INFLUENCE OF SAFETY CLIMATE ON SAFETY BEHAVIOUR: EVIDENCE FROM CONSTRUCTION INDUSTRY OF A DEVELOPING COUNTRY

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Occupational Health and Safety (H&S) problems remain prevalent in the construction industry in most developing countries, despite considerable efforts to ensure safer operations. Research posits that both human and climatic factors contribute to accidents on construction sites. The human factors which are seen in unsafe practices account for a greater percentage of occupational H&S incidents. This study therefore sought to empirically examine how safety climate factors influence worker behaviour on construction projects in Kumasi, Ghana. Using a quantitative research design, purposive sampling was employed to select construction companies, with 210 valid responses collected from 250 distributed questionnaires. Data analysis involved descriptive statistics, mean score ranking, and partial least square-structural equation modelling. Findings revealed a significant positive relationship between safety climate and safety behaviour in the construction sector. The research provides valuable guidance for H&S professionals and construction managers, including enhancing H&S programs for workers, implementing effective H&S management systems, and addressing worker H&S concerns promptly. This study provides insights into improving H&S performance in construction industry of developing countries.

Keywords: safety climate; safety behaviour; partial least squares; structural equation modelling, construction industry

INTRODUCTION

The construction industry is not only identified as a significant contributor to a nation's GDP but also a major contributor to occupational H&S challenges due to its activities (Oni *et al.,* 2023). Workers face serious injuries, which can lead to hospitalisation, loss of work time, disability, and even death (Ahmad *et al.,* 2016). Improving H&S on construction sites is crucial as accidents not only result in pain and discomfort but also affect productivity, quality, time, and the environment, ultimately increasing project costs (Osei-Asibey *et al.,* 2023). Construction site accidents are mainly caused by careless or unsafe behaviour (Adinyira *et al.,* 2020). According to the World Bank's GNI categorisation system, a developing country is one that is classified as low-income or lower-middle-income based on its gross national income

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(GNI) per capita. This classification reflects a country's level of economic development and is revised annually. A construction industry of a developing country is one that struggles with inefficiencies and systemic challenges that hinder its growth and performance. It is characterised by bureaucratic impediments in project planning and management, ineffective enforcement of existing regulations and outdated statutes and codes, leading to cost overruns, delays, and low-quality construction (Rwelamila and Ogunlana, 2015). The work safety climate of an organisation is explained by some writers as the views people have regarding how important H&S is as compared to other work ethics like work speed (Griffin and Curcuruto *et al.,* 2016; Zohar, 2014). Lestari *et al. (*2020) added that work climate states the rules and best H&S practices needed to achieve safety on the construction site. Encouraging and emphasising the importance of managing H&S in the workplace is one way to turn systems and procedures into reality. However, little attention has been given to the importance of climate safety in ensuring best H&S practices by workers on the construction site. This research seeks to build an in-depth knowledge of the influence of safety climate on safety behaviour in construction industry of a developing country. This paper explores the relationship between safety climate and safety behaviour in the construction industry. It aims to uncover insights into how safety climate influences worker behaviour and provide practical implications for improving H&S outcomes on construction sites. Through empirical research and analysis, factors contributing to safety climate and their impact on safety behaviour will be examined, offering valuable insights for industry stakeholders.

Safety Climate

Safety Climate (SC) is a framework that guides workers on adopting proper safety behaviour in the workplace (Griffin and Curcuruto *et al.,* 2016). According to Arzahan *et al. (*2022) safety climate is different from safety culture, which is an organisation's core belief. This is because safety climate is seen as the knowledge and the understanding workers have in H&S within a specific time frame. Restuputri *et al. (*2021) argue that, to ensure an effective H&S, more attention must be paid to various mechanisms that will help improve a positive safety culture. The safety climate will be the tool that will be used to measure whether there has been an improvement in the safety culture or not. This is to say that, the safety climate is used to assess the state of safety culture in an organisation. Research has been conducted on SC in various industries, including construction, manufacturing, road administration, airport ground handling, and wood processing (Griffin and Curcuruto *et al.,* 2016; Oah and Moon, 2018; Keffane, 2020; Cabrera *et al.,* 2020; Novie and Ahmad, 2018). Studies conducted by Jiang *et al. (*2019) revealed that SC factors have no universal set that is to be strictly followed although some of the factors by different scholars appear to be similar. Therefore, the factors that affect SC within one industry may not be valid in another, which suggests that no common set of SC factors exist (Jiang *et al.,* 2019). The SC which was considered for the study was adopted from Flin *et al. (*2000), Mohamed (2002), Fang *et al. (*2006) and Choudhry *et al. (*2009). Research has shown a positive relationship between safety climate and occupational H&S performance, with negative attitudes directly linked to accident rates (Kalteh *et al.,* 2019).

Safety Behaviour

In recent times, safety behaviour (SB) has been conceptualised to include the specific behaviour performance of workers on site. The performance has been categorised into contextual and task performance, which serve as the bases for differentiating safety

behaviour at the workplace (Meyer *et al.,* 2019). Task performance involves adhering to H&S rules like wearing protective gear, directly contributing to H&S, whilst contextual performance, involves activities that enhance H&S, such as attending H&S meetings or volunteering to take part in H&S activities. These activities contribute to a safer environment. The concept of SB has been adopted in various studies, such as those by Zid *et al. (*2018) and Osman *et al. (*2019). Safety behaviour is the best practices that workers should adopt to ensure occupational H&S and avoid workplace accidents. Many H&S practitioners believe that worker behaviour is a major contributor to accidents, with H.W. Heinrich's dominos theory suggesting that 80% of all accidents stem from unsafe actions (Busch, 2021). Studies have found a positive correlation between risk-taking behaviour and H&S outcomes, and a meta-analytic path model for workplace H&S focusing on personal and situational factors has established a causal link between safe behaviour and H&S outcomes (Lyu *et al.,* 2018; Panuwatwanich, 2017).

Conceptual Framework and Hypotheses

Figure 1 shows the conceptual framework and hypotheses developed for the study through relevant literature from safety climate factors and safety behaviour.

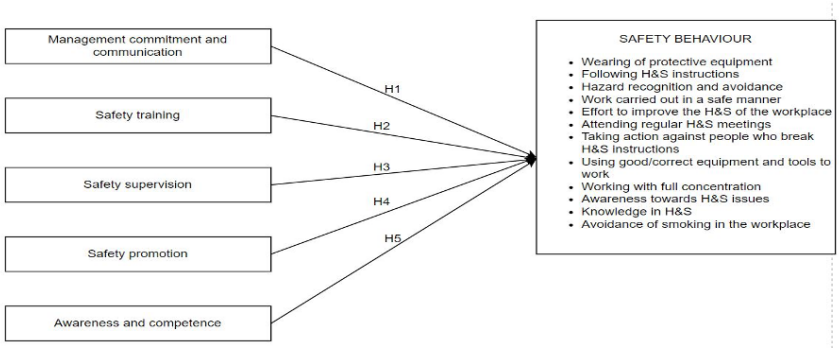

Figure 1: Conceptual framework of safety climate factors on safety behaviour

Hypotheses

H1: 'Management commitment and communication' positively influences safety behaviour.

H2: 'Safety training' positively influences safety behaviour.

H3: 'Safety supervision' positively influences safety behaviour

H4: 'Safety promotion' positively influences safety behaviour.

H5: 'Awareness and competence' positively influences safety behaviour.

To this end, five safety climate factors were identified after reviewing several models. The factors have various indicators that form each construct of the safety climate factor. The safety behaviour also identified is geared towards the best H&S practices that need to be employed by workers to ensure H&S on site. Therefore, various indicators also inform the safety behaviour construct. Table 1 details the definition of the various indicators under the constructs of the latent variables.

Table 1: Definition of safety climate factors and safety behaviour

Factors	Variables	References
Safety climate factors	**Exogenous variables**	
Management commitment and communication (MCC)	1. Management acts quickly to correct H&S problems 2. Management and supervisors listen and discuss H&S issues 3. Management encourages feedback and H&S participation from site workers on safety issues 4. Management offers enough H&S information 5. Management believes H&S is of the same importance as production	
Safety Training (ST)	1. Training in PPE usage 2. Regular and useful H&S training	
Safety Supervision (SS)	1. Production level should be frequently checked by supervisors 2. Workers attention should be drawn to the production level 3. No- smoking rules in the workplace should be strictly enforced by supervisors 4. Supervisors should make emphasis on H&S in each day of work 5. Supervisors should make sure that workers wear PPE	Cabrera et al., 2020; Oah and Moon, 2018; Griffin and Curcuruto et al., 2016; Choudhry et al., 2009; Fang et al., 2006; Flin et al., 2000; Mohamed 2002
Safety Promotion (SP)	1. H&S bulletin boards 2. H&S signs and posters 3. Recognition and reward for good H&S performance by individuals	
Awareness and Competence (AC)	1. Workers are clear about responsibilities for workplace H&S 2. Workers understand the H&S rules in my job 3. Workers deal with H&S problems in my workplace 4. Workers comply with the H&S rules all the time	
Safety Behaviour	**Endogenous variables**	
	1. Wearing of protective equipment 2. Following H&S instructions 3. Hazard recognition and avoidance 4. Work carried out in a safe manner 5. Effort to improve the H&S of the workplace 6. Attending regular H&S meetings 7. Taking action against people who break H&S instructions 9. Using good/correct equipment and tools to work 10. Working with full concentration 11. Awareness towards H&S issues 12. Knowledge in H&S	Meyer et al., 2019; Zid et al., 2018; Osman et al. 2019; Lyu et al., 2018; Panuwatwanich, 2017

METHOD

Questionnaire Survey

For this study, a quantitative approach comprising both desktop and field studies, as outlined by Adinyira *et al. (*2020), was adopted to confirm and test the research hypotheses. The questions were structured into four sections starting from sections A, B, C, and D. Section A collected demographic information to analyse its potential impact on experience and expertise ratings. Section B asked respondents to rank safety climate variables on construction sites on a Likert scale of 1=Insignificant; 2=Less significant; 3=Moderately significant; 4= Significant; 5=Very Significant, while Section C assessed inappropriate behaviour frequency on a Likert scale 1=Not frequent; 2=Less frequent; 3=Moderately frequent; 4= Frequently; 5=Very frequently. Finally, Section D explored the influence of safety climate on safety behaviour on a Likert scale 1=Very low; 2=Low; 3=Medium; 4=High; 5=Very high. Pilot questionnaires were distributed to industry professionals and academics for feedback on clarity, ambiguity, and completion time, ensuring relevance and suitability for the study. The researcher administered the questionnaires in person to building contractors and their operatives over a period of two weeks.

Participants

Key respondents were class D1 construction contractors and their operatives in Kumasi, identified using purposive sampling, a non-probability sample method. A Class D1 construction contractor in Ghana is the highest-grade contractor certified to undertake general building works of any size or value. The study's sampling size was based on two criteria: Construction sites visited should have H&S policies and be working, and operatives selected to answer the questionnaire should have completed

several projects and gained enough experience. A total of 250 questionnaires were distributed.

Data Analysis

The data collected was sorted and coded and subjected to analysis using descriptive statistics, mean ranking and partial least square (structural equation modelling). Mean scores and standard deviations were obtained to determine the significant safety climate factors and the frequently occurring unsafe behaviours on the sites visited. This was shown via frequency tables. The relationship between safety climate and unsafe behaviour was examined using Partial Least Squares (PLS) - Structural Equation Modelling (SEM).

RESULTS

A total of 250 questionnaires were administered, out of which 210 were retrieved. Thus, a response rate of 87.5% was achieved from all the 12 construction sites employed for the study. As shown in Table 2, 90.5% of the respondents were males while 9.5% represented females with most of the respondents falling between the ages of 18 to 40 years.

Table 2: Respondents characteristics

Information Background	Characteristics	Frequency	Percentage (%)
Gender	Male	190	90.5
	Female	20	9.5
Age (years)	18-30	105	50.0
	31-40	63	30.0
	41-49	29	13.8
	50 years and above	13	6.20
Role of respondents in their firms	Construction manager	7	3.3
	Construction supervisors	24	11.4
	Operator	9	4.3
	Safety officer	10	4.8
	Carpenters	29	13.8
	Electricians	20	9.5
	Tiller	18	8.6
	Steel fixers	12	5.7
	Masons	33	15.7
	Labourers	48	22.9
Working experience (years)	1-4	20	9.5
	5-10	108	51.4
	11-15	52	24.8
	16 and above	30	14.3
Educational background	MPhil/MSc	20	9.5
	BSc	42	20.0
	High National Diploma	52	24.8
	Technician (CTC1,2,3)/ SHS/JHS	96	45.7

Safety Climate Factors in the Construction Industry

The study analysed safety climate factors in the construction industry. The top three significant factors, as presented in Table 3, were 'management believes H&S is of the same importance as production', 'regular and useful H&S training', and 'H&S signs and posters'. However, 'workers are clear about responsibilities for workplace H&S', 'No-smoking rules in the workplace should be strictly enforced by the supervisors', and 'workers deal with H&S problems in my workplace' were considered insignificant. The study highlights the importance of addressing safety climate factors in the construction industry.

Table 3: Safety climate factors

Safety climate factors	Mean	Standard deviation	Ranking
Management Commitment and Communication (MCC)	**3.19**	**1.302**	
1. Management acts quickly to correct H&S problems	3.60	1.090	**5th**
2. Management and supervisors listen and discuss H&S issues	2.43	1.570	**14th**
3.Management encourages feedback and H&S participation from site workers on H&S issues	2.40	1.461	**15th**
4. Management offers enough H&S information	3.06	1.278	**10th**
5. Management believes H&S is of the same importance as production	4.44	1.111	**1st**
Safety Training (ST)	**3.86**	**1.255**	
1. Training in PPE usage	3.67	1.254	**4th**
2. Regular and useful H&S training	4.05	1.256	**2nd**
Safety Supervision (SS)	**2.76**	**1.221**	
1. Production level should be frequently checked by supervisors	2.31	1.468	**16th**
2. Workers attention should be drawn to the production level	2.25	1.371	**18th**
3. No- smoking rules in the workplace should be strictly enforced by supervisors	3.27	1.071	**8th**
4. Supervisors should make emphasis on H&S in each day of work	2.66	1.083	**13th**
5. Supervisors should make sure that workers wear PPE	3.29	1.114	**7th**
Safety Promotion (SP)	**3.45**	**1.126**	
1. H&S bulletin boards	3.17	0.996	**9th**
2. H&S signs and posters	3.72	1.352	**3rd**
3. Recognition and reward for good H&S performance by individuals	3.46	1.031	**6th**
Awareness and Competence (AC)	**2.52**	**1.274**	
1. Workers are clear about responsibilities for workplace H&S	2.04	1.332	**19th**
2. Workers understand the H&S rules in my job	3.02	1.119	**11th**
3. Workers deal with H&S problems in my workplace	2.26	1.346	**17th**
4. Workers comply with the H&S rules all the time	3.00	1.298	**12th**

Unsafe Behaviour Occurring on Construction Projects

The study examined common unsafe behaviours on construction projects in Ghana; results in Table 4 revealed that 'disregarding the wear of PPE (Personal Protective Equipment)', 'Not paying much attention to the instruction on manuals before using new machines', and 'Placing materials and objects in dangerous positions and locations' were the most frequently observed unsafe behaviours. Conversely, 'Smoking at the workplace', and ' Doing work under the influence of drug or alcohol' were reported as infrequent occurrences. This underscores the necessity of addressing H&S practices in the construction sector.

Table 4: Level of occurrence of unsafe behaviours

Unsafe Behaviours (variables)	Mean	Standard deviation	Ranking
1. Disregarding the wear of PPE (Personal Protective Equipment)	4.40	1.317	**1st**
2. Not paying much attention to the instruction on manuals before using new machines	4.35	1.161	**2nd**
3. Placing materials and objects in dangerous positions and locations	4.21	1.051	**3rd**
4. Using faulty tools and equipment to work	3.87	1.107	**4th**
5. Not switching of power source and not reporting to supervisors when machines become abnormal during work	3.59	1.096	**5th**
6. Leaving the work benches dirty after work	3.45	0.988	**6th**
7. Removing H&S guards from the workplace or equipment	3.43	1.066	**7th**
8. Working with lack of concentration	3.30	0.960	**8th**
9. Failing to caution members or failing to rescue workers out of danger	3.06	1.098	**9th**
10. Working above the expected speed limit	3.03	1.030	**10th**
11. Doing work under the influence of drug or alcohol	2.24	0.924	**11th**
12. Smoking at workplace	2.08	0.901	**12th**

Composite Reliability and Convergent Validity

Internal consistency reliability was assessed using composite reliability and Cronbach's alpha, yielding satisfactory values as shown in Table 5 for both measures

(composite reliability ranging from 0.750 to 0.980 and Cronbach's alpha ranging from 0.744 to 0.976). Convergent validity was confirmed with all constructs exhibiting average variance extracted (AVE) values above 0.5, indicating a robust relationship between the latent variables and their indicators.

Table 5: Composite reliability and convergent validity

Constructs	Cronbach's Alpha	Composite Reliability	AVE
Management commitment and communication	0.943	0.949	0.898
Safety Training	0.744	0.750	0.795
Safety supervision	0.773	0.775	0.815
Awareness and Competence	0.976	0.980	0.977
Safety promotion	0.778	0.785	0.698
Safety behaviour	0.973	0.974	0.776

T Statistics and P Values

Table 6 presents path model relationships with t-values using a two-tail distribution and an alpha value of 0.05. Only four constructs—Management commitment and communication, Safety training, Safety supervision, and Safety promotion—showed significant relationships with Safety behaviour, surpassing the critical t-score of 1.96 for df = 98, while Awareness and competence did not reach significance.

Table 6: T statistics and P values

Relation	Original sample	Sample mean	Standard deviation	T statistics	P values
Management commitment and communication > Safety behaviour	0.195	0191	0.099	1.974	0.049
Safety training > Safety behaviour	0.186	0.170	0.148	1.254	0.021
Safety supervision > Safety behaviour	0.450	0.484	0.178	2.534	0.012
Awareness and competence > behaviour	-0.115	-0.128	0.113	1.024	0.306
Safety promotion > Safety behaviour	0.341	0.331	0.141	2.426	0.016

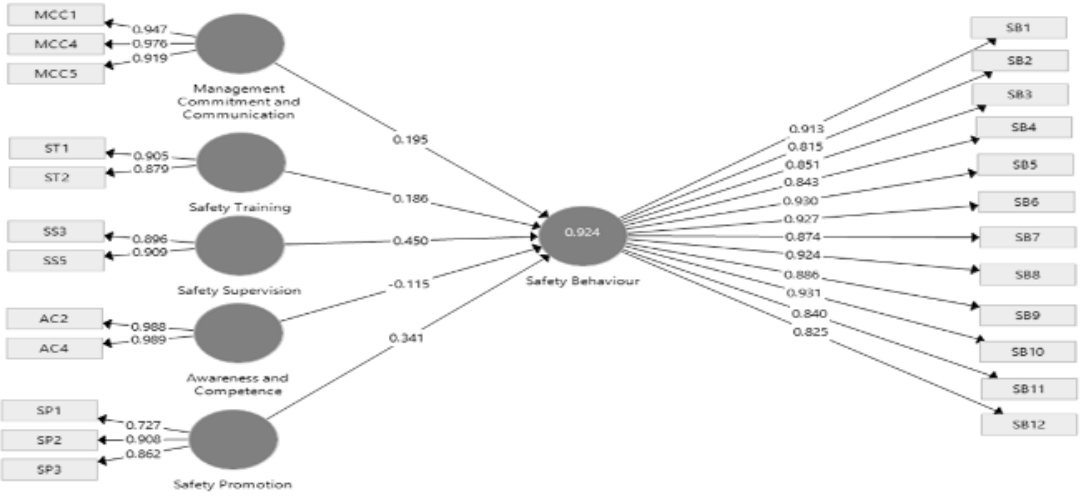

Figure 1: Path algorithm of constructs

DISCUSSION

The analysis of safety climate and behaviour in Ghana's construction industry reveals a significant correlation, despite certain indicators not aligning perfectly with the PLS-SEM model. Management Commitment and Communication (MCC) emerged as a crucial factor, indicating management's role in fostering a positive safety climate, in line with previous research emphasising its importance (Mohamed 2002; Fang *et al.,*

2006). Safety Supervision (SS) also played a pivotal role, particularly in enforcing the consistent use of Personal Protective Equipment (PPE), supported by previous studies such as (Oah and Moon, 2018; Cabrera *et al.,* 2020) showcasing the effectiveness of supervisor interventions in enhancing H&S communication. Specific indicators within SS, such as reminders for PPE usage, were particularly influential. Safety Training (ST) was identified as crucial for risk prevention, with informal methods like on-the-job training proving effective in enhancing safety behaviour. Targeted training, especially in PPE usage, was deemed significant in bolstering H&S compliance among workers. Safety Promotion (SP) initiatives, including displaying H&S precautions prominently and recognising good H&S practices, were also vital in fostering a robust safety climate within construction environments. However, the study highlighted areas for improvement, particularly in Awareness and Competence (AC). The lack of significance in this indicator suggests a gap in employees' understanding of H&S issues and their ability to consistently comply with H&S rules. Addressing this gap through targeted training and communication efforts could be crucial in enhancing overall H&S performance within the construction industry. In conclusion, while certain safety climate indicators may not align perfectly with the model, they offer valuable insights into safety behaviour dynamics within the construction industry. By focusing on key areas such as management commitment and communication, safety supervision, safety training, and safety promotion, stakeholders can work towards creating a safer and more productive work environment for all employees, ultimately enhancing H&S outcomes in Ghana's construction sector and similar developing contexts.

CONCLUSION

The study investigated the impact of safety climate on safety behaviour in construction industry of a developing country, identifying key factors like management commitment and communication, safety training, safety supervision, and safety promotion. Data from 250 construction workers on 12 sites revealed significant indicators such as 'management's belief in H&S is of the same importance as production', 'regular and useful H&S training', and 'H&S signs and posters'. Unsafe behaviours were ranked, with 'disregarding the wear of PPE' being the most frequent. Positive correlations were found between safety behaviour and climate factors, except for awareness and competence. Safety behaviour was examined holistically, but the impact of safety climate on its two key dimensions was not explicitly analysed. This limitation highlights an area for future research. The study recommends strengthening management and supervisory roles, formalising training, and promoting H&S to improve worker competence. The findings also guide policymakers toward mandating focused training and integrating H&S promotion into national regulations, while encouraging future research to explore weak indicators and long-term impacts.

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