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Impact of Safety Training and Communication on Construction Project Productivity: Case Study of Cape Coast

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Abstract

The building sector, in particular, has a high rate of accidents, which affects the productivity of workers and the success of projects. This study explores the impact of safety training and communication on construction site productivity in Cape Coast, Ghana. A quantitative research approach was used in this study. Data was collected through an online self-administered questionnaire with 77 respondents who work in the construction industry. Collected data was analysed using descriptive statistics. From the results, it is deduced that first aid and cardiopulmonary resuscitation (CPR) are critical components of safety courses. They significantly impact productivity because they reduce the incidence of workplace accidents and illnesses. Hierarchical barriers, lack of resources, and language differences were identified by respondents as challenges associated with the implementation of safety training and communication programs. The results of the study highlights as some of the significant impacts of safety training and communication. Construction companies need to increase safety knowledge and safety communication to increase productivity. To achieve these, such programmes should be funded and supported by top management.

Keywords: *Accidents; High productivity; Labour-intensive; Noncompliance*
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I. INTRODUCTION

The construction industry has formidable risks since the work conditions are often dangerous. It is among the most perilous industries worldwide [1]. The risk is not only due to the higher intensity of construction work but also the characteristics of the construction domain. As per the International Labour Organization (2020), the construction industry is considered to be highly dangerous, with a significant occurrence of dangers, accidents, and fatalities. The situation is even worse in developing countries. Most communication strategies that are deemed central to workplace safety are ineffective, leading to the failure of more than 50% of construction projects [2]. Health and safety information must not only be received, understood, and passed on but also adopted and implemented by workers [3]. However, in most construction projects, particularly in the developing world, this crucial communication is usually lacking or irregular. Other drivers include short project duration, limited financial resources, increasing production pressure, and negligent culture, all of which lead to poor implementation of safety practices and management or supervisory-worker communication [4]. According to [5], lack of safety training and communication breakdown are some of the leading factors in incidents and downtime in construction. Although it is apparent that proper training in safety and appropriate communication is a critical factor in safety management, these aspects still need to be prioritised in the construction industry, which is characterised by work intensity and shortages of capital. Safety training is commonly neglected, and when implemented, it is not supported by periodic interaction and management commitment. This is very important because [6] pointed out that there is a need for good safety practices accompanied by the right communication skills within construction when working to enhance the safety of employees as well as the success of the construction. Moreover, [7] argued that safety training, coupled with regular formal and informal communication with workers and management, are some of the factors that influence productivity in construction projects. Several scholars have discussed the integration between safety training and communication, indicating that such factors boost project productivity [8,9]. Although it is understood that the level of safety practices is directly related to

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the level of communication, literature needs to investigate issues pertinent to the construction industry in developing countries. [10] noted that despite the high demand for detailed safety training in these areas, studies concerning the implementation of those methods and their contribution to project success are scarce.

This study seeks to fill this gap by examining the effects of safety training and communication on the productivity of building projects in Cape Coast. This study examines the impact of safety training and communication interventions on construction productivity.

II. LITERATURE REVIEW

A. Influence of Safety Training and Communication on Construction Project Productivity

In the past decades, the construction industry has been recognised as having a central role in the development of a nation through the provision of employment and economic growth. However, this industry is accused of experiencing high risks; in fact, this industry is considered to be one of the riskiest [11]. Therefore, construction sector productivity is not only viewed as an aspect of a country's economic growth but also as an evaluation of a country's development and people's living standards [12,13]. While one may easily conclude that the construction industry is a necessity now, it remains a complex industry in various aspects, including safety, workmanship, and productivity. Thus, safety at the construction site is a significant factor influencing the safety and effectiveness of construction processes and projects.

Continued training and awareness are crucial for creating a safe working environment among construction crews and guaranteeing a response to any mishap. These training programmes are intended to convey information and provide proper communication to help review possible risks, hazards, and work processes [14]. It is evident that communication is a key factor in the achievement of safety objectives and organisational productivity, as feedback and suggestions are well facilitated.

B. Safety Training and Communication Programmes for Construction Projects

Safety training and communication are significant for improving the efficiency of construction projects [15]. Such programmes are required by legal frameworks. The U.S. Occupational Health and Safety Act (OSHA, 1971) focuses on raising the awareness of construction workers on preventive actions and measures to minimise incidents and risks at construction sites [14]. On the other hand, pandemic safety training focuses on hygiene practices, material safety, fire safety, and even cybersecurity, which is a relatively new issue in the construction industry due to the growing use of digital technologies [2].

Of all the training programs available, one can highlight Hazard Communication Training or HazCom, which is aimed at a consistent approach to labelling, identification, and handling of hazardous materials among the workforce, thus promoting standard and effective hazard communication [16]. Another crucial part relates to ergonomic training, where employees learn about safety and ways to prevent workplace injuries, particularly musculoskeletal disorders, and how to modify the workplace environment. There is the need for workers and employers to understand that a safety-compliant working environment increases human capital productivity (Utilities One Inc., 2024).

C. Impact of Safety Training and Communication on the Productivity of Construction Projects

The importance of practicing safety training and communication in construction cannot be overemphasised. Apart from decreasing the rate of incidents and fatalities in the workplace, these practices lead to healthier and more efficient employment [17]. Recurrent training encourages all workers, regardless of their years of experience, to be conversant with recommended safety measures, thereby reducing the possibility of mishaps and increasing efficiency [6]. It is considered an effective organisational socialisation process for newly hired employees. For experienced workers, it serves as a revision in safety practices, as suggested by [15]. According to [15], when workers are trained properly, they work better without injuries, thus improving productivity. In addition, misunderstandings or mistakes minimise in the presence of effective communication. Good communication reduces rework and delays [10]. Thus, construction teams can improve risk identification and adapt the communication approach much faster to achieve the goal of fast and efficient prevention of a wide range of disruptions [16]. Safety training benefits organisations by contributing to the development of safety culture among workforce. This helps in revising a culture that leads to safety and create awareness of on-site risks. A good organisational safety culture helps to avoid and reduce accidents [18]. Apart from inspiring higher morale, safety culture increases employees' confidence because it better prepares them to handle risk at the workplace [19]. It is imperative to expose employees to new technologies to improve their awareness on hazard identification and diminish accident occurrence to enhance productivity [20].

D. Challenges Facing the Implementation of Safety Training and Communication Programmes

Despite the acknowledgement of safety training and communication programs, there are some issues with the implementation process. An essential challenge is that employers are unaware of new training methods that considerably decrease work-related accidents and injuries [17]. In addition, the possibility of health and safety violations is high, especially if employees and management are not compliant with the set standards [19].

[21] also pointed out that language differences and diverse cultures are additional challenges to the conveyance of safety information. The best way to communicate safety information is to use simple graphical representations, translate the messages into various languages, and ensure that they come up with clear signs. The difficulty is the effective participation of employees in safety training. Conventional approaches may not attract employees or involve their active participation. To tackle this challenge, it is necessary to create a preventive, safety-oriented organizational culture. Employees should be engaged in safety committees, their opinions should be sought, and a reward

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system established to promote a safe work environment [22]. The construction sector requires a preventive approach to ensure safety and effective communication. To overcome these challenges, management and employees must foster a safety culture that everyone embraces.

III. METHODOLOGY

This study's participants included construction project workers. Data was collected using an online self-administered questionnaire survey targeting safety management training and communication activities. This questionnaire was developed using Google Forms because it is affordable. It offers researchers the opportunity to reach their target population within the shortest possible time. This is in accordance with [23]'s opinion that survey results are promptly obtained via online platforms. A sample size of 77 participants was used. The study of [24] formed the basis for the sample size selected. Central Limit Theorem (CLT) indicated that a sample size larger than 30 can be used as a representative sample of the normal distribution, thus validating the use of the sample size used in this study. However, to maximise the chances of reaching out to a diverse population and hence getting a fairly large sample size in line with [25]. The sample size was also checked through power analysis at 0.05 level of significance, 0.8 level of power and hypothesised effect size. This was done to ensure that 77 respondents would suffice the required statistical power to determine if there is any difference or even a trend in data that would be collected. Each question in the questionnaire was developed based on aim and objectives. To ensure the content validity of the study, the questionnaire was reviewed and pre-tested by seeking feedback from construction safety and project management practitioners. A pilot questionnaire was conducted on a group of respondents to test the reliability, validity, and adequacy of the questionnaires. From the results of the pilot study, it was necessary to make some modifications to the actual questionnaire and to adjust the number and types of questions to allow the collection of all the needed information.

Based on this assumption, a data collection procedure was designed to minimise the inherent sources of bias as much as possible. The subjects were selected based on their awareness and experience in safety risk management. To reduce response bias, the poll was anonymous, reducing the chances of biased answers being given in the survey. In an attempt to mitigate potential prejudices, such as restricted range and acquiescence tendencies, a 5-point Likert rating scale was adopted, where 1= strongly disagree, 2= disagree, 3= neutral/uncertain, 4= agree and 5= strongly agree. After the data was collected, they were systematically sorted, cleaned, and standardised to ensure uniformity in the analysis. The responses were analysed manually using Microsoft Excel and the Statistical Package for Social Sciences (SPSS) version 27 because they are easy to use and suitable for survey data analysis, as noted by [25]. The data was analysed using descriptive statistics, frequency, mean, relative importance index, and percentages. The equation for the RII used is $=(\sum W)/(N * M)$, where $\sum W$ = Sum of all weights assigned to each variable, N= Number of respondents to the survey and M= Maximum weight assigned (5).

The results were summarised in tabular form. Other potential variables that may affect the study's outcome were also considered. These included the various construction projects that participants have been involved in, the participant's proficiency level, the size of the construction projects, and the roles undertaken by participants. To minimise external bias when monitoring and evaluating the outcomes of the implemented safety training and communication plan, it was important to control for confounding factors.

IV. FINDINGS

Table 1 shows that the majority of the respondents were males 63 (81.8%). The dominant age group was 20-25 years, 25 (32.5%) of the study. A greater percentage of the respondents had bachelor's degree 27 (35.1%). This was followed by master's degree 19 (24.7%). On the other hand, those with PhD formed (7.8%) of the study. Safety officers accounted for (36.5%) of the respondents, project managers were 18 (23.4%), with the least being skilled labourers 5 (6.5%). About 60% of the respondents have 6-15 years of working experience. The results indicate that 37 (48.1%) have executed 6-10 number of projects, 40.2% have done less or six projects, and 11.7% (11-15) projects.

TABLE 1: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Gender	**Frequency**	**Percent (%)**
Male	63	81.8
Female	14	18.2
Age distribution		
20 – 25	25	32.5
26 – 30	21	27.3
31 – 35	24	31.1
Above 35	7	9.1
Highest Educational Qualification		
Diploma	10	12.9
Higher National Diploma	15	19.5
Bachelor's Degree	27	35.1
Master's Degree	19	24.7
PhD	6	7.8
Professions		
Project Manager	18	23.4
Safety Officer	28	36.5
Site Engineer	17	22.1
Contractor	9	11.8
Skilled worker	5	6.5
Years of experience		
0 – 5 years	24	31.2
6 -10 years	34	44.1
11 – 15 years	12	15.6
Over 15 years	7	9.1
Number of projects executed		
Less or six projects	31	40.2
6 -10 projects	37	48.1
11 – 15 projects	9	11.7
TOTAL	**77**	**100**

Table 2 presents the key safety training programs used in the Ghanaian construction sector to influence the performance and productivity of construction projects. The provision of first aid and CPR training was ranked first with RII (0.855). This indicates that most Ghanaian companies organise safety training programmes for their workers. Personal protective equipment (PPE) programmes was identified the second most significance training and communication programme with RII (0.829). Safety Incentive programmess, hazard communication programmes, and Incident reporting and investigating programmes, were ranked 3rd, 4th, and 5th, respectively, with RIIs (0.826, 0.821, and 0.800). Training on ergonomics receives little or no attention as it can be deduced from the results in Table 2.

TABLE 2: SAFETY TRAINING PROGRAMS THAT INFLUENCE THE PRODUCTIVITY OF CONSTRUCTION PROJECTS

Safety Training and Communication Programs	**Frequencies**					**RII**	**Rank**
	1	**2**	**3**	**4**	**5**		
First Aid and CPR Training	-	-	17	22	38	**0.855**	1st
Personal Protective Equipment (PPE) Programs	2	3	16	17	39	**0.829**	2nd
Safety Incentive Programs	-	5	18	16	38	**0.826**	3rd
Hazard Communication programs	-	4	19	19	35	**0.821**	4th
Incident Reporting and Investigation programs	1	3	19	26	28	**0.800**	5th
Cybersecurity Training	1	3	20	26	27	**0.795**	6th
Fire Safety Training	1	2	24	21	29	**0.795**	6th
Site Circulation Planning and programs	2	-	24	26	25	**0.787**	8th
Development of safety management plan	2	4	26	14	31	**0.777**	9th
Ergonomics Training	-	1	35	22	19	**0.753**	10th

As shown in Table 3, the key impact of implementing safety training and communication programs on the overall productivity of construction projects is to enhance risk management. This factor recorded a mean score of 4.221 and a standard deviation of 3.397. Next to this was the minimisation in workplace accidents and injuries, with mean score and standard deviation of 4.130 and 3.328, respectively. Impacts including increase in quality performance of construction projects was ranked 3rd with a mean score of 4.078 and a standard deviation of 3.672. Reduction in errors and reworks was ranked 4th having a mean score of 4.026. Following this was enhanced workplace communication which had a mean score of 4.013 and a standard deviation of 3.568. The least ranked impact according to the respondents was the adaptation to evolving work environments and technologies, recording a mean score of 3.766 and a standard deviation of 3.334.

TABLE 3: IMPACT OF SAFETY TRAINING AND COMMUNICATION ON THE PRODUCTIVITY OF CONSTRUCTION PROJECTS

Impact of safety training and communication	**Frequencies**					**Mean**	**SD**	**Rank**
	1	**2**	**3**	**4**	**5**			
Enhanced risk management	-	3	16	19	39	**4.221**	3.397	**1st**
Minimizing Workplace Accidents and Injuries	-	5	18	16	38	**4.130**	3.328	**2nd**
Quality performance of the construction project	2	1	18	24	32	**4.078**	3.672	**3rd**
Guaranteeing of Company's Success	1	2	19	26	29	**4.039**	3.622	**4th**
Aid the sustainability of the construction project	2	-	19	29	27	**4.026**	3.607	**5th**
Reduced errors and rework	1	4	16	27	29	**4.026**	3.618	**6th**
Enhanced Workplace Communication	-	-	24	28	25	**4.013**	3.568	**7th**
Cost Savings and Return on Investment	1	2	20	26	28	**4.013**	3.597	**8th**
Enhancing Employee Awareness and Knowledge	1	1	19	35	21	**3.961**	3.524	**9th**
Timely delivery of construction project	-	6	17	30	24	**3.935**	3.520	**10th**
Boost Productivity, Improve Employee Morale, & Enhance Workplace Communication	2	2	26	18	29	**3.909**	3.524	**11th**
Decreases in additional cost (compensation insurance) on projects	3	2	23	20	29	**3.909**	3.535	**12th**
Improving Employee Confidence and Morale	2	-	20	37	18	**3.896**	3.464	**13th**
Adapting to Evolving Work Environments and Technologies	-	1	35	22	19	**3.766**	3.334	**14th**

Table 4 below presents the challenges associated with implementation of safety training and communication programmes of construction projects. Notable among them is the hierarchical barriers with mean score and standard deviation of (4.169 and 3.728), respectively as captured in Table 4. Lack of resources with (mean = 4.104) was identified as the second most significant variable. Ranking in third place is language differences which scored a mean value of 4.026. The act reduced reporting as indicated in the table was ranked 4th with a mean score of 3.974. Ranking in 5th place as shown in the table was non-compliance penalties (mean= 3.974). it can also be seen that resistance to change as a challenge was deemed to

be less a influential as it had a mean value of 3.792 and a standard deviation of 3.381.

TABLE 4.: CHALLENGES ASSOCIATED WITH THE IMPLEMENTATION OF SAFETY TRAINING AND COMMUNICATION PROGRAMS OF CONSTRUCTION PROJECTS

Impact of safety training and communication	**Frequencies**					**Mean**	**SD**	**Rank**
	1	**2**	**3**	**4**	**5**			
Hierarchical Barriers	1	-	15	30	31	**4.169**	3.728	**1st**
Lack of Resources	-	-	19	31	27	**4.104**	3.650	**2nd**
Language Differences	-	6	18	21	32	**4.026**	3.625	**3rd**
Reduced Reporting	1	4	22	19	31	**3.974**	3.582	**4th**
Non-compliance Penalties	2	4	18	23	30	**3.974**	3.589	**5th**
Inadequate Emergency Response	-	3	27	19	28	**3.935**	3.524	**6th**
Lack of Clarity	1	4	25	17	30	**3.922**	3.535	**7th**
Information Overload	4	-	23	21	29	**3.922**	3.549	**8th**
Poor Safety Culture	4	2	20	21	30	**3.922**	3.560	**9th**
Knowledge Gap	3	5	20	18	31	**3.896**	3.542	**10th**
Poor Feedback Channels	5	1	24	14	33	**3.896**	3.557	**11th**
Inadequate Implementation	3	1	19	32	22	**3.896**	3.494	**12th**
Rapid Technological Change	1	5	22	29	20	**3.805**	3.400	**13th**
Resistance to Change	2	3	21	34	17	**3.792**	3.381	**14th**

A. Discussion of Findings

The demographic characteristics reveals that a significant proportion of the respondents were males aged 20-25. The majority of respondents were also bachelor's degree holders. A larger proportion of the subjects being males is a testament of the male dominated nature of the construction industry. The academic qualification of participants and years of experience indicate that they possess sufficient knowledge about the subject areas. The study unveils the provision of first aid and CPR Training as the most effective safety training programme. The results of this study support earlier research studies with regard to safety training and communication in improving efficiency in construction projects. [14], in their recent study, pointed out that safety training programmes are essential in enhancing the ability of construction workers to manage risks. The findings also confirm the importance respondents attach to the use of PPE, which is consistent with the view of [26] regarding the role of PPE in enhancing safety in the workplace. However, the implementation of ergonomic training in most firms receives insignificant attention as claimed by the [19], resulting in musculoskeletal diseases. More importantly, the principles of ergonomics in general minimizes the risks of fatigue and injuires, saves cost through reduced workers' compensation claims and medical expenses and improves work satisfaction overall. While ergonomic issues are given some level of attention in other jurisdictions, the opposite is the case in Ghana. This may be due to cultural differences and the structure of the construction industry in other settings and what is expected of organisations. This calls for further studies to understand the reason behind the low recognition of this subject area. Also, the issues identified in this work, such as hierarchical impediments and resource deficiencies, harmonise with [21] and [22] about the challenges of applying protective measures across sectors. Comparing the results of this study with extant literature, the findings of this current study are vindicated, with the exception of some areas that need improvement to align practices with international standards.

Although this study offers some important findings, it is pertinent to discuss the limitations of the research. Some possible limitations include self-reported data and the study employed a small sample size of 77 respondents, which limits its generalisability to the broader population. Consequently, the implementation of valuable and sound safety training programmes can also not be validated to have caused construction project success due to the cross-sectional structure of the study. It is necessary to consider these shortcomings. Despite attempts to prevent possible bias due to anonymisation and the questionnaire structure, some still occurred.

In addition, the study failed to include additional control factors that could have offered variation, including the size and magnitude of construction firms, the size and type of construction projects, and variations in types of safety training programmes. In the future, research should overcome these issues by recruiting larger samples and using more suitable study designs, such as better control of confounding factors to augment the validity of the obtained results.

The findings of this study have real-life applications in construction project management in Ghana. These results indicate that although the programmes of first aid, CPR, and PPE are already at the top of priorities for enhancing safety management, it is necessary to continue their promotion. It is suggested that construction firms should incorporate aspects of these safety programs into their business practices to improve organisational safety concerning risk management and the incidence of accidents in the workplace, as evidenced by this study. Furthermore, solving the conflict between hierarchical barriers and resource limitations in safety control calls for safety management feedback from other departments or subordinates. Since ergonomics plays a crucial role in the prevention of long-term injuries, it will be useful for construction companies and firms to integrate ergonomic assessment and training among their safety measures. As stated, this shift could lead to enhanced worker health and productivity, integration of the industry into international benchmarks, and an increase in the competitiveness of the Ghanaian construction industry.

This study, therefore, adds to the knowledge base of construction safety management by analysing Ghanaian construction sector safety training and communication practices. Thus, by focusing on the general and specific effectiveness of the particular safety programmes and the difficulties of their usage, the research contributes to the

construction safety knowledge from the regional perspective. Moreover, recommendations given in the findings that may enhance safety performance can be used as a guideline for improving construction safety for both local and international organisations. The research also contributes knowledge on how safety training is related to the level of output, especially given limited resources. Thus, positioning the identified research findings in the context of risk management and organisational behaviour theories, this work provides a comprehensive view of the relationships between safety training, communication, and productivity in construction projects. Although this contribution is universally applicable, it is crucial for researchers and practitioners who want to enhance safety management in similar settings.

V. Conclusion and Recommendations

The impact of safety training and communication on construction project performance in Cape Coast, Ghana, was the focus of this study. As seen in the study, the construction industry has high impact for economic growth. Still, it has shown various safety issues that have a great influence on productivity. This paper left evidence that practices like first aid and CPR training and others, including the use of personal protective equipment (PPE), are indispensable in boosting safety and, therefore, effectiveness in the construction area. In addition, safety training, especially when accompanied by comprehensive communication, enhances risk control and minimises costly accidents on construction sites. These facts are essential for improving the productivity of construction projects ultimately leading to successful construction projects delivery. However, there are organisational barriers in the implementation process in the form of hierarchies and resource constraints. These challenges call for additional participative safety management systems in which top management and site operatives actively and effectively undertake safety training and communication. In order to eliminate these problems, construction companies in Cape Coast, and by extension those in Ghana, should beef up their safety training programmes. Safety training should not be limited to site operatives but should extend to the safety officers and even management to ensure they all embrace safety culture. Moreover, superordinate and structural barriers and the lack of resources need to be addressed by involving all levels of organisations in the decision-making process. Strengthening the emphasis on occupational safety and health education, especially in areas like ergonomics, could provide an excellent opportunity to address some of the threats to worker well-being and efficiency. In conclusion, safety compliance through cultural change, together with support from resources and communications, will play a major role towards enhancing the productivity and competitiveness of the Ghanaian construction industry.

References

[1] Y. Rosenfeld, O. Rozenfeld, R. Sacks, and H. Baum, "Efficient and timely use of safety resources in construction," *Proc. CIB W99 2006 Int. Conf. Global Unity for Safety and Health in Construction*, Beijing, China, pp. 290–297, Jun. 2006.

[2] A. Kasimu and M. Usman, "Delay in Nigerian construction industry," *J. Environ. Sci. Resour. Manag.*, vol. 5, no. 2, pp. 120–129, 2023.

[3] A. M. Vecchio-Sadus, "Enhancing safety culture through effective communication," *Safety Sci. Monitor*, vol. 11, no. 3, pp. 1–10, 2017.

[4] M. Loosemore and N. Malouf, "Safety training and positive safety attitude formation in the Australian construction industry," *Safety Sci.*, vol. 113, pp. 233–243, 2019.

[5] T. M. Toole and M. Asce, "Construction site safety roles," *J. Constr. Eng. Manag.*, vol. 128, pp. 203–210, 2022.

[6] A. Oluwatumininu, C. A., and W. Thwala, "An effective strategy for safety management and enhanced productivity in construction industry," in *AHFE 2021, LNNS 267*, J. I. Kantola et al., Eds. Springer Nature Switzerland, 2021, pp. 86–91. doi: 10.1007/978-3-030-80876-1_13.

[7] H. Lingard, "Occupational health and safety in the construction industry," *Constr. Manag. Econ.*, vol. 31, no. 6, pp. 505–514, 2013.

[8] T. Aksorn and B. H. W. Hadikusumo, "Measuring effectiveness of safety programmes in the Thai construction industry," *Constr. Manag. Econ.*, vol. 26, pp. 37–41, 2018.

[9] A. Cohen and M. J. Colligan, *Assessing Occupational Safety and Health Training*, Cincinnati, Ohio: National Institute for Occupational Safety and Health, 2018, pp. 98–145.

[10] J. Takala, "Life and health are fundamental rights for workers," *Labour Education*, no. 126, pp. 1–4, 2017.

[11] G. Carter and S. Smith, "IT tool for construction site safety management," in *CIB W78 Conf.*, Mpulunga, South Africa, 2021.

[12] C. E. Eze, W. N. Nwaki, and B. I. Obonadhuze, "Construction tradespeople perception of the factors motivating labor productivity on construction projects," *J. Technol. Manag. Bus.*, vol. 7, no. 2, pp. 50–68, 2020.

[13] F. Afuye, "Motivation and its impact on workers' productivity in construction firms in Lagos, Nigeria," Ph.D. dissertation, Kenyatta University, Kenya, 2016.

[14] D. J. Edwards and J. Nicholas, "The state of health and safety in the UK construction industry with a focus on plant operators," *Struct. Surv.*, vol. 20, no. 2, pp. 78–87, 2022.

[15] S. Cheung, H. C. H. Sueng, and K. K. W. Cheung, "PPMS: A web-based construction project performance monitoring system," *Autom. Constr.*, vol. 13, no. 3, pp. 361–376, 2017.

[16] RPF Environmental Testing and Consulting Services, "Importance of safety training in construction: How health and safety training can benefit the construction industry," 2023. [Online]. Available: https://www.airpf.com. [Accessed: Jan. 23, 2024].

[17] B. A. Muhammad, I. Abdulateef, and B. D. Ladi, "Assessment of cost impact in health and safety on construction projects," *Am. J. Eng. Res.*, vol. 4, no. 3, pp. 25–30, 2018.

[18] M. Torner and A. Pousette, "Safety in construction – A comprehensive description of the characteristics of high safety standards in construction work, from the combined perspective of supervisors and experienced workers," *J. Safety Res.*, vol. 40, no. 6, pp. 399–409, 2019.

[19] Occupational Safety Group Inc., "Common challenges to building a strong safety culture and how to overcome them," 2023. [Online]. Available: https://www.osg.ca. [Accessed: Jan. 3, 2024].

[20] Utilities One Inc., "The impact of communication on construction project planning and scheduling," 2024. [Online]. Available: https://utilitiesone.com. [Accessed: Jan. 25, 2024].

[21] Y. Feng, S. Zhang, and P. Wu, "Factors influencing workplace accident costs of building projects," *Saf. Sci.*, vol. 72, pp. 97–104, 2018.

[22] D. Cleverdon, "Challenges in safety training," 2023. [Online]. Available: www.LinkedIn.com/pulse. [Accessed: Dec. 16, 2023].

[23] Y. S. Salvador, "Safety management in construction projects," *J. Duhok Univ.*, pp. 546–560, 2018.

[24] B. Attabra-Yartey, "Assessing the impact of occupational health and safety needs on the lives of construction workers: A case study at Abasa General Enterprise Limited-Kumasi," M.S. thesis, Abasa General Enterprise Ltd., Kumasi, Ghana, 2022.

[25] E. P. C. Chang, J. C Chrisman, J. H. Chua, and F. W. Kellermanns, "Regional Economy as a Determinant of the Prevalence of Family Firms in the United States: A Preliminary Report," *Entrepreneurship Theory and Practice*, *vol. 32, no. 3*, pp. 559-573, 2008.

[26] A. O. Adu-Boateng, "Determinants for the adoption of climate change policies for urban Africa: A study of urban local governments in Ghana," Ph.D. dissertation, Oxford Brookes Univ., U.K., 2020.