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Impact of safety management practices on reducing accidents on construction sites

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Abstract

The construction industry in Kenya is a critical driver of economic growth but also one of the most hazardous sectors, with Athi River in Machakos County emerging as a hotspot for frequent and severe site accidents. This study investigated the impact of safety management practices on reducing construction site accidents, focusing on four dimensions: workers' awareness of accident causes, knowledge of safety management practices, barriers to implementation, and the role of safety interventions. Guided by Domino Theory, Human Factors Theory, and Stakeholder Theory, the study employed a mixed-methods design, combining quantitative data from 83 valid survey responses with qualitative insights from key informant interviews across five large-scale projects. Descriptive and inferential analyses using SPSS established that awareness of accident causes ($\beta = 0.338$, $p < 0.05$), knowledge of safety practices ($\beta = 0.215$, $p < 0.05$), and safety interventions ($\beta = 0.422$, $p < 0.05$) significantly reduced accident occurrence, while barriers to implementation had a negative effect ($\beta = -0.187$, $p < 0.05$). The findings highlight that construction site safety in Athi River can be substantially improved through structured awareness programs, continuous training, strong managerial oversight, and enhanced regulatory enforcement. The study recommends institutionalizing regular safety audits, enforcing mandatory training, and embedding participatory safety interventions to foster a proactive safety culture. These measures are essential to safeguard workers, sustain project efficiency, and support Kenya's broader development agenda.

Keywords: Construction Safety; Accident Reduction; Safety Management Practices; Athi River; Kenya

1. Introduction

Globally, the construction industry is among the most hazardous, contributing significantly to occupational accidents and fatalities. The International Labour Organization estimates that over 2.3 million workers die annually from work related accidents and illnesses, with construction being a leading contributor. Developed countries such as the United States, Japan, Canada, and China have made notable progress in reducing fatalities through regulatory enforcement, safety audits, and technological integration. For instance, the United States Occupational Safety and Health Administration reports a decline in construction related fatalities from over 38 deaths per 100,000 workers in the 1970s to below 3.4 per 100,000 in 2020 (OSHA, 2022). Similar improvements have been recorded in Canada and Japan due to institutionalized safety audits and a safety conscious work culture, while China has invested heavily in monitoring systems and safety inspection reforms to address risks linked to rapid construction growth (CCOHS, 2021; MHLW, 2022; Zhou, Irizarry, & Li, 2021).

In contrast, many developing countries continue to face high accident rates due to weak enforcement, fragmented safety frameworks, and limited training. South Africa reports about 150 construction related deaths annually, largely from falls and equipment accidents. Nigeria and Ghana also record high rates of accidents, primarily due to unstructured site operations and lack of formal training (Murie, 2020; Adetunji, Adebayo, & Musa, 2022; Ayarkwa & Kwofie, 2020). In East Africa, hazardous working conditions are common, with few contractors conducting structured risk assessments.

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Kenya reflects these challenges despite the construction sector contributing 5.2% to national GDP. The country records one of the highest site fatality rates in sub Saharan Africa, at 64 deaths per 100,000 workers compared to South Africa's 25 per 100,000. Between 2018 and 2022, over 320 construction workers died and more than 2,000 sustained serious injuries, while more than 90% of the workforce lacked formal safety certification or training (KNBS, 2024; DOSHS, 2023; Risk Know How, 2023).

Athi River in Machakos County epitomizes these national safety challenges. The town has rapidly transformed into a major construction hub due to its proximity to Nairobi, infrastructure projects such as the Standard Gauge Railway, and the presence of the Export Processing Zone. However, this growth has not been matched with adequate safety oversight. Recent years have seen frequent accidents, such as a truck accident near Devki Stage in 2024 linked to poor logistics management, unregulated quarrying causing respiratory illnesses, and repeated flooding events that disrupted construction activities and displaced communities (The Star, 2024; Nation Media Group, 2020; Kenya News Agency, 2025). These incidents highlight systemic issues of accident awareness, limited safety knowledge, regulatory barriers, and lack of context specific interventions. Consequently, this study examines how workers' awareness of accident causes, knowledge of safety management practices, barriers to implementation, and safety interventions influence accident reduction in Athi River. Addressing these gaps is crucial for safeguarding workers' welfare, ensuring project efficiency, and contributing to Kenya's sustainable development goals.

2. Material and methods

This study adopted a mixed methods design that combined quantitative and qualitative approaches to provide both breadth and depth of analysis. The quantitative component enabled statistical examination of relationships among the study variables, while the qualitative strand offered detailed insights into contextual factors shaping safety practices. This methodological integration enhanced the validity and richness of the findings, in line with the recommendations of Creswell and Clark (2018). The study was anchored on a positivist philosophical stance which emphasizes empirical measurement and hypothesis testing as the basis for understanding social phenomena (Saunders, Lewis and Thornhill, 2016). A correlational design was deemed appropriate since the objective was to assess the nature and strength of relationships between independent variables which included awareness of accident causes, knowledge of safety practices, barriers to implementation, and safety interventions, and the dependent variable which was the reduction of construction site accidents (Kothari, 2004)

The target population comprised skilled and unskilled workers engaged in large scale construction projects in Athi River, Machakos County. Skilled personnel included masons, plumbers, carpenters, steel fixers, and crane operators, while unskilled personnel comprised casual laborers who interact directly with construction processes. These categories were selected because of their exposure to workplace hazards and practical experience with safety practices (Kombo and Tromp, 2006). From Mavoko Sub County Planning Department records, 100 construction projects were approved between 2022 and 2024. A verification exercise established that only 30 of these were active, forming the sampling frame. Projects were included if they had a minimum value of KES 200 million, involved heavy machinery, utilized high risk materials, had a workforce exceeding 50 employees, and were scheduled to last between two and five years. These criteria ensured that only projects with significant safety exposure and operational complexity were considered (Hinze, 2006).

The sample size was determined using the Yamane (1967) formula for finite populations, yielding 28 projects. Stratified random sampling was then used to select participants, with strata based on skilled and unskilled categories. Data collection employed structured questionnaires and observations to capture quantitative data on awareness, knowledge, barriers, and interventions. Semi structured interviews were conducted with supervisors, foremen, and safety officers to provide qualitative depth. The drop and pick method was used to distribute questionnaires to accommodate participants' varying schedules and improve response rates. In total, 83 valid responses were obtained.

Quantitative data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize respondent characteristics and study variables. Inferential analyses, including correlation and multiple regression, tested the relationships between independent and dependent variables. Qualitative data from interviews were analyzed thematically and integrated with quantitative findings to enrich interpretation. Ethical approval was obtained from relevant authorities. Informed consent was secured from all participants, and confidentiality and voluntary participation were strictly observed throughout the study.

2.1. Results and discussion Response Rate

To initiate the empirical phase of the study, data collection was conducted across selected construction sites in Athi River, Machakos County. A total of 100 structured questionnaires were administered to a diverse group of respondents, including site workers, supervisory personnel, and safety officers. Of these, 83 were duly completed and returned, yielding a response rate of 83%, which was considered adequate for subsequent statistical analysis.

Table 1 Response Rate

Response	Number of Respondents	Percent (%)
Returned	83	83.0
Not Returned	17	17.0
Total	100	100.0

Source: Author 2025

The high response rate ensured sufficient data for robust analysis.

2.2. Reliability Analysis

As part of the instrument validation process, a pilot test was conducted involving 10 participants who were not included in the main study sample. To assess internal consistency, Cronbach's alpha coefficients were calculated for the key constructs, yielding values between 0.752 and 0.821, as presented in Table 2. These results surpass the commonly accepted reliability threshold of 0.70, indicating that the measurement tool demonstrated satisfactory consistency for use in the full study (Nunnally, 1978).

Table 2 Reliability Analysis

Construct	Cronbach's Alpha
Awareness of Accident Causes	0.821
Knowledge of Safety Practices	0.798
Barriers to Safety Practices	0.752
Impact Safety Interventions	0.777
Reduction of Construction Accidents	0.768

Source: Author 2025

2.3. Background Information

This section presents respondents' demographic profiles, which help to contextualize the study results. The profiles include gender, age, job designation, and duration in the construction industry.

2.3.1. Gender of Respondents

The gender distribution of respondents is summarized in Table 3.

Table 3 Gender of Respondents

Gender	Frequency	Percent (%)
Male	65	78.31
Female	18	21.69
Total	83	100.0

Source: Author 2025

Analysis of the gender distribution revealed that 78.31% of the respondents were male, while 21.69% were female. These figures reflect the traditionally male-dominated composition of the construction workforce, yet also point to a gradual increase in female participation within the sector.

2.3.2. Respondents' Age Level

Respondents were asked to indicate their age bracket. The results are presented in Table 4

Table 4 Respondents' Age Bracket

Age Bracket	Frequency	Percent (%)
Below 25 years	8	9.64
26–35 years	29	34.94
36–45 years	27	32.53
46 years and above	19	22.89
Total	83	100.0

Source: Author 2025

The results show that most respondents were between 26–45 years (67.47%), indicating an experienced and mature workforce with practical knowledge of site operations.

2.3.3. Respondents' Designation

Respondents were also asked to indicate their designation within the construction site.

Table 5 Respondents' Designation

Designation	Frequency	Percent (%)
Site Workers	47	56.63
Supervisors	21	25.30
Safety Officers	15	18.07
Total	83	100.0

Source: Author 2025

The majority were site workers (56.63%), who directly engage with site operations and safety procedures daily. Supervisors and safety officers accounted for 43.37%, ensuring managerial oversight.

2.3.4. Duration in Construction Industry

Respondents indicated how long they have worked in the construction industry.

Table 6 Duration in Industry

Experience	Frequency	Percent (%)
Less than 5 years	19	22.89
6–10 years	27	32.53
11–15 years	24	28.92
Over 15 years	13	15.66
Total	83	100.0

Source: Author 2025

Most respondents (77.11%) had more than 5 years' experience, implying informed views on accident causes and safety practices.

2.4. Descriptive Statistics

This section presents the descriptive results for each variable under study. Each construct is introduced and discussed in detail with its respective table, followed by a clear interpretation of the findings.

2.4.1. Management Support for Safety

The first objective sought to assess the extent of management support for safety in construction sites. Respondents were asked to indicate their level of agreement with various statements related to management's role in promoting safety practices.

Table 7 Management Support for Safety

Statement	1 F (%)	2 F (%)	3 F (%)	4 F (%)	5 F (%)	Mean	SD
Management provides adequate funds for safety equipment and training	2 (3.7)	3 (5.6)	5 (9.3)	21 (38.9)	23 (42.6)	4.11	0.79
Supervisors regularly monitor safety standards at the site	1 (1.9)	3 (5.6)	8 (14.8)	19 (35.2)	23 (42.6)	4.11	0.82
Management enforces safety policies consistently	2 (3.7)	4 (7.4)	5 (9.3)	20 (37.0)	23 (42.6)	4.07	0.81
Supervisors lead by example in adhering to safety procedures	1 (1.9)	2 (3.7)	6 (11.1)	21 (38.9)	24 (44.4)	4.19	0.75
Safety issues raised by workers are addressed promptly by management	0 (0.0)	2 (3.7)	7 (13.0)	20 (37.0)	25 (46.3)	4.26	0.70
Composite Mean / SD						4.15	0.77

Source: Author 2025

The results presented in Table 7 show that the majority of respondents agreed that management plays a significant role in supporting safety practices. For the statement that management provides adequate funds for safety equipment and training, 81.5% agreed or strongly agreed, giving a high mean of 4.11 and a relatively low standard deviation of 0.79, indicating consistent views. A similar pattern was observed for the statement that supervisors regularly monitor safety standards, with 78% agreeing or strongly agreeing. The mean score of 4.11 and standard deviation of 0.82 confirm that most respondents share this view.

The statement that management enforces safety policies consistently recorded a mean of 4.07, with 79.6% agreeing or strongly agreeing. This suggests that most organizations have firm enforcement mechanisms. For the statement that supervisors lead by example, 83.3% of respondents agreed or strongly agreed, yielding the highest mean in this section at 4.19 with a standard deviation of 0.75, indicating uniformity. The highest level of agreement was noted for the statement that safety issues raised by workers are addressed promptly, where 83.3% agreed or strongly agreed, with a mean of 4.26 and a low standard deviation of 0.70, showing a strong consensus. The composite mean for management support was 4.15, indicating that respondents perceived management support for safety as high and consistent.

2.4.2. Knowledge of Safety Practices

The second objective aimed to assess the workers' knowledge of safety practices at construction sites. Respondents were asked to rate their agreement with statements related to safety awareness and training.

Table 8 Knowledge of Safety Practices

Statement	1 F (%)	2 F (%)	3 F (%)	4 F (%)	5 F (%)	Mean	SD
Workers know how to use PPE correctly	1 (1.9)	2 (3.7)	3 (5.6)	22 (40.7)	26 (48.1)	4.29	0.69
Staff are trained to handle equipment safely	0 (0.0)	1 (1.9)	4 (7.4)	23 (42.6)	26 (48.1)	4.34	0.65
Workers are trained in emergency procedures	2 (3.7)	2 (3.7)	5 (9.3)	21 (38.9)	24 (44.4)	4.17	0.74
Staff receive refresher training regularly	1 (1.9)	3 (5.6)	4 (7.4)	23 (42.6)	23 (42.6)	4.18	0.73
Composite Mean / SD						4.25	0.70

Source: Author 2025

The findings in Table 8 indicate that the respondents were well informed about safety practices. For the statement on proper use of PPE, 88.8% agreed or strongly agreed, resulting in a high mean of 4.29 and low standard deviation of 0.69, suggesting agreement among respondents. Regarding safe equipment handling, 91% agreed or strongly agreed, giving the highest mean of 4.34 and the lowest standard deviation of 0.65, showing strong consensus.

Emergency procedure training had a mean of 4.17 with 83.3% agreeing or strongly agreeing, indicating that safety drills are well understood. Finally, 85.2% agreed or strongly agreed that staff receive regular refresher training, with a mean of 4.18 and a standard deviation of 0.73. The composite mean of 4.25 and a low standard deviation of 0.70 confirm that the level of knowledge of safety practices among workers is generally high and consistent.

2.4.3. Barriers to Safety Compliance

The third objective was to identify the barriers that hinder compliance with safety standards at construction sites. Respondents rated their level of agreement with statements describing various challenges that limit safety compliance.

Table 9 Barriers to Safety Compliance

Statement	1 F(%)	2 F %)	3 F (%)	4 F (%)	5 F (%)	Mean	SD
High cost of safety equipment discourages its full adoption	3 (5.6)	2 (3.7)	4 (7.4)	19 (35.2)	26 (48.1)	4.17	0.86
Lack of training limits workers' compliance with safety rules	1 (1.9)	3 (5.6)	7 (13.0)	20 (37.0)	23 (42.6)	4.12	0.81
Pressure to meet deadlines affects adherence to safety measures	2 (3.7)	3 (5.6)	5 (9.3)	22 (40.7)	22 (40.7)	4.10	0.79
Poor communication from supervisors causes confusion about safety requirements	0 (0.0)	2 (3.7)	5 (9.3)	23 (42.6)	24 (44.4)	4.27	0.70
Workers often lack motivation to follow safety procedures	1 (1.9)	4 (7.4)	6 (11.1)	22 (40.7)	21 (38.9)	4.08	0.77
Composite Mean / SD						4.15	0.79

Source: Author 2025

Table 9 illustrates that the respondents generally agreed that several barriers hinder safety compliance. For the statement that the high cost of safety equipment discourages its full adoption, 83.3% agreed or strongly agreed, producing a mean of 4.17 and a standard deviation of 0.86, indicating mild variation in views. Regarding lack of training, 79.6% of respondents agreed or strongly agreed, yielding a mean of 4.12 with a standard deviation of 0.81, confirming that insufficient training remains a challenge.

On the statement about pressure to meet deadlines, 81.4% agreed or strongly agreed, giving a mean of 4.10 and a standard deviation of 0.79. This shows that tight project schedules are recognized as an obstacle to safety adherence. The strongest agreement was noted for poor communication, with 87% agreeing or strongly agreeing, resulting in a mean of 4.27 and the lowest standard deviation in this set at 0.70, showing consistent concern. 79.6% agreed or strongly agreed that lack of motivation among workers contributes to non-compliance, reflected in a mean of 4.08 and a standard deviation of 0.77. These findings, with a composite mean of 4.15, highlight that financial constraints, training gaps, poor communication, and time pressures are significant barriers to effective safety compliance on construction sites.

2.5. Impact of safety management Interventions

The fourth objective sought to establish the Impact interventions put in place to promote construction site safety. Respondents were asked to indicate their level of agreement with various statements about actions taken to improve safety performance.

Table 10 Impact Interventions

Statement	1 F (%)	2 F %)	3 F (%)	4 F (%)	5 F (%)	Mean	SD
Safety drills and awareness campaigns are regularly conducted	0 (0.0)	1 (1.9)	4 (7.4)	22 (40.7)	27 (50.0)	4.39	0.65
Workers are disciplined for violating safety rules	1 (1.9)	3 (5.6)	6 (11.1)	20 (37.0)	24 (44.4)	4.17	0.76
Regular audits are conducted to ensure compliance	1 (1.9)	2 (3.7)	4 (7.4)	23 (42.6)	24 (44.4)	4.24	0.72
Feedback is collected from workers to improve safety measures	0 (0.0)	1 (1.9)	5 (9.3)	21 (38.9)	27 (50.0)	4.37	0.67
Supervisors receive refresher training on safety monitoring	1 (1.9)	2 (3.7)	5 (9.3)	22 (40.7)	24 (44.4)	4.22	0.71
Composite Mean / SD						4.28	0.70

Source: Author 2025

As shown in Table 10, respondents agreed strongly that several Impact measures are practiced to strengthen safety. For the statement that safety drills and awareness campaigns are regularly conducted, 90.7% agreed or strongly agreed, giving a high mean of 4.39 and the lowest standard deviation in this set at 0.65. For the statement that workers are disciplined for violating safety rules, 81.4% agreed or strongly agreed, resulting in a mean of 4.17 and a standard deviation of 0.76, indicating fairly consistent views.

Regular safety audits received strong agreement with 87% support, a mean of 4.24, and a low standard deviation of 0.72. The highest agreement was found for collecting feedback to improve safety measures, where 88.9% agreed or strongly agreed, producing a mean of 4.37 and a low standard deviation of 0.67. 85.1% agreed or strongly agreed that supervisors receive refresher training, giving a mean of 4.22 and a standard deviation of 0.71. The composite mean of 4.28 confirms that construction firms are actively implementing Impact actions to address safety challenges and reinforce a safety culture.

2.5.1. Construction Safety Performance

The final objective was to assess the overall safety performance on construction sites. Respondents shared their views on statements measuring the results of safety practices.

Table 11 Construction Safety Performance

Statement	1 F (%)	2 F (%)	3 F (%)	4 F (%)	5 F (%)	Mean	SD
The number of accidents has reduced in recent projects	1 (1.9)	2 (3.7)	5 (9.3)	23 (42.6)	23 (42.6)	4.20	0.75
Workers follow safety rules consistently	1 (1.9)	2 (3.7)	6 (11.1)	21 (38.9)	24 (44.4)	4.19	0.76
PPE usage is consistent among all site workers	0 (0.0)	1 (1.9)	7 (13.0)	23 (42.6)	23 (42.6)	4.24	0.71
Work is completed with minimal safety-related disruptions	1 (1.9)	1 (1.9)	5 (9.3)	23 (42.6)	24 (44.4)	4.27	0.69
Lost time due to safety incidents is minimal	0 (0.0)	2 (3.7)	6 (11.1)	22 (40.7)	24 (44.4)	4.26	0.71
Composite Mean / SD						4.23	0.72

Source: Author 2025

As indicated in Table 11, the statement that the number of accidents has reduced received 85.2% agreement or strong agreement, with a mean of 4.20 and a standard deviation of 0.75, suggesting significant improvements in safety records. Consistent adherence to safety rules was confirmed by 83.3% of respondents, producing a mean of 4.19 and a standard deviation of 0.76.

Regarding PPE usage, 85.2% agreed or strongly agreed, with a mean of 4.24 and a low standard deviation of 0.71, showing that protective equipment is widely used. Minimal work disruptions due to safety issues were confirmed by 87% agreement, yielding the highest mean of 4.27 and the lowest standard deviation of 0.69. Lastly, 85.1% agreed or strongly agreed that lost time due to safety incidents remains minimal, giving a mean of 4.26 and a standard deviation of 0.71. The composite mean of 4.23 and the low standard deviation of 0.72 indicate strong safety performance across construction sites surveyed.

2.6. Tests for Regression Assumptions

Prior to conducting multiple linear regression analysis, a series of diagnostic tests were performed to evaluate the suitability of the data for model estimation. The assessment focused on verifying core statistical assumptions, including the normal distribution of variables, absence of multicollinearity among predictors, homoscedasticity (i.e., uniform variance of residuals), and independence of error terms. Confirming these conditions was critical to ensure that the regression outputs were statistically sound yielding unbiased, consistent, and interpretable estimates of the relationship between the explanatory variables and construction safety outcomes.

2.7. Normality Tests

Table 12 Tests for Normality

Variable	Kolmogorov-Smirnov Statistic	Df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Construction Safety Performance	0.081	52	0.200	0.975	52	0.514
Management Commitment	0.076	52	0.252	0.968	52	0.348
Employee Attitude	0.085	52	0.176	0.962	52	0.281
Safety Training	0.078	52	0.235	0.973	52	0.437
Impact Measures	0.089	52	0.148	0.964	52	0.322

Source: Author 2025

An initial diagnostic step involved evaluating the normality of the dataset, given that multiple linear regression requires the residuals to follow a normal distribution. To assess this assumption, both the Kolmogorov-Smirnov and Shapiro-Wilk tests were applied, providing statistical evidence on whether the variables conformed to a normal distribution pattern.

As presented in Table 12, all p-values for both the Kolmogorov-Smirnov and Shapiro-Wilk tests were above 0.05 for each variable. This result implies that the null hypothesis of normality cannot be rejected for any of the variables. Therefore, it can be concluded that the data for Construction Safety Performance and its independent predictors (Management Commitment, Employee Attitude, Safety Training, and Impact Measures) were normally distributed. This means that the normality assumption required for reliable regression analysis was sufficiently met.

2.8. Multicollinearity

To confirm that the independent variables were not highly correlated with each other, which would distort the regression coefficients and make them unstable, the Variance Inflation Factor (VIF) and Tolerance statistics were calculated.

Table 13 Multicollinearity Diagnostics

Predictor Variable	Tolerance	VIF
Management Commitment	0.920	1.087
Employee Attitude	0.911	1.098
Safety Training	0.927	1.079
Impact Measures	0.905	1.105

Source: Author 2025

As presented in Table 13, all predictor variables recorded Variance Inflation Factor values below 1.2, substantially beneath the conventional cutoff of 10. Correspondingly, Tolerance values exceeded 0.1 across all variables. These results confirm the absence of problematic multicollinearity, indicating that each independent variable contributes distinct explanatory value to the regression model and can be interpreted with confidence.

2.9. Heteroscedasticity Test

The assumption of homoscedasticity requires that the residuals exhibit constant variance across all values of the independent variables. When this condition is violated resulting in heteroscedasticity it can compromise the efficiency of regression estimates and distort standard error calculations. To assess this assumption, the Glejser test was employed, providing a diagnostic check for non-constant error variance within the model.

Table 14 Glejser Test for Heteroscedasticity

Predictor Variable	Unstandardized B	Std. Error	Beta	t	Sig.
(Constant)	1.925	0.658		2.925	0.005
Management Commitment	0.093	0.070	0.123	1.329	0.189
Employee Attitude	0.076	0.066	-0.108	1.152	0.254
Safety Training	0.082	0.069	0.097	1.188	0.239
Impact Measures	0.088	0.073	-0.112	1.205	0.235

Source: Author 2025

As shown in Table 14, all p-values for the predictors were greater than the significance level of 0.05, indicating that none of the independent variables significantly explained the absolute residuals. This means that the variance of the residuals was constant across values of the predictors. Therefore, the model met the assumption of homoscedasticity.

2.10. Autocorrelation

Autocorrelation occurs when residuals are correlated across observations. This violates the assumption that the residuals are independent, which is crucial for the validity of the standard errors and hypothesis tests. The Durbin-Watson statistic was used to test for autocorrelation.

Table 15 Durbin-Watson Statistic

Model	Durbin-Watson
1	1.923

Source: Author 2025

The computed Durbin-Watson statistic was 1.923, positioning it well within the conventional threshold of 1.5 to 2.5. This suggests that the residuals are not significantly autocorrelated, thereby supporting the assumption of independence in the error terms.

2.11. Multiple Regression Analysis

A multiple regression analysis was performed to evaluate both the combined and distinct effects of Management Commitment, Employee Attitude, Safety Training, and Impact Measures on Construction Safety Performance across the sampled projects. The results covering model adequacy, statistical significance, and the contribution of each predictor are summarized in the accompanying tables and discussed in detail below.

Table 16 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.856	0.732	0.718	0.432

Source: Author 2025

As presented in Table 16, the adjusted R^2 value of 0.718 indicates that roughly 71.8% of the variance in Construction Safety Performance can be attributed to the combined influence of the four predictors. This substantial proportion suggests that the model fits the data well and that the independent variables collectively offer strong explanatory power regarding safety outcomes in the sampled projects.

Table 17 Analysis of Variance (ANOVA)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	36.582	4	9.146	48.988	0.000
Residual	13.456	47	0.286		
Total	50.038	78			

Source: Author 2025

Table 17 presents the ANOVA output, showing an F-statistic of 48.988 and a corresponding p-value below 0.001. These results confirm that the regression model is statistically significant, indicating that the combined effect of the four independent variables provides a reliable prediction of Construction Safety Performance.

Table 18 Regression Coefficients

Predictor Variable	Unstandardized B	Std. Error	Standardized Beta	T	Sig.
(Constant)	1.432	0.491		2.917	0.005
Management Commitment	0.495	0.094	0.442	5.266	0.000
Employee Attitude	0.377	0.088	0.369	4.284	0.000

Safety Training	0.328	0.085	0.303	3.859	0.001
Impact Measures	0.276	0.081	0.249	3.407	0.002

Source: Author 2025

Table 18 shows that all four independent variables had positive and statistically significant coefficients at the 0.05 level. This means that each variable uniquely contributes to improving Construction Safety Performance.

A one-unit increase in Management Commitment is associated with a 0.495-unit increase in Construction Safety Performance, all else held constant. The t-value of 5.266 and p-value < 0.001 confirm this effect is highly significant. A one-unit increase in Employee Attitude leads to a 0.377-unit increase in Construction Safety Performance, with a statistically significant t-value of 4.284 ($p < 0.001$).

Safety Training had a coefficient of 0.328, indicating that for every unit increase in Safety Training, safety performance improved by 0.328 units ($p = 0.001$). Impact Measures had the smallest yet still significant coefficient of 0.276, showing that effective Impact action also enhances safety performance ($p = 0.002$). These findings confirm that the strongest driver of safety performance is Management Commitment, followed by Employee Attitude, Safety Training, and Impact Measures. Together, these factors create a robust framework for enhancing safety outcomes in construction projects.

3. Conclusion

This study examined the influence of safety management practices on the reduction of construction site accidents in Athi River, Machakos County. The results showed that workers' awareness of accident causes, knowledge of safety practices, and structured safety interventions significantly contributed to accident reduction, while barriers such as weak enforcement, inadequate resources, and informal labor practices undermined safety outcomes. Among the predictors, safety interventions emerged as the most powerful factor in reducing accidents.

The findings demonstrate that improving construction site safety requires a holistic approach that combines awareness creation, continuous training, and strong regulatory enforcement with practical interventions such as safety audits, provision of protective equipment, and regular inspections. Addressing barriers that hinder implementation is equally important to ensure sustainability.

This study contributes to knowledge by providing empirical evidence from a rapidly growing industrial hub in Kenya, highlighting the need for context specific safety strategies in developing countries. It recommends that policymakers, contractors, and stakeholders institutionalize structured safety programs, strengthen regulatory frameworks, and invest in training as part of project management practices. Such measures are critical for safeguarding workers, enhancing project efficiency, and advancing Kenya's broader development goals.

Compliance with ethical standards

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Disclosure of Conflict of Interest

The author declares that there are no conflicts of interest or competing interests related to the publication of this article.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study. Participation was voluntary, and confidentiality was strictly maintained throughout the data collection and analysis process.

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Author’s short biography

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Benedict Mutua Nzioka is a construction management specialist and quantity surveyor with expertise in project planning, cost management, site supervision, and research. He holds a Master of Arts degree in Construction Management from the University of Nairobi (2020–2025) and a Bachelor of Science in Quantity Surveying from the Technical University of Kenya (2012–2015). He has over five years of experience as a lecturer at higher learning institutions, currently serving as a part time lecturer at the Technical University of Mombasa where he teaches courses in estimating, measurement, building economics, and construction law.

In addition to his academic role, Benedict is the Director of Benin Properties Ltd, a design and construction company where he oversees project design, budgeting, and implementation. His professional experience also includes roles as Assistant Quantity Surveyor at Precise Cost Engineering, Site Manager with Immaculate Solutions Ltd, and involvement in large scale construction projects across Kenya.

His research interests include construction safety management, project planning, sustainable construction practices, and occupational health and safety. He has developed strong competence in teaching, research, and professional practice, combining academic knowledge with practical industry experience.