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LIMITATIONS FOR THE IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE IN CONSTRUCTION HEALTH AND SAFETY IN GHANA

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Abstract. Building accidents and fatalities are prevalent, especially in rising nations like Ghana, despite rapid technical developments. Weak regulations, training, and change resistance typically undermine traditional safety measures. This study aimed to identify potential obstacles that prevent the implementation of artificial intelligence (AI) in construction health and safety in Ghana. A survey research approach was employed to get the study population, which consisted of 110 construction experts made up of project managers, site engineers, skilled workers, and safety officers complete the questionnaire. Data analysis included descriptive statistics, chi-square, and regression. According to varied demographic responses, AI increases design and engineering, safety and security, and human resources efficiency, decision-making, and safety. Lack of innovation culture, training, and regulation harms health and safety. Using AI promises to overcome these hurdles by minimising risks, improving worker well-being, and safe work environment. The Ghanaian industry study focus and small sample size may prejudice, as the limitations of the study. Samples must be larger and more diversified to generalise. The practical implication is that Ghanaian builders may use the study's findings. Understanding AI's potential and limitations helps them develop AI solutions and problem-solving methodologies. Safety, cost, and worker well-being can improve. The successful integration of AI in construction health and safety can affect society. AI can reduce workplace accidents and improve productivity, well-being, and healthcare costs. This work adds to the growing body of knowledge on AI's building safety applications in emerging economies like Ghana. It identifies environmental restrictions and enables governments, industry leaders, and researchers to develop and implement AI solutions.

Keywords: *Artificial intelligence (AI), construction industry, Ghana, health, safety.*

INTRODUCTION

Artificial Intelligence (AI) has the potential to revolutionise the construction industry by addressing challenges such as cost and time overruns, health and safety

issues, and productivity and labour shortages (Hire et al., 2022). AI techniques, such as machine learning, knowledge-based systems, computer vision, robotics, and optimisation, have been successfully applied in other industries to improve profitability, efficiency, safety, and security (Abioye et al., 2021). In the construction industry, AI applications can be used for activity monitoring, risk management, resource, and waste optimisation, and safety checks of ladders (Abioye et al., 2021; Majumder, 2022). AI can help in the pre-use stage of ladder safety by assessing the structural rigidity of the ladder and reducing accidents and hazards (Prabha et al., 2021). Additionally, AI can be integrated into Real Estate 4.0 to address health and safety issues in the real estate sector, making it safer for workers. Overall, AI offers opportunities to improve health and safety performance in construction and to enhance the industry's overall efficiency and productivity. However, despite the potential benefits of AI in construction health and safety, numerous challenges remain, such as the need for large amounts of data and the need for workers to be trained in the use of AI systems (Abioye et al., 2021).

The application of artificial intelligence (AI) in construction health and safety is very important. The construction industry is known for its poor safety and health, leading to accidents and fatalities. AI-driven techniques can effectively manage safety issues and reduce the number of accidents (Hire et al., 2022). Immersive technologies, including AI, have emerged as viable solutions for addressing occupational safety and health (OSH) performance in construction. These technologies have been applied to hazard identification, safety training, risk assessment, and safety design (Babalola et al., 2023). Technological innovations are crucial for ensuring OHS in the construction sector, which is prone to injury and death. Various technologies have been developed and applied in the construction industry to enhance OHS, contributing to the widespread use of such technologies (Yıldız & Yılmaz, 2022). AI techniques have the potential to address safety and productivity issues in construction, enabling the implementation of industrialised concepts and removing personnel from hazardous environments (Hatami et al., 2022). Automation in safety planning, including the application of AI, has been extensively studied, highlighting the need for further research and the challenges faced in integrating AI into construction safety planning (Chen & Chan, 2022). The implementation of AI in construction health and safety in Ghana faces several potential challenges and limitations. One major challenge is the lack of comprehensive national occupational health and safety (OHS) policies, which hinder the effective regulation and enforcement of health and safety standards (Kheni & Afatsawu, 2022).

Another challenge is the fragmented nature of the construction industry, resulting in difficulties with data acquisition and retention, which are essential for AI implementation (Boakye et al., 2022). Additionally, the construction industry in Ghana lacks adequate on-site resources, including logistics and well-defined frameworks for regulating health and safety standards (Regona et al., 2022). Furthermore, the manual nature of the construction environment and the unique characteristics of each project pose challenges for AI implementation, such as catering to one-off designs and sporadic demands for work (Boadu et al., 2021a). These challenges must be addressed to fully harness the potential of AI in

improving construction health and safety in Ghana. This study aimed to identify potential obstacles that prevent the implementation of AI in construction health and safety in Ghana. This study aims to explore the current technologies essential for health and safety in the Ghanaian construction industry, examine the characteristics of the construction industry in Ghana and their implications for health and safety, and investigate the potential to expand AI use in the Ghanaian construction industry.

1. STATE OF HEALTH AND SAFETY AND AI IN THE GHANAIAN CONSTRUCTION INDUSTRY

The current state of health and safety in the Ghanaian construction industry is characterised by a moderate level of utilisation of health and safety technologies, including wearable safety devices, geographic information systems, sensing technologies, virtual reality, and BIM (Agyekum et al., 2022). However, there are barriers to the adoption of these technologies, such as excessive costs, weak innovation culture, lack of continuous training, resistance to change, and lack of governmental support and regulations (Osei-Asibey et al., 2021; Mustapha, 2016). Accidents and hazards in the industry are caused by various factors, including a lack of safety and health policies, inadequate training, a shortage of safety specialists, and inadequate risk assessments (Boadu et al., 2021a). The enforcement of occupational health and safety standards also faces challenges, such as poor OHS enforcement and institutional constraints (Bang & Nemade, 2023). Additionally, the health and safety culture in the Ghanaian construction industry is at the first level, the pathological stage, with safety not considered a key business risk (Williams et al., 2019; Mustapha, 2016).

Research on artificial intelligence (AI) in construction health and safety in Ghana has revealed several key findings. One study found a lack of health and safety management at all levels of the construction chain, with poor culture and attitudes towards health and safety among construction workers, supervisors, and companies (Aasonaa, 2023). Another study emphasised the need to decolonise occupational safety and health (OSH) research and practice to improve safety culture in non-Western countries, such as Ghana (Sherratt & Aboagye-Nimo, 2022). Additionally, factors influencing safety performance in the construction industry were identified, with management support and commitment to safety performance being the most influential (Boakye et al., 2022). A study of small- and medium-sized enterprise (SME) contractors in Ghana identified safety culture indicators that can improve health and safety performance, providing a basis for a positive construction safety culture (Adzivor et al., 2022). Bamfo-Agyei (2017) focused on the safe use of tower cranes and highlighted the importance of competent personnel and adequate training in preventing accidents. Finally, health and safety considerations are given low priority in the procurement of public sector projects in Ghana, highlighting the need for improved health and safety (H&S) practices in procurement decisions (Boadu et al., 2021b).

Artificial intelligence (AI) techniques have the potential to address safety and productivity issues in the construction industry by removing personnel from hazardous environments and implementing industrialised concepts (Hatami et al.,

2022). However, the adoption of AI techniques in construction remains limited (Boadu & Wang et al., 2021). In Ghana, the enforcement of occupational health and safety (OHS) standards faces several challenges, including poor enforcement and institutional constraints (Phinias, 2023). Implementing leading indicators in the construction industry can provide benefits, such as accident prevention, compliance with regulations, and early warning systems; however, it also presents challenges, such as training and communication, time and cost, and worker involvement (Simpson & Sam, 2019). The perception of H&S management practices on construction sites in Ghana is generally positive, but the findings are limited to the study areas (Chen & Chan, 2022). Automation in safety planning in construction has been studied extensively, with a focus on permanent structures, the need for further research on temporary structures, and the application of artificial intelligence.

2. TECHNOLOGIES ESSENTIAL FOR HEALTH AND SAFETY IN THE GHANAIAN CONSTRUCTION INDUSTRY

Technologies essential for health and safety in the Ghanaian construction industry include wearable safety devices, geographic information systems, sensing technologies, virtual reality, and BIM (Agyekum et al., 2022). Construction professionals in Ghana moderately utilise these technologies (Osei-Asibey et al., 2021). However, there are barriers to the adoption of these technologies, such as excess costs related to acquiring new technologies, weak innovation culture, lack of continuous training in the workforce, resistance to change with the ageing workforce, and little or no governmental support and regulations (Nnaji & Karakhan, 2020). The adoption and implementation of innovative solutions, including technology, can improve construction safety performance (Williams et al., 2019).

The use of technology for safety and health management in construction has gained attention; however, there is still resistance to its continuous use (Dobrucali et al., 2023). The state of health and safety culture in the Ghanaian construction industry is at the first level, the pathological stage, indicating the need for improvement. Integrating technology into health and safety can enhance safety performance during construction (Mustapha, 2016). Zhou (2013) highlights various technologies, including ICT, sensor-based technology, 3S technology, RFID, and virtual reality, that have been adopted for construction safety management. Kheni (2008) focuses on health and safety practices in construction SMEs in Ghana, revealing a lack of proactive practices but identifying specific practices associated with firm characteristics. Boadu (2020) explored the characteristics of the construction industry in developing countries, including Ghana, and their implications for health and safety management.

3. METHODOLOGY

A comprehensive literature review was conducted to gather insights into the use of artificial intelligence (AI) techniques in the construction industry. Relevant

publications were sourced using keywords, such as 'AI', 'construction safety', 'productivity', and 'enforcement' across databases including Google Scholar, JSTOR, and Science Direct. A structured questionnaire was developed after the literature review (Sarantakos, 2005). The questionnaire survey was aimed to gauge the perception and understanding of AI applications in construction health and safety, the challenges in enforcing occupational health and safety (OHS) standards, and the potential to expand AI use in this context, specifically within the Ghanaian construction industry. A pilot study was conducted to test the validity and reliability of the questionnaire. The questionnaire consisted of close-ended questions and used a five-point Likert scale for respondents to express their level of agreement or disagreement with certain assertions related to the research area. The target population was 110, including a stratified sample of construction experts, project managers, site engineers, skilled workers, and safety officers working in Ghana using a survey research approach (Akomah et al., 2020). However, because the population was small, the entire population was used as the sample size in this study.

To ensure a high response rate, the questionnaire was distributed online and in person. Data was analysed using descriptive statistics and the Statistical Package for Social Sciences (SPSS). Frequencies and percentages were used to summarise the data, while inferential statistics, chi-square tests, and regression analysis were utilised to explore the relationships between variables. The insights derived from this analysis were then cross-verified with findings from the literature review to present a comprehensive understanding of the status and potential of AI applications in construction safety management in Ghana.

4. RESULTS AND DISCUSSION

This section discusses the results of the data obtained from the field study. It begins with demographic data and factors limiting the implementation of AI in construction health and safety in Ghana.

The demographic data of the respondents are as follows: gender, age groups, educational qualifications, years in the construction firm, and position in the construction project. The majority (66.4 %) of the respondents were males indicating the nature of work in the construction industry.

Figure 1 shows that the majority (23.6 %) of the respondents were between the ages of 26 and 30. This is followed by 19.1 % of the respondents in the age group between 31 and 35 and 16.4 % of the respondents in the age group of 20–55. The respondents with the least (3.6 %) were within the age group of less than 20.

Figure 2 shows that the majority (36.4 %) of the respondents had a bachelor's degree. This is followed by 27.3 % of the respondents who had a master's degree and 15.5 % of the respondents who had a higher national diploma. The respondents with the least (7.3 %) qualification had a senior high school certificate. The results inferred that all respondents in the study were adequately educated to understand and contribute relevant information to the study.

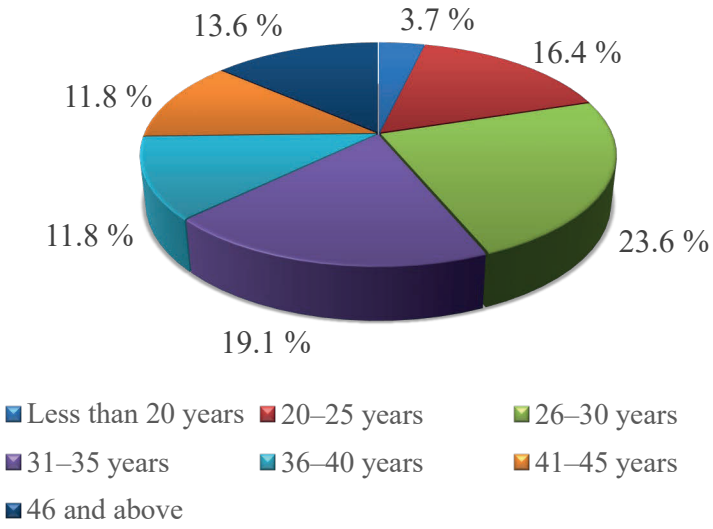

Fig. 1. Respondents' age groups.

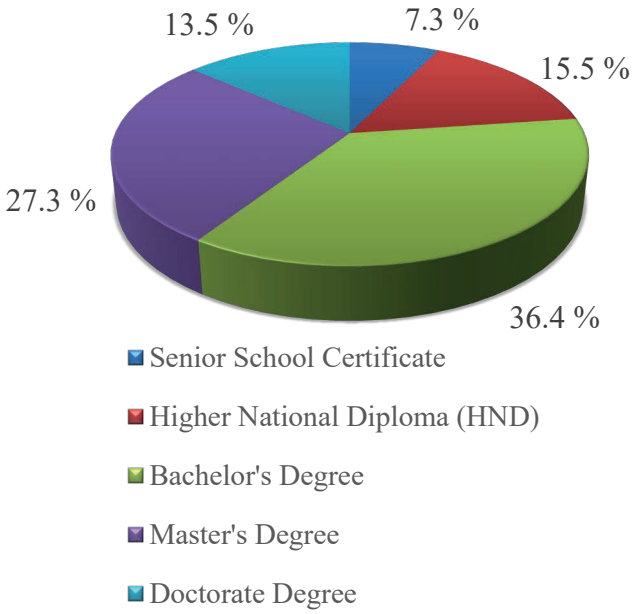

Fig. 2. Respondents' educational qualification.

Figure 3 shows that the majority (28.2 %) of the respondents had spent 2 to 5 years in their respective firms. This is followed by 19.1 % of the respondents who had stayed in their firms for 6 to 10 years and 13.6 % of the respondents who had spent 21 to 25 years in their respective firms. The least number of respondents (10 %) had stayed in their firm for 16–20 years. The results inferred that the majority of construction personnel in Ghana had spent about 6 to 10 years in their respective construction firm.

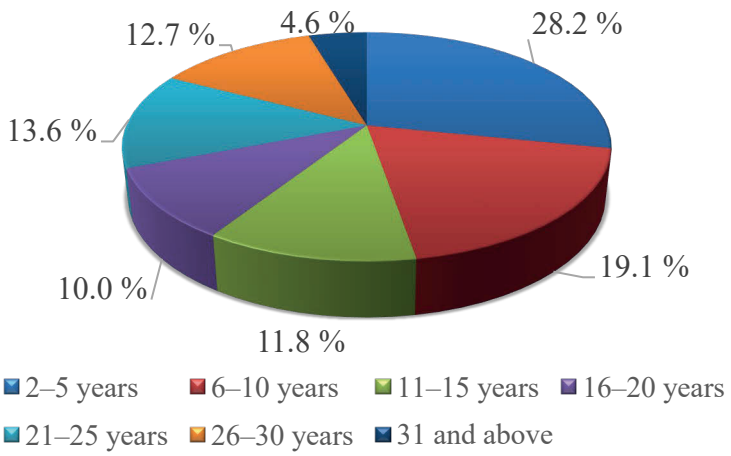

Fig. 3. Respondents' years of service in the firm.

Figure 4 shows that the majority (32.7 %) of the respondents were identified as safety officers in a construction project. This is followed by 26.4 % of the respondents who were identified as site engineers and 20.9 % of the respondents who were identified as skilled workers. The least number of respondents (20 %) were identified as project managers. The results inferred that the majority of respondents were safety officers in construction projects.

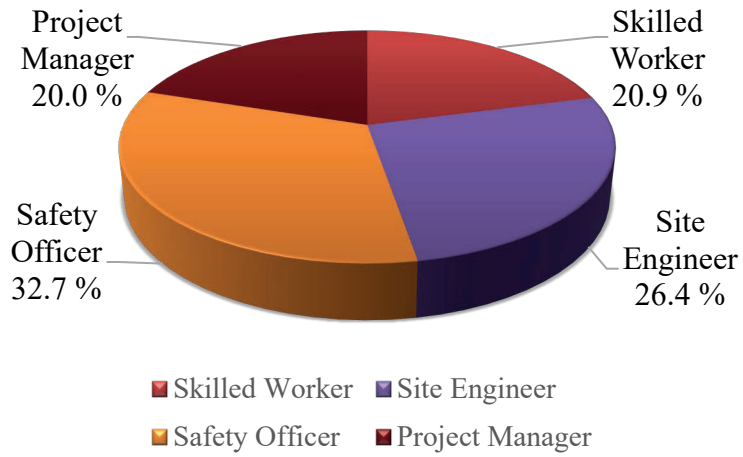

Fig. 4. Respondents' position in a project**.**

5. CURRENT TECHNOLOGIES ESSENTIAL FOR HEALTH AND SAFETY IN THE GHANAIAN CONSTRUCTION INDUSTRY

The influence was categorised into four categories, namely, CTE, CSHS, OHSC, and AI. The 5-point Likert scale was collapsed into a 3-point scale where strongly agree and agree were named agree, the neutral was maintained while disagreeing, and strongly disagreed were named disagree. The data from Table 1 reveals construction professionals' perspectives on essential technologies for health

and safety in Ghana. Overall, the findings showcase a strong appreciation for technological advancements, with all technologies receiving mean scores above 4 on a 5-point scale. Among the highest-rated technologies are wearable safety devices (4.72), 3S technology (4.76), and sensing technologies (4.66), indicating their perceived significance in preventing injuries and monitoring worker well-being. Virtual reality (VR) also scores high (4.68), highlighting its potential for training and safety simulations. Conversely, ICT comes in with a slightly lower score of 4.41, suggesting room for improvement in integrating information and communication technologies for safety purposes.

Finally, building information modeling (BIM) receives a respectable score of 4.55, demonstrating its growing traction in improving safety through enhanced project planning and risk identification. This nuanced data provides valuable insights into the Ghanaian construction industry's readiness to embrace technology for a safer work environment.

Table 1. Respondents' View on Current Technologies Essential

Descriptive Statistics					
Variables	***N***	**Sum**	**Mean**	**Std. deviation**	**Variance**
Wearable safety devices	110	519	4.72	0.527	0.278
Sensing technologies	110	513	4.66	0.494	0.244
Virtual reality (VR)	110	515	4.68	0.574	0.329
ICT	110	485	4.41	0.595	0.354
3S technology	110	524	4.76	0.541	0.292
Radio-frequency Identification (RFID)	110	512	4.65	0.532	0.283
Building information modelling (BIM)	110	501	4.55	0.517	0.268

6. URRENT STATE OF HEALTH AND SAFETY IN THE GHANAIAN CONSTRUCTION INDUSTRY

Table 2 paints a concerning picture of the current state of health and safety in the Ghanaian construction industry. Respondents identified weak innovation culture (mean = 4.45), lack of continuous training (mean = 4.51), and resistance to change (mean = 4.53) as major impediments to progress. These factors, with standard deviations hovering around 0.65, suggest a consistent level of concern across these areas. Further, incompetent personnel (mean = 4.57) and poor enforcement (mean = 4.43) add to the challenges, while the high mean for lack of comprehensive OHS policies (mean = 4.25) highlights a critical gap in regulatory frameworks. While concerns seem evenly distributed across several factors, some have higher deviations. Time and cost (mean = 4.43, *SD* = 0.81) indicate greater variability in viewpoints, suggesting this may be a point of contention or one where some perceive it as a significant hurdle while others do not. Similarly, worker involvement (mean = 4.56, *SD* = 0.72) reveals some variance in opinions on its

impact on overall health and safety. The findings underscore the multifaceted nature of challenges in Ghana's construction industry.

While focusing on innovation, training, and OHS policies is crucial, addressing individual factors like personnel competence and enforcement alongside concerns like cost and worker involvement will be vital in creating a safer and more efficient construction environment.

Table 2. Respondents Views on Current State of Health and Safety

Descriptive Statistics					
Variables	***N***	**Sum**	**Mean**	**Std. deviation**	**Variance**
Weak innovation culture	110	489	4.45	0.644	0.414
Excess costs related to acquiring new technologies	110	493	4.48	0.687	0.472
Lack of continuous training in the workforce	110	496	4.51	0.660	0.436
Resistance to change with the ageing workforce	110	498	4.53	0.660	0.435
Little or no governmental support and regulations	110	492	4.47	0.700	0.490
Lack of proactive practices	110	480	4.36	0.700	0.490
Incompetent personnel	110	503	4.57	0.598	0.357
Poor enforcement and institutional constraints	110	487	4.43	0.642	0.412
Time and cost	110	487	4.43	0.807	0.651
Worker involvement	110	502	4.56	0.723	0.523
Lack of comprehensive national occupational health and safety (OHS) policies	110	468	4.25	0.806	0.650
The fragmented nature	110	495	4.50	0.775	0.601
Manual nature of the construction environment	110	501	4.55	0.761	0.580
Valid *N* (listwise)	110				

Occupational Health and Safety Challenges (OHSC)

The data in Table 3 reveal a concerning picture of construction workers' occupational health and safety (OHS) challenges. Respondents identified a multitenancy with all variables exceeding a mean score of 4 on a 5-point scale, indicating significant concern. Lack of awareness of OHS standards emerged as the top challenge, with a mean of 4.56, followed closely by corruption (4.57) and weak OHS enforcement institutions (4.55). The data also highlights systemic issues like lack of political will (4.53) and weak legal systems (4.54) contributing to the pervasiveness of these challenges. While the mean scores suggest a general perception of significant challenges across the board, the standard deviations and variances provide further insights.

Variables like pressure to meet deadlines and budgets (*SD* = 0.614, *Var* = 0.377) and hazardous work conditions (*SD* = 0.586, *Var* = 0.344) exhibit lower variance, indicating a more consistent concern among respondents. Conversely, language barriers (*SD* = 0.736, *Var* = 0.542) and stigma associated with reporting injuries (*SD* = 0.665, *Var* = 0.442) show higher variance, suggesting these issues may be more prevalent in specific sub-groups within the construction workforce. The data underscores the need for comprehensive and multi-pronged interventions to address the diverse OHS challenges plaguing the construction industry. From raising awareness and strengthening enforcement to fostering a culture of safety and improving legal frameworks, concerted efforts are crucial to protect the health and well-being of construction workers.

Table 3. Respondents Views on Occupational Health and Safety Challenges

Descriptive Statistics					
Variables	***N***	**Sum**	**Mean**	**Std. deviation**	**Variance**
Lack of awareness of OHS standards	110	502	4.56	0.723	0.523
Lack of enforcement resources	110	485	4.41	0.654	0.427
Corruption	110	503	4.57	0.670	0.449
Lack of safety culture	110	480	4.36	0.687	0.472
Weak OHS enforcement institutions	110	501	4.55	0.698	0.488
Limited resources	110	490	4.45	0.712	0.507
Cost of compliance	110	492	4.47	0.726	0.527
Pressure to meet deadlines and budgets	110	502	4.56	0.614	0.377
Hazardous work conditions	110	494	4.49	0.586	0.344
Language barriers	110	488	4.44	0.736	0.542
Political interference	110	504	4.58	0.548	0.301
Discriminations	110	485	4.41	0.681	0.464
Lack of access to healthcare	110	495	4.50	0.632	0.399
Stigma associated with reporting injuries	110	507	4.61	0.665	0.442
Retaliation against workers who report hazards or injuries	110	491	4.46	0.774	0.600
Lack of transparency and accountability	110	487	4.43	0.656	0.430
Weak legal system	110	499	4.54	0.601	0.361
Lack of public awareness	110	504	4.58	0.548	0.301
Lack of political will	110	498	4.53	0.646	0.417

Climate change	110	496	4.51	0.674	0.454
Ineffective supervision	110	500	4.55	0.672	0.452
Inability to prosecute violators of health and safety standards	110	488	4.44	0.736	0.542
Poorly defined framework for regulating health and safety standards	110	490	4.45	0.712	0.507
Lack of government support	110	489	4.45	0.685	0.469
Resistance to change with an ageing workforce	110	491	4.46	0.725	0.526
Negligence and non-compliance with rules and regulations	110	505	4.59	0.595	0.354
Valid *N* (listwise)	110				

7. THE POTENTIAL TO EXPAND AI USE TO IMPROVE CONSTRUCTION HEALTH AND SAFETY IN GHANA

Respondents in the Ghanaian construction industry expressed a positive outlook on the potential for expanding AI use across various aspects of their work. The data from Table 4 shows that, on average, respondents rated the potential for AI to improve various areas with scores ranging from 4.28 (supplier management) to 4.66 (design and engineering), with a mean score of 4.47 across all areas. This indicates a general agreement that AI can benefit diverse construction activities significantly. Looking at specific areas, the highest mean scores were recorded for design and engineering (4.66), safety and security (4.55), and human resources (4.53).

These high scores suggest that respondents see great potential for AI in automating tasks, improving decision-making, and enhancing safety in these critical areas. Additionally, most areas' relatively low standard deviations (ranging from 0.57 to 0.83) indicate a consistent positive sentiment towards AI use. However, there are some areas where the potential for AI seems less clear. For example, areas like marketing and sales (4.29) and customer relationship management (CRM) (4.31) received lower mean scores, suggesting that respondents are less certain about the benefits of AI in these more human-centric areas.

Additionally, the high standard deviation for risk management (0.75) suggests some variation in opinion on how AI can effectively address this complex issue. Finally, the data gives a promising picture of AI integration's future in the Ghanaian construction industry. Respondents recognise the potential for AI to improve efficiency, safety, and decision-making across a wide range of tasks. While some areas offer greater clarity than others, the overall positive sentiment suggests a strong foundation for further exploration and development of AI solutions tailored to the specific needs of the Ghanaian construction sector.

Table 4. Respondents' Views on the Potential to Expand AI Use

Descriptive Statistics					
Variables	***N***	**Sum**	**Mean**	**Std. deviation**	**Variance**
Design and engineering	110	513	4.66	0.681	0.464
Construction planning and scheduling	110	481	4.37	0.662	0.438
Quality control and inspection	110	491	4.46	0.713	0.508
Safety and security	110	500	4.55	0.585	0.342
Project management	110	500	4.55	0.600	0.360
Cost estimation	110	488	4.44	0.628	0.395
Materials management	110	495	4.50	0.646	0.417
Equipment management	110	498	4.53	0.631	0.398
Risk management	110	490	4.45	0.750	0.562
Contract management	110	492	4.47	0.631	0.398
Supplier management	110	471	4.28	0.825	0.681
Customer relationship management (CRM)	110	474	4.31	0.787	0.619
Marketing and sales	110	472	4.29	0.828	0.685
Human resources	110	498	4.53	0.631	0.398
Training and development	110	502	4.56	0.614	0.377
Knowledge management	110	496	4.51	0.632	0.399
Collaboration	110	482	4.38	0.778	0.605
Sustainability	110	499	4.54	0.616	0.379
Productivity	110	489	4.45	0.685	0.469
Innovation	110	499	4.54	0.570	0.324
Skill shortage replacement	110	509	4.63	0.572	0.328
Reduce safety hazards	110	497	4.52	0.617	0.380
Quality control issues	110	490	4.45	0.659	0.434
Avoid cost overruns	110	444	4.04	1.049	1.100
Valid *N* (listwise)	110				

As per the analysis of the hypothesis, the researcher employed multiple linear regression and analysis at 95 % confidence intervals. The analysis showed a good model fit: F (3.106) = 68.87; $p < 001$; Adj $R^2 = 0.661$ and $R^2 = 0.661$. The analyses show that AI positively impacted current technologies essential for using construction health and safety within the Ghanaian construction industry ($\beta = 0.058$; $t = 0.708$; $p < 001$). Hence, Hypothesis 1 was accepted. Table 5 shows AI had a positive impact on the current state of health and safety challenges within the Ghanaian construction industry ($\beta = 0.021$; $t = 0.208$, $p < 001$), indicating that Hypothesis 2 was accepted. Also, applying AI technology to improve health and

safety procedures has much to offer the Ghanaian construction sector. The industry may take a more proactive and preventative stance by utilising real-time monitoring, predictive analytics, and immersive training experiences. Despite some obstacles, artificial intelligence (AI) can completely transform construction health and safety in Ghana, eventually improving worker wellbeing and fostering the industry's long-term success.

Table 5. ANOVA Analysis

ANOVA[a]						
Model		**Sum of squares**	**df**	**Mean square**	***F***	**Sig.**
1	Regression	13.636	3	4.545	68.872	0.000[b]
	Residual	6.996	106	0.066		
	Total	20.632	109			
[a] Dependent variable: AI						
[b] Predictors: (Constant), OHSC, CTE, CSHS						

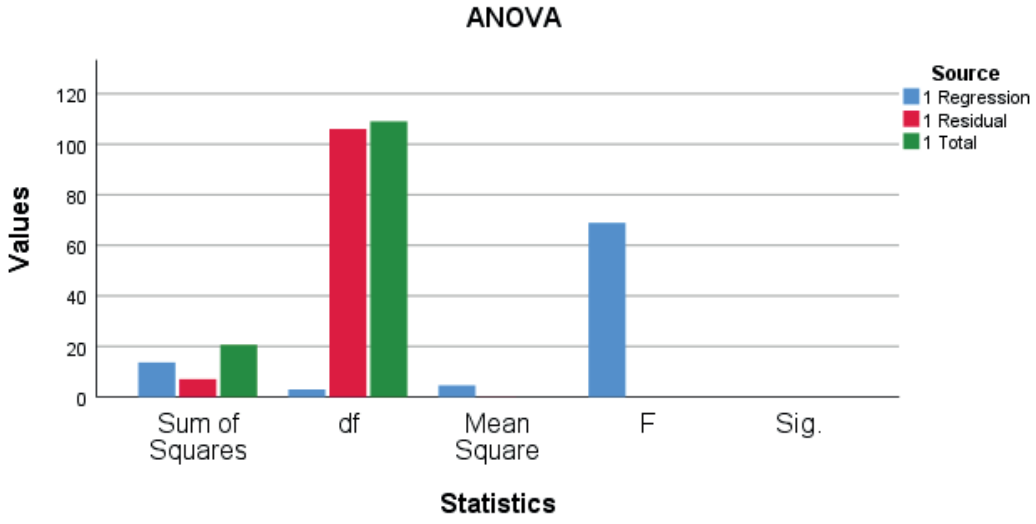

Fig. 5. ANOVA chart.

8. SUMMARY OF FINDINGS

This study investigates the potential of AI to improve health and safety in Ghana's construction industry. Construction experts, project managers, site engineers, skilled workers, and safety officers working in Ghana were the respondents (mostly male, aged 26–30, with bachelor's degree and 2–5 years of experience) who see strong potential for AI across various areas, with design and engineering, safety and security, and human resources receiving the highest scores (4.66, 4.55, and 4.53, respectively). However, marketing and sales and CRM scored lower (4.29 and 4.31), demonstrating some uncertainty about AI's benefits in human-centric areas. Technology-wise, wearable safety devices, 3S technology,

and sensing technologies were deemed most essential for health and safety (means above 4.7 on a 5-point scale).

Major challenges identified include weak innovation culture, lack of continuous training, resistance to change, and incompetent personnel. OHS challenges revealed a lack of awareness, corruption and weak enforcement of OHS policy as key concerns. These findings concur with the findings of Hire et al. (2022) and Babalola et al. (2023). Statistical analysis confirmed AI's positive impact on both essential technologies and current health and safety practices. Despite these challenges, the study finds a positive correlation between AI use and improved CHS. Linear regression analysis confirms the positive impact of AI on both essential technologies for CHS ($\beta = 0.058$; $t = 0.708$; $p < 001$) and the current state of CHS ($\beta = 0.021$; $t = 0.208$; $p < 001$). This suggests that AI can offer real-time monitoring, predictive analytics, and immersive training experiences, paving the way for a safer and more proactive construction environment in Ghana.

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that AI holds immense potential to transform construction health and safety in Ghana. Construction industry professionals (project managers, site engineers, skilled workers, and safety officers) working in Ghana recognised the benefits of AI in improving efficiency, decision-making, and safety across various tasks, particularly in design, engineering, and human resources. This finding contributes to the growing body of knowledge surrounding AI's applicability in construction safety, specifically within developing economies like Ghana.

Additionally, the study identifies key challenges hindering optimal health and safety practices, such as weak innovation culture, lack of training, and regulatory deficiencies. By addressing these roadblocks and leveraging AI's potential, the Ghanaian construction industry can take a proactive approach to prevent hazards, improve worker well-being, and foster a safer work environment.

This, in turn, will contribute to societal benefits by reducing human suffering, promoting workforce retention, and boosting the construction sector's overall productivity and competitiveness. Further research focused on developing culturally sensitive AI solutions tailored to the specific needs of Ghana's construction workforce will be crucial for maximising the positive impact of this technology and achieving a safer, more sustainable future for the industry.

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