such as Harman's single-factor test or the use of temporally separated data collection points.

Based on these findings, several concrete and measurable managerial implications can be formulated for PT XYZ and comparable precision manufacturing companies. With respect to kaizen culture, management should establish a mandatory kaizen proposal cycle—such as a minimum of two documented improvement proposals per operator per quarter—coupled with a structured 5S audit schedule conducted monthly by a cross-functional team. Audit results should be displayed on visual management boards at each production line, enabling real-time performance monitoring and reinforcing accountability at the workstation level. A quantifiable target such as a 15% reduction in non-value-added activities within six months of full 5S implementation would provide a measurable benchmark for program effectiveness. With respect to OSH, management should prioritize the activation or strengthening of the P2K3 committee, given that national data indicate fewer than 2% of BPJS-registered companies maintain an active P2K3. Practical interventions should include monthly near-miss reporting reviews, mandatory PPE compliance audits tied to individual performance assessments, and the installation of hazard warning systems at high-risk machining stations. A target of zero lost-time injuries per production quarter, tracked and reported at the departmental level, would constitute a concrete and operationally meaningful OSH performance indicator. Integrating kaizen and OSH into a single departmental performance scorecard—rather than managing them as separate programs under different functional owners—would institutionalize the complementary relationship confirmed by this study and provide management with a unified tool for monitoring operational performance.

## 5. Conclusion

This study aimed to analyze the effect of kaizen culture and Occupational Safety and Health (OSH) implementation on employee productivity, both partially and simultaneously, within the F-Line Department of PT XYZ, a precision component (spinnerette) manufacturing company serving the synthetic fiber industry in Cikarang, Indonesia. The results of the multiple linear regression analysis indicate that kaizen culture has a positive and significant effect on employee productivity ($\beta = 0.564$; $t = 6.456$; $p = 0.000$), as does OSH ($\beta = 0.406$; $t = 4.642$; $p = 0.000$). Simultaneously, both variables were found to have a significant effect on employee productivity ($F = 214.236$; $p = 0.000$), with the model explaining 87.5% of the variation in employee productivity ($R^2 = 0.875$). Kaizen culture demonstrated a relatively more dominant contribution than OSH, suggesting that in high-precision manufacturing processes such as spinnerette production, workflow efficiency achieved through 5S practices exerts a comparatively larger marginal effect on productivity. Nevertheless, occupational safety management remains an indispensable operational prerequisite, and these findings confirm that kaizen and OSH are complementary—rather than substitutive—in supporting employee operational performance.

Based on these findings, the management of PT XYZ and similar manufacturing companies are advised to design continuous improvement programs (5S/kaizen) and occupational safety programs in an integrated manner, rather than as standalone initiatives, given that the two programs have been shown to mutually reinforce their effects on productivity. In addition, participatory mechanisms—such as mandatory periodic kaizen proposals and OSH dissemination through open discussion forums—should be maintained and replicated across other departments, as this approach has proven effective in enhancing employee engagement and awareness. Furthermore, simple visual interventions, such as standardized production

information boards and the installation of hazard warning signs, should be prioritized as low-cost yet impactful strategies for improving occupational safety behavior on the production floor.

This study is not without limitations. The cross-sectional design, with a single unit of analysis confined to one department within a single company, limits the generalizability of the findings to the broader manufacturing context. The research model also incorporates only two independent variables, while the $R^2$ value of 0.875 indicates that 12.5% of the variation in employee productivity remains unexplained by other factors, such as work motivation, compensation, leadership style, or workload. Furthermore, the use of perception-based questionnaire measurements may introduce common method bias, as all variables were measured from the same source at a single point in time, and this study did not explore potential mediating or moderating effects between the two independent variables. In light of these limitations, future research is encouraged to: expand the model by incorporating relevant variables such as motivation, leadership, and work discipline; adopt a longitudinal design to capture the dynamics of changes in kaizen and OSH implementation in relation to productivity over time; broaden the unit of analysis across multiple departments or similar manufacturing companies; explore potential mediating or moderating effects—for instance, examining whether job satisfaction mediates the relationship between kaizen culture, OSH, and employee productivity; and combine perception-based data with objective, non-perceptional data, such as actual production output or defect rates, to strengthen the external validity of the findings.

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