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# Accident Investigation Impact on Safety Climate: Moderating Roles of Management and Employees in Ghanaian Construction.

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**Abstract**

This study examines the relationship between accident investigation procedures and safety climate in construction companies, focusing on the moderating roles of management commitment, enforcement, communication, and employee involvement, compliance, and awareness. Grounded in transformational leadership, social exchange, and planned behavior theories, data were collected from 208 skilled employees in Accra using questionnaires. Statistical analysis via SPSS revealed a significant positive relationship between accident investigation procedures and safety climate ($B = 0.469$, $p < 0.001$). While management commitment positively influenced the safety climate, it did not moderate this relationship. However, management communication significantly moderated the relationship ($B = -0.144$, $p = 0.013$), and staff involvement ($B = -0.123$, $p = 0.020$) and employee compliance also had significant moderating effects. Employee awareness did not show a moderating effect, though its influence on safety outcomes remains important. The findings emphasize integrating effective management practices and employee involvement to optimize safety climate in construction.

**Keywords**: accident investigation, management commitment, management communication, management enforcement, employee compliance, employee involvement, employee awareness, and safety climate

## Introduction

The construction industry in Ghana, like many other countries, is confronted with significant challenges related to workplace accidents and safety hazards. These incidents often stem from a complex interplay of factors, occurring at various construction sites and at irregular intervals (Osei-Asibey et al., 2021; Hoła & Szóstak, 2019). Globally, construction sites are notorious for high accident rates, with 20% of occupational fatalities in the U.S. linked to the construction sector (Earnest et al., 2019). Similarly, in Europe, 2.9% of occupational injuries in the UK and 13.1% in Denmark are construction-related (Health and Safety Executive, 2021; Hansen et al., 2022).

In developing countries, the situation is even more concerning. Kenya, for instance, records 74% of its occupational accidents in the construction industry (Raymond et al., 2017), while Ethiopia and Uganda report 58.65% and 32.4%, respectively (Kiconco et al., 2019; Ashuro et al., 2021). In Ghana, construction site accidents account for 57.9% of the sector's injuries and fatalities (Amissah et al., 2019; Adesi, 2023). Despite difficulties in obtaining comprehensive health and safety statistics, historical data from the Labour Department shows that in 2000, the fatality rate stood at 77.6 per 100,000 workers (Manu et al., 2018).

Between 1998 and 2008, the construction sector reported 216 fatal and 846 non-fatal injuries (Danso et al., 2023). Additionally, under-reporting of workplace accidents remains a significant issue, largely due to factors such as job insecurity, poor safety culture, and lack of management commitment (Darimaani, 2024).

**Research Questions**

1. How do management roles influence the relationship between accident investigation procedures and workplace safety climate in Ghanaian construction companies?
2. How do employee roles affect the relationship between accident investigation procedures and workplace safety climate in Ghanaian construction companies?
3. How do the combined roles of management and employees moderate the relationship between accident investigation procedures and workplace safety climate in Ghanaian construction companies?

## Literature Review

### Construction Accident Investigation

Workplace investigations are essential for employers to uncover the root causes of workplace incidents and take appropriate corrective actions (Woska, 2013). These investigations not only help organizations learn from past mistakes but also highlight the need for further research to optimize how organizations learn and improve risk control strategies (Dodshon & Hassall, 2017). By understanding the risks associated with their work activities through thorough accident investigations, companies can enhance and refine their risk management systems (Struble & Struble, 2020). Properly conducted investigations not only prevent future accidents but also ensure that management systems are aligned with industry standards (Salguero-Caparrós et al., 2015).

However, modern accident investigations are not without their challenges. They face both internal and external pressures, which require ongoing reassessment, better communication, and input from all stakeholders to ensure investigations are credible and effective (Roed-Larsen & Stoop, 2012). Applying lessons learned from investigations can significantly improve safety by addressing organizational flaws that may have contributed to the incident (Strauch, 2015). Implementing safety recommendations, however, often encounters challenges due to the complex interactions between different stakeholders (Cedergren, 2013). Systems theory-based approaches, particularly in construction accident analysis, offer a way to uncover the multiple factors and actors involved in accidents (Woolley et al., 2018). Many occupational accident investigations still lack the necessary depth, underscoring the need for a standardized model and comprehensive access to accident databases to improve reporting (Salguero-Caparrós et al., 2015). The ConAC framework, which analyzes the root causes of construction accidents across different national contexts, has proven effective in providing insights for enhancing safety in the industry (Gibb et al., 2014).

### Accident Investigation Procedures

Accident investigators often view human factors as a primary cause of accidents but face challenges due to limited resources and underutilization of available data. This situation underscores the need for improved strategies and practices in accident investigation (Rollenhagen et al., 2010). The diversity in accident investigation methods leads to varied data sets, making it challenging for users and highlighting the importance of better communication between practitioners and researchers (Benner, 2019). Utilizing

systems theory-based approaches in construction accident investigations can enhance the analysis by revealing multiple contributing factors and actors involved (Woolley et al., 2018). A novel approach that combines text mining techniques with latent Dirichlet allocation models has shown promise in analyzing investigation reports, identifying key factors and themes that lead to accidents, and helping site managers improve safety management practices (Liu et al., 2023).

The Accident Investigation Methodology (AIM) effectively identifies countermeasures and research needs using modern systems theory and interview techniques (Gustin, 1981). This methodology involves five stages: identifying data sources, acquiring research material, classifying information, developing a computer knowledge base, simulating accident processes, and analyzing results (Hoła & Szóstak, 2017). While current incident investigations focus on identifying causes and generating recommendations, there is room for improvement by integrating risk control identification, analysis, and human factors to optimize organizational learning (Dodshon & Hassall, 2017). A systematic investigation process includes data collection, evidence analysis, identifying contributing factors, and recommending corrective actions (Colvin, 2018). Commonly used methods such as questionnaires, interviews, and fault tree analysis help assess safety knowledge, attitudes, and behaviors, and understand the sequence of events leading to accidents (Omidi, 2023; Malakoutikhah et al., 2021).

**Management roles in Accident Investigation**

Worker's individual and behavioral factors and supervisory conditions are more related to serious accidents in the construction industry (Mohajeri, et al., 2020). Weak safety awareness, operating regulations, supervision dereliction of duty, equipment resources, and inadequate supervision are key factors influencing construction workers' unsafe behavior, aiding in safety management (Li, et al., 2022).

**Management commitment**

Upper management plays a significant role in shaping organizational safety, as noted by many investigators (Rollenhagen et al., 2010). Effective leadership in accident investigation involves adhering to standard operating procedures, actively monitoring safety, and making responsible decisions, especially concerning fatigue management (Sumwalt & Lemos, 2019). Both transformational and transactional leadership styles are crucial in accident investigation procedures (Hasanspahić et al., 2021). Strong leadership also entails implementing well-considered risk control measures, providing adequate supervision, and maintaining effective oversight (Struble & Struble, 2020).

Positive safety leadership fosters a top-down influence on safety culture and management (Wu et al., 2017). Key attributes of effective safety leadership include commitment, competence, and empowerment, alongside a focus on safety compliance and governance (Timbang et al., 2023). In contrast, weak leadership is characterized by a blame culture, inadequate focus on controls, and limited dissemination of post-investigation findings (Stemn et al., 2019). Strong leadership ensures thorough investigations, detailed reporting, and safeguards investigator independence from external pressures (Martin & Walters, 2001; Challinor, 2017). Additionally, effective leadership involves learning from experience, knowledge sharing, and providing social support (Nilsen et al., 2018).

**Enforcement of Accident Investigation Procedure**

While leadership style has a limited effect on inspectors' enforcement behavior, organizational culture plays a more significant role (Klijn et al., 2020). Critical safety leadership practices, such as fostering open

safety communication, conducting on-site inspections, and providing constructive feedback, are key to ensuring that accident investigation procedures are adhered to (Oah et al., 2018). Supervisors employing transactional safety leadership can motivate employees to properly report accidents, thereby reinforcing the accident investigation process (Probst, 2015). Research shows that effective leadership in enforcing safety protocols leads to better safety outcomes, such as fewer accidents and injuries (Perry et al., 2021). Additionally, when managers and supervisors enforce safety rules consistently and cultivate a strong safety culture, employees tend to adopt positive safety practices, reducing the likelihood of workplace accidents (Aeknarajindawat, 2020).

Leaders also enforce accident investigation procedures by utilizing structured methods like the Human Factors Analysis and Classification System (HFACS-RR) to conduct detailed and systematic investigations (Reinach & Viale, 2006). Their involvement in daily work activities positively impacts safety compliance (Dahl & Olsen, 2013). Strong leadership ensures accident investigations are initiated, conducted, and completed in a timely manner, identifying causes, preventing future incidents, and documenting findings for legal purposes (Martin & Walters, 2001). To further improve accident investigations, leaders must clarify jurisdictional guidelines, standardize investigator qualifications, bolster law enforcement supervision, and develop effective defense systems (Ye, 2014).

**Management Communication**

Safety leadership decisions, particularly those involving communication and engagement, play a crucial role in shaping behaviors and actions throughout the work system, ultimately contributing to the safe resolution of incidents (Donovan et al., 2018). Leadership communication has been shown to significantly influence employees' commitment to safety (Rashid et al., 2023). One of the key behaviors of effective safety leadership is maintaining clear communication regarding accident investigation procedures and providing feedback, which directly impacts employees' safety practices (Zhang et al., 2022).

In addition, effective communication between management and employees is vital for executing safety procedures, underscoring the importance of having clear communication channels to ensure adherence to safety protocols (Ahamad et al., 2022). Communication patterns, shaped by leadership, organizational, and personal factors, are essential in identifying, discussing, and addressing safety issues within an organization (Espinoza-Gala et al., 2021). Leadership styles that model safety behaviors have been linked to creating positive safety climates and motivating workers to engage in health and safety actions, primarily through effective communication strategies (Sankar et al., 2022).

**Employee Roles in Accident Investigation**

**Employee Involvement**

Employee involvement is essential for improving workplace safety and fostering a positive safety culture. Active participation in accident investigations, particularly in the construction industry, enables a deeper understanding of the root causes of incidents, allowing for the implementation of targeted preventive measures (Adesi, 2023; Bayraktar et al., 2016). Research highlights that employee involvement plays a crucial role in accident prevention and contributes significantly to enhancing workplace safety practices (Laurent et al., 2021; Sankar et al., 2022). Engaging employees in safety activities not only improves safety outcomes but also boosts morale by creating a culture that values workers' rights to a safe environment.

**Employee Awareness on Investigation Procedure**

Human factors competence plays a vital role in accident investigations by providing a deeper understanding of worker behavior and identifying potential risks (Bridger, 2021). In the construction industry, workers' actual knowledge of occupational health and safety measures is often lower than their perceived understanding, emphasizing the need for more effective safety training and awareness campaigns (Yılmaz, 2021). Positive impacts on safety awareness can be achieved through the involvement of safety experts, targeted training, and information dissemination (Yılmaz, 2021). Moreover, perceived organizational safety support improves employees' compliance with risk-awareness procedures by enhancing their perception of usefulness, while supervisor support fosters greater safety motivation (Hu et al., 2016).

Barriers to workplace safety management often include a lack of commitment from top management, low employee awareness, and insufficient organizational resources (Tsai et al., 2019). To address these challenges, organizations can foster a culture of security and safety awareness through education, policy implementation, and active managerial participation, ensuring long-term effectiveness and commercial sustainability (Acquaye, 2020). Employee safety awareness is shaped by several factors, such as safety education, training, and managerial leadership, all of which play a crucial role in promoting safe workplace behaviors (Fan et al., 2017). The presence of safety-specific transformational leadership further enhances employee compliance, participation, and attitudes toward safety (Mullen et al., 2017).

**Employee Compliance**

A lack of safety behavioral compliance can escalate risks, resulting in a higher probability of accidents among workers (Wang & Yu, 2021). Inadequate record-keeping and a culture of concealing safety issues have been identified as significant barriers to compliance (Arum et al., 2019). Noncompliance with safety regulations is a pervasive issue across various construction sectors, including small and medium enterprises, which often lack the resources to implement comprehensive safety management systems (Alawi et al., 2020). Studies have indicated that social support and management commitment significantly influence safety behaviors among construction workers (Alfayez, 2021).

**Safety Climate at the Workplace**

Organizational learning and management support are closely linked to employees' willingness to report near-miss events, though conflicting incentives and poor reporting systems often discourage reporting (Armstrong, 2021; Bakshi & Peura, 2020). Cultivating a positive safety culture that encourages near-miss reporting in a 'no-blame' environment is key to preventing future incidents (Duryan et al., 2020). However, 65.33% of employees still fail to report near-misses, often due to fear, lack of training, job instability, and other organizational factors (Musasa & Jerie, 2020; Ahmadpour-Geshlagi et al., 2021). Companies that emphasize near-miss reporting are more likely to take immediate corrective actions, improving safety outcomes (Bellovin & Ntsb, 2019). Workplace culture, management style, and project stakes also influence reporting rates, with peer pressure and fear of retaliation further affecting employees' willingness to report unsafe practices (Dillon et al., 2016; Lam & Chan, 2023).

**Effect of accident investigation procedure on safety climate**

Accident investigations are integral to shaping safety climate, which reflects the shared perceptions, attitudes, and beliefs about safety within an organization (Syaiful & Dwiyanti, 2022). A positive safety

climate, where management prioritizes safety, can enhance safety knowledge, reduce rule violations, and motivate workers, particularly in the construction industry (Lyu et al., 2018). Research shows that safety policies, procedures, and accident investigations are key indicators of safety climate, with management's involvement being the most influential factor (Schwatka et al., 2016; Mosly, 2019). Improving accident investigation procedures has been linked to reductions in accident rates and improvements in safety climate, as a positive attitude toward safety practices fosters better safety behavior and compliance (Ghasemi et al., 2020; Khoshakhlagh et al., 2021). Furthermore, positive safety perceptions regarding accident investigations correlate with higher employee health literacy, highlighting the broader impact of safety climate on overall well-being (Karayurek, 2021).

**Theories**

In this research, three key theories were employed to provide a robust theoretical framework for understanding the dynamics of accident investigation procedures and their impact on safety climate within construction companies.

Using the Transformational Leadership Theory (Bass, 1985), it was investigated how strong leadership may encourage a dedicated and encouraging work environment, which in turn inspires and motivates individuals to reach greater performance levels. This theory is especially pertinent now that we know that transformational leaders can increase their team members' adherence to safety procedures and their involvement in accident investigations by modeling behaviors like idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration.

The reciprocal relationships that exist between employees and the organization were examined using the Social Exchange Theory (Blau, 1964). According to this notion, when workers believe they are being treated fairly and that their efforts are valued, they are more inclined to participate and adhere to safety procedures. Comprehending this process of exchange facilitates the identification of ways in which safety behaviors and climate might be impacted by perceptions of organizational support.

In order to evaluate employees' intentions about their safety-related acts, the Theory of Planned Behavior (Ajzen, 1991) was also incorporated. According to this idea, people's intentions—which are molded by their attitudes, subjective norms, and sense of behavioral control—have an impact on their actions. This theory's incorporation facilitates a more profound comprehension of the psychological elements that motivate adherence to safety protocols, finally establishing a connection between workers' intentions and their actual actions in the context of accident investigations.

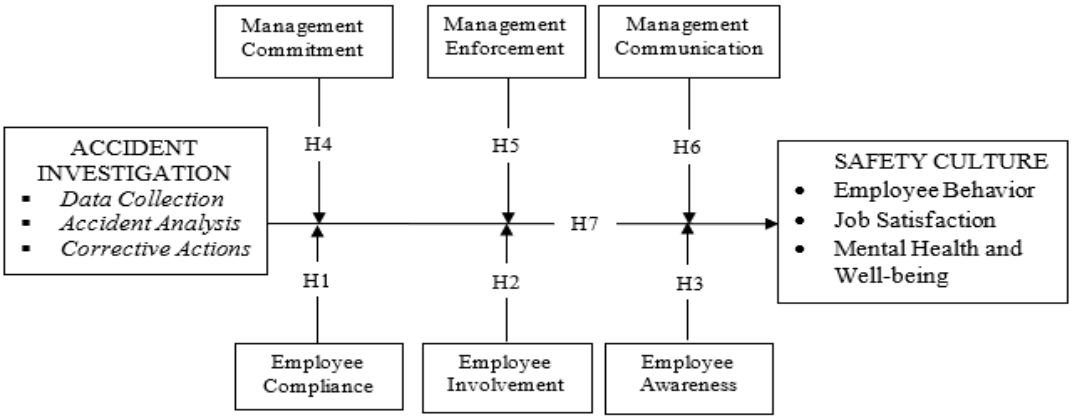


**Figure 1: Conceptual Framework**
**Source: Authors, (2024)**

**Methodology**

This study employed a descriptive research design utilizing a quantitative strategy to confirm relevant theories through a deductive approach. This approach integrates currently available methods with globally recognized practices via observational testing and theory identification. The study's population comprised over 400 skilled employees from three construction companies, with a sample size of 208 determined using Yamane's formula (1967). Well-structured closed-ended questionnaires were administered to participants on-site to collect data.

Data gathered from the questionnaires were analyzed using the Statistical Package for Social Sciences (SPSS) version 24. Before inputting the quantitative data, the information was cleaned, edited, and coded. The results from the analysis were presented in tables and figures, with descriptive statistics including mean, standard deviation, and frequency, while inferential statistics employed Analysis of Variance (ANOVA). Participants were informed that participation was voluntary, allowing them to opt out at any time, and their anonymity and confidentiality were assured throughout the process.

**Table 1: Descriptive statistics and normality analysis**

| SN | Statement | M | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|
| **Accident Investigation Procedure** | | | | | |
| AIP1 | The process of collecting data during accident investigations is conducted systematically and thoroughly. | 4.3 | 0.8 | -1.2 | 2.1 |
| AIP2 | Evidence from accidents is analyzed carefully and methodically to ensure accurate conclusions are drawn. | 4.2 | 0.8 | -1.2 | 2.7 |
| AIP3 | The investigation process effectively identifies all contributing factors that led to the accident. | 4.2 | 0.8 | -1.1 | 1.9 |
| AIP4 | The recommendations for corrective actions are based on a thorough analysis of the evidence and contributing factors. | 4.2 | 0.7 | -1.1 | 2.6 |
| AIP5 | The overall accident investigation process is systematic and comprehensive, addressing all key aspects from data collection to corrective actions. | 4.3 | 0.6 | -1.0 | 3.1 |
| **Management committee** | | | | | |
| MCR1 | In my experience, management shows a strong commitment to safety by prioritizing thorough and transparent accident investigations. | 4.2 | 0.7 | -0.7 | 1.0 |
| MCR2 | I feel confident that management's dedication to comprehensive accident investigations contributes to a safer workplace. | 4.4 | 0.6 | -0.7 | 0.8 |
| MCR3 | I believe that our organization views accidents not just as failures but as chances to enhance safety practices. | 4.3 | 0.6 | -1.1 | 3.5 |
| MCR4 | From my perspective, management's commitment significantly improves the effectiveness of our accident investigations. | 4.4 | 0.6 | -1.0 | 3.2 |

| | | | | | |
|---|---|---|---|---|---|
| MCR5 | I think that stakeholders recognize and appreciate management's genuine commitment to safety and continuous improvement. | 4.3 | 0.6 | -0.5 | 0.9 |
| **Management communication** | | | | | |
| MComR1 | Management clearly communicates the importance and details of accident investigation procedures to all employees. | 4.2 | 0.7 | -1.1 | 2.1 |
| MComR2 | I understand the accident investigation procedures and my role in these processes due to effective communication from management. | 4.3 | 0.7 | -1.2 | 3.1 |
| MComR3 | Management emphasizes the importance of employee participation in accident investigations through clear communication. | 4.3 | 0.7 | -1.2 | 3.4 |
| MComR4 | Management maintains open lines of communication about safety issues, allowing for free sharing of safety information. | 4.3 | 0.6 | -0.6 | 1.5 |
| MComR5 | The transparency in communication about accident investigations positively impacts stakeholders' perception of our organization's commitment to safety. | 4.3 | 0.7 | -0.9 | 1.4 |
| **Enforcement of Safety Policies** | | | | | |
| MESP1 | Management rigorously enforces safety policies to ensure compliance with accident investigation procedures. | 4.3 | 0.7 | -0.7 | 0.8 |
| MESP2 | Management follows up diligently to ensure that all accident investigation procedures are adhered to. | 4.3 | 0.7 | -1.3 | 4.4 |
| MESP3 | The enforcement of safety policies by management contributes to thorough and accurate accident investigations. | 4.3 | 0.6 | -0.4 | 1.2 |
| MESP4 | Management's consistent application of safety policies reinforces the importance of safety within the organization. | 4.4 | 0.6 | -0.2 | -0.9 |
| MESP5 | Management's proactive enforcement of safety policies demonstrates a commitment to managing and mitigating risks effectively. | 4.4 | 0.6 | -0.7 | 1.0 |
| **Staff Compliance** | | | | | |
| SC1 | I believe that management is genuinely committed to my safety and well-being. | 4.3 | 0.7 | -1.1 | 3.1 |
| SC2 | Because of management's commitment to safety, I am more likely to comply with accident investigation procedures. | 4.4 | 0.6 | -0.7 | 0.8 |
| SC3 | My compliance with accident investigation procedures ensures that investigations are thorough and accurate. | 4.3 | 0.7 | -1.3 | 3.5 |

| | | | | | |
|---|---|---|---|---|---|
| SC4 | Management's commitment to safety encourages a culture where adherence to accident investigation procedures is valued and practiced. | 4.3 | 0.7 | -1.4 | 5.0 |
| SC5 | The thoroughness and accuracy of accident investigations, influenced by my compliance, positively affect stakeholder perception of our organization's safety culture. | 4.3 | 0.6 | -0.7 | 1.7 |
| **Staff Awareness** | | | | | |
| SA1 | The safety training I receive is adequate and helps me understand how to contribute to accident investigations effectively. | 4.3 | 0.7 | -1.2 | 3.1 |
| SA2 | I perceive our organization as having a supportive safety culture that encourages accurate reporting of accidents and near-misses. | 4.3 | 0.6 | -1.1 | 3.4 |
| SA3 | The supportive safety culture and training I receive improve my awareness and attitudes towards safety. | 4.4 | 0.6 | -1.0 | 3.9 |
| SA4 | I am more likely to report accidents and near-misses accurately and promptly due to the safety training and supportive culture. | 4.4 | 0.6 | -0.7 | 0.3 |
| SA5 | My active participation in reporting and safety practices enhances the effectiveness of accident investigations and positively impacts stakeholder perception. | 4.4 | 0.5 | -0.1 | -1.0 |
| **Staff Involvement** | | | | | |
| SI1 | My positive attitude towards safety encourages me to actively participate in safety programs and accident investigations. | 4.4 | 0.6 | -0.4 | 0.2 |
| SI2 | The social norms established by my peers and management motivate me to be actively involved in safety programs and accident investigations. | 4.3 | 0.6 | -0.7 | 1.2 |
| SI3 | I feel that I have adequate control over safety practices, which drives my active participation in accident investigation procedures. | 4.3 | 0.7 | -1.1 | 2.4 |
| SI4 | Management creates an environment where safety involvement is the norm, making me more likely to participate actively in safety programs. | 4.3 | 0.6 | -0.8 | 1.1 |
| SI5 | My active involvement in safety programs contributes to more comprehensive and actionable accident investigations, enhancing stakeholder perception of our safety culture. | 4.4 | 0.6 | -0.4 | 0.2 |
| **Safety Climate** | | | | | |
| SaCI1 | I feel that a positive workplace health and safety climate encourages me to exhibit improved behaviors at work. | 4.4 | 0.6 | -1.5 | 6.4 |

| | | | | | |
|---|---|---|---|---|---|
| SaCI2 | The health and safety climate at my workplace helps me experience reduced feelings of depression. | 4.3 | 0.7 | -1.3 | 3.3 |
| SaCI3 | I find that a strong health and safety climate at work increases my job satisfaction. | 4.3 | 0.7 | -1.7 | 5.4 |
| SaCI4 | The emphasis on health and safety in my workplace contributes to my better overall health. | 4.3 | 0.7 | -1.4 | 4.0 |
| SaCI5 | I believe that a positive health and safety climate at work helps reduce productivity loss in my role. | 4.3 | 0.9 | -1.9 | 4.2 |

**Source: Authors, (2024)**

**Exploratory Factor Analysis**

According to (De Coninck et al., 2020) an exploratory factor analysis is one of the widely used first step for scale development and it was chosen to investigate the structure of the study items. All items were first checked for normality, and Bartlett's test of sphericity and a Kaiser-Mayer-Olkin (KMO) test were then conducted. As all items met the acceptable ranges, and the sample size met conventional EFA guidelines (Comrey & Lee, 1992) the data was judged suitable to be analysed using EFA for the study.

In this analysis 208 responses were used and were analysed using principal component with Varimax rotation. This technique was used to identify the latent variables underlying a construct (Tabachnick & Fidell, 2007; Yong & Pearce, 2013). The analysis was performed using SPSS version 27.0. To determine the number of factors to extract, Cattell's scree test was used (Cattell, 1966) in conjunction with Kaiser's criterion (Kaiser, 1960). As advised by the literature, a number of possible factor solutions were investigated in order to establish the most parsimonious factor model (De Coninck et al., 2020; Gorsuch, 1997). For each solution, any items that did not meet the factor loading criterion for retention of ≥ 0.40 were removed from the analysis (Guadagnoli & Velicer, 1988). Likewise, any items that cross-loaded strongly onto two or more factors, with a loading ≥0.32 were also discarded (Costello & Osborne, 2005). The result obtained as shown in Table 4.3 shows outcome of the exploratory factor analysis. As evidenced the Bartlett's test for sphericity was found to be significant ( $\chi^2$=5195.673, df=666, Sig=0.000) and a KMO test achieved a score of 0.862, placing the data into the "marvellous" category (Kaiser & Rice, 1974). Hence the data gathered was considered suitable for EFA. Initially, 40 items were used in the EFA and was reduced to 37 after 3-items were removed from the model for further analysis. The initial solution obtained gave eight factors with eigenvalues >1.0 (Kaiser, 1960), accounting for 71.66% of the total variance in the respondents' scores. The amount of variance explained by each component is given as follows: component 1, 21.61%; component 2, 19.67%; Component 3, 9.55%; Component 4, 6.04%; Component 5, 4.77%; Component 6, 4.12%; Component 7, 3.18% while component 8,2.72% as shown in the Table 4.3.

**Constructs Reliability analysis**

The internal consistency of the responses was measured using Cronbach alpha (α). The alpha coefficient for the whole scale, containing all 37 items, was 0.892. To test the internal consistency of the subscales, alpha was then calculated for all constructs as shown in Table 4.4. According to (Field, 2017; Nunnally, 1978), alpha value ≥0.70 are considered to indicate, the high alpha values obtained suggest that the initial scale produced from the EFA has the potential to be a reliable assessment tool for measuring the study items. The relationship between the study constructs is shown in the Figure 4.1

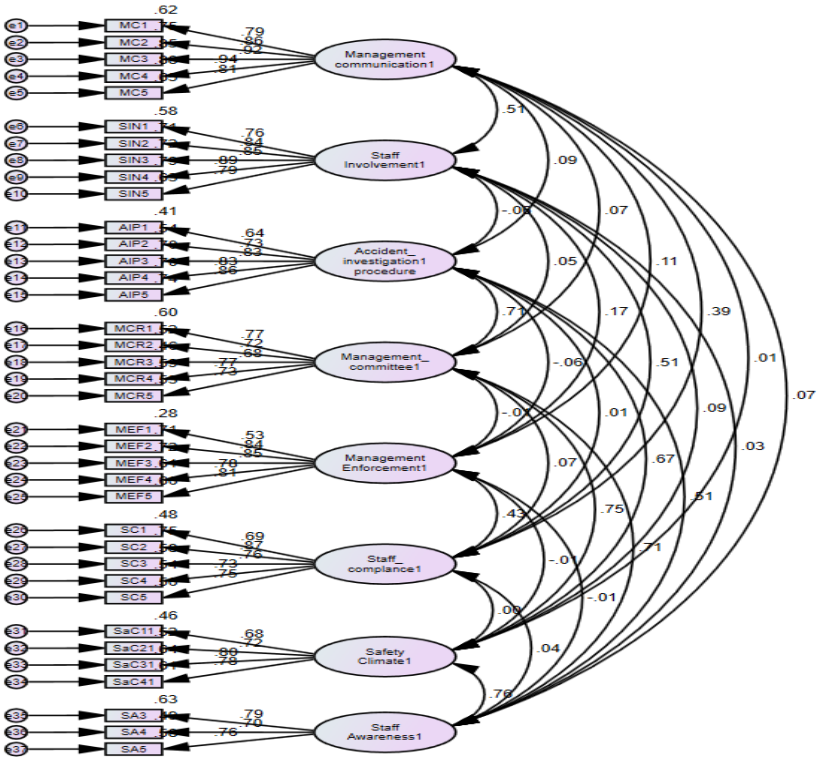


**Figure 2: Association among the study constructs**
**Source: Authors, (2024)**

### Constructs validity analysis

Other model fit indices, such as the standardized loading of the items and model adequacy indices, were utilized to analyze the model in order to obtain additional proof of scale validity. Table 4.3 displays that all item loadings under the communalities columns were over the suggested value of 0.50, ranging from 0.524 to 0.863 (Hair et al., 2010). Convergent validity is therefore attained. In addition, every square root value on Table 4.4's leading diagonal was more than the constructs' correlation. Discriminant validity is therefore attained. The following were the model adequate fit indices: df=601, RMSEA=0.054, CFI=0.927, SRMR=0.05, and $\chi^2$=959.198. The model is statistically adequate, according to the validity results; therefore, the proposed hypotheses might be investigated.

**Table 2: Reliability and correlation analysis**

| Construct | CR | CA | AVE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Management communication (1) | 0.937 | 0.939 | 0.75 | 0.866 | | | | | | | |
| Staff involvement (2) | 0.916 | 0.912 | 0.685 | 0.511*** | 0.828 | | | | | | |
| Accident investigation procedure (3) | 0.887 | 0.883 | 0.614 | 0.09 | -0.058 | 0.784 | | | | | |
| Management commitment (4) | 0.853 | 0.852 | 0.538 | 0.067 | 0.051 | 0.708*** | 0.734 | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Management enforcement (5) | 0.877 | 0.867 | 0.595 | 0.111 | 0.169* | -0.065 | -0.006 | 0.771 | | | |
| Staff compliance (6) | 0.874 | 0.871 | 0.583 | 0.387*** | 0.505*** | 0.009 | 0.072 | 0.430*** | 0.763 | | |
| Safety climate (7) | 0.834 | 0.833 | 0.557 | 0.012 | 0.086 | 0.666*** | 0.754*** | -0.011 | 0.002 | 0.746 | |
| Staff awareness (8) | 0.797 | 0.834 | 0.568 | 0.066 | 0.03 | 0.513*** | 0.709*** | -0.014 | 0.037 | 0.759*** | 0.754 |

Note: CR is Composite reliability; CA is Cronbach alpha (α).

**Source: Authors, (2024)**

Table 2 sheds light on the connections between different safety and management-related constructs. Strong internal consistency and reliability in the measurement of each construct are indicated by the high Composite Reliability (CR) and Cronbach's Alpha (CA) scores for all constructs. Good convergent validity is confirmed by the Average Variance Extracted (AVE) values, which are all over 0.5 and indicate that each construct explains more than half of the variance in its indicators.

Staff participation and management communication had a somewhat positive connection ($r = 0.511$, $p < 0.001$), indicating that higher levels of management communication are linked to higher levels of staff involvement. Its modest connection ($r = 0.090$) with accident investigation procedures, however, suggests that management communication has little effect on accident investigation methods.

Strong accident investigation processes are linked to better management commitment, according to the moderately positive connection between accident investigation procedure and management commitment ($r = 0.708$, $p < 0.001$). Management enforcement, on the other hand, has modest correlations with other variables, like management commitment ($r = -0.006$) and accident investigation procedure ($r = -0.065$), suggesting that enforcement has little effect on these constructs.

Strong positive relationships have been shown between staff compliance and both staff involvement ($r = 0.505$, $p < 0.001$) and safety climate ($r = 0.430$, $p < 0.001$), suggesting that higher levels of compliance with policies lead to higher levels of staff involvement and a safer workplace environment. A stronger safety climate is linked to efficient accident investigation processes and high management commitment, according to the moderately positive correlations between safety climate and accident investigation procedure ($r = 0.666$, $p < 0.001$) and management commitment ($r = 0.754$, $p < 0.001$).

Increased staff awareness is associated with improved compliance and a more favorable safety climate, as seen by the substantial positive connections between staff awareness and safety climate ($r = 0.754$, $p < 0.001$) and staff compliance ($r = 0.759$, $p < 0.001$). Its correlations with management communication ($r = 0.066$) and accident investigation procedure ($r = 0.513$, $p < 0.001$), on the other hand, are weak, indicating that although staff awareness affects safety climate and compliance, it has less of an effect on these two areas.

**Testing of formulated hypotheses**

The result in Table 3 shows the summary result of the model. In this analysis PROCESS statistical software was used for the analysis. In this study, seven hypotheses were formulated and tested as follows:

Hypothesis 1 Staff compliance moderates the relationship between accident investigations procedure and safety climate.

The result obtained suggests that there is no moderation effect of staff compliance between the two variables, accident investigations procedure and safety climate ($B=-0.032$, $t=-0.473$, $p=0.637$). Hence the

hypothesis is not supported.

Hypothesis 2 Staff involvement moderates' relationship between accident investigations procedure and safety climate.

As shown evidenced in the result, staff involvement statistically moderates the relationship between accident investigations procedure and safety climate (B=-0.123, t=-2.342, p=0.020). Hence the hypothesis is supported.

Hypothesis 3 Staff awareness moderates the relationship between accident investigation procedure and safety climate.

The results obtained suggest that there is no significant effect of the moderator of the relationship between accident investigation procedure and safety climate (B=0.047, t=0.526, p=0.599). Hence the hypothesis is not supported.

Hypothesis 4 management commitment moderates the relationship between accident investigation procedure and safety climate.

As shown in the result, there is no statistically significant effect of the moderator, management commitment on the relationship between accident investigation procedure and safety climate (B=0.109, t=1.261, p=0.209). Hence the hypothesis 4 is not supported.

Hypothesis 5 shows the moderation of management enforcement on the relationship between accident investigation procedure(X5) and safety climate.

As evidenced in the results table, management enforcement (W5) does not moderate the association between accident investigation procedure and safety climate (B=-0.073, t=-0.876, p=0.382). Hence the hypothesis 5 is not supported.

Hypothesis 6 shows the moderation of effect of management communication on the relationship between accident investigation procedure and safety climate.

The result suggests that the association between accident investigation procedure (X6) and Safety climate is moderated by the management communication (W6). Thus X6*W6 shows significant results (B=-0.144, t=-2.515, p=0.013). Hence the hypothesis 6 is supported.

Hypothesis 7 shows the relationship between accident investigations procedure and safety climate.

The result suggests that there is a statistically significant and positive relationship between accident investigations procedure and safety climate (B=0.469, t=9.657, p=0.000). Hence the hypothesis is supporting.

**Table 3: Summary of results**

| | **Path** | **B** | **Se** | **t** | **P** | **LLCI** | **ULCI** | **$R^2$-change** |
|---|---|---|---|---|---|---|---|---|
| H1 | Constant | 4.319 | 0.029 | 146.662 | 0.000 | 4.261 | 4.377 | |
| | Accident investigation procedure(X1) | 0.467 | 0.049 | 9.555 | 0.000 | 0.371 | 0.563 | |
| | Staff Compliance(W1) | 0.014 | 0.040 | 0.341 | 0.734 | -0.066 | 0.093 | |
| | X1*W1 | -0.032 | 0.067 | -0.473 | 0.637 | -0.163 | 0.100 | 0.001 |
| H2 | Constant | 4.315 | 0.029 | 148.973 | 0.000 | 4.258 | 4.372 | |
| | Accident investigation procedure(X2) | 0.455 | 0.049 | 9.343 | 0.000 | 0.359 | 0.551 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Staff Involvement (W2) | 0.045 | 0.038 | 1.191 | 0.235 | -0.029 | 0.119 | |
| | X2*W2 | -0.123 | 0.053 | -2.342 | 0.020 | -0.227 | -0.019 | 0.018 |
| H3 | Constant | 4.312 | 0.026 | 162.846 | 0.000 | 4.26 | 4.365 | |
| | Accident investigation procedure(X3) | 0.231 | 0.045 | 5.108 | 0.000 | 0.142 | 0.321 | |
| | Staff Awareness(W3) | 0.614 | 0.055 | 11.19 | 0.000 | 0.506 | 0.722 | |
| | X3*W3 | 0.047 | 0.089 | 0.526 | 0.599 | -0.129 | 0.222 | 0.001 |
| H4 | Constant | 4.299 | 0.03 | 141.488 | 0.000 | 4.239 | 4.358 | |
| | Accident investigation procedure(X4) | 0.207 | 0.055 | 3.757 | 0.000 | 0.098 | 0.316 | |
| | Management Commitment (W4) | 0.532 | 0.065 | 8.147 | 0.000 | 0.404 | 0.661 | |
| | X4*W4 | 0.109 | 0.086 | 1.261 | 0.209 | -0.061 | 0.28 | 0.004 |
| H5 | Constant | 4.318 | 0.029 | 146.502 | 0.000 | 4.259 | 4.376 | |
| | Accident investigation procedure (X5) | 0.476 | 0.049 | 9.641 | 0.000 | 0.379 | 0.574 | |
| | Management Enforcement (W5) | 0.017 | 0.043 | 0.390 | 0.697 | -0.068 | 0.102 | |
| | X5*W5 | -0.073 | 0.083 | -0.876 | 0.382 | -0.238 | 0.091 | 0.003 |
| H6 | Constant | 4.323 | 0.029 | 149.009 | 0.000 | 4.265 | 4.38 | |
| | Accident investigation procedure (X6) | 0.444 | 0.049 | 9.024 | 0.000 | 0.347 | 0.541 | |
| | Management Communication(W6) | -0.056 | 0.046 | -1.210 | 0.228 | -0.147 | 0.035 | |
| | X6*W6 | -0.144 | 0.057 | -2.515 | 0.013 | -0.258 | -0.031 | 0.021 |
| H7 | Accident investigation procedure →Safety climate | .469 | .049 | 9.658 | .000 | .373 | .564 | |

Note: Dependent variable: Safety Climate

**Source: Authors, (2024)**

Table 3 displays the findings from a set of hypotheses (H1 to H7) that investigate how different moderating factors—like staff compliance, staff involvement, and management commitment—relate to accident investigation procedures and how they affect safety outcomes, including safety climate. Every hypothesis explores the ways in which safety-related variables are impacted by the interplay between accident investigation protocols and these moderators.

According to H1, the data demonstrate that accident investigation processes (X1) significantly and favorably affect safety outcomes (B = 0.467, p = 0.000), indicating that enhanced accident investigation practices are linked to improved safety outcomes. The results, however, are not significantly impacted by

staff compliance (W1) alone (B = 0.014, p = 0.734), nor are they significantly impacted by the interaction between staff compliance and accident investigation processes (X1 * W1) (B = -0.032, p = 0.637). This implies that the association between accident investigation methods and safety results is not moderated by staff compliance.

Accident investigation techniques (X2) for H2 once more demonstrate a significant favorable impact (B = 0.455, p = 0.000). Nonetheless, staff engagement (W2) does not substantially affect safety results on its own (B = 0.045, p = 0.235). It's interesting to note that there is a significant interaction (X2 * W2) between staff participation and accident investigation methods (B = -0.123, p = 0.020), suggesting that increased staff engagement reduces the beneficial effects of accident investigation procedures on safety outcomes.

According to H3, staff awareness (W3) (B = 0.614, p = 0.000) and accident investigation procedures (X3) (B = 0.231, p = 0.000) both significantly improve safety results. Increasing staff understanding is very important for improving safety. The influence of accident investigation processes is not significantly affected by staff awareness, as indicated by the non-significant interaction term (X3 * W3) (B = 0.047, p = 0.599).

H4 demonstrates a significant favorable effect for both management commitment (W4) and accident investigation methods (X4) (B = 0.207, p = 0.000, and B = 0.532, p = 0.000, respectively). One of the most important factors influencing good safety outcomes is management commitment. Nonetheless, there is no significant interaction (B = 0.109, p = 0.209) between management commitment and accident investigation procedures (X4 * W4), indicating that management commitment has no discernible impact on the effectiveness of accident investigation processes.

According to H5, management enforcement (W5) has little effect on safety outcomes (B = 0.017, p = 0.697), whereas accident investigation procedures (X5) have a large beneficial effect (B = 0.476, p = 0.000). Enforcement by itself does not mitigate the impact of accident investigations on safety outcomes, as shown by the non-significant interaction between management enforcement and accident investigation processes (X5 * W5) (B = -0.073, p = 0.382).

According to H6, accident investigation techniques (X6) have a significant beneficial influence (B = 0.444, p = 0.000). On the other hand, management communication (W6) by itself has no discernible impact (B = -0.056, p = 0.228). Remarkably, there is a significant interaction (B = -0.144, p = 0.013) between accident investigation procedures and management communication (X6 * W6). This suggests that inadequate communication may mitigate the beneficial impact of accident investigation processes on safety outcomes.

H7 concludes by analyzing the direct connection between safety culture and accident investigation practices. The findings demonstrate a strong beneficial effect (B = 0.469, p = 0.000), suggesting that enhancing accident investigation protocols has a major positive impact on an organization's safety culture.

**Discussion**

The study emphasizes leadership's influence on accident investigation processes and the important role that senior management plays in establishing the safety culture inside construction organizations. It takes effective leadership to keep a workplace safe. This is demonstrated by active monitoring, adherence to safety procedures, and responsible decision-making, particularly when it comes to fatigue management (Sumwalt & Lemos, 2019). In order to drive these procedures and promote proactive risk management and supervision, both transformational and transactional leadership styles are crucial (Hasanspahić et al., 2021). The study did find, however, that management commitment did not significantly moderate the relationship between accident investigation procedures and safety climate (B = 0.109, t = 1.261, p = 0.209).

This suggests that, despite its importance, management commitment may not have the expected amplifying effect on safety climate. This finding suggests that although management commitment plays a beneficial role, accident investigations might have a significant independent impact as well. To improve safety outcomes, businesses might also need to incorporate additional leadership behaviors like communication and enforcement.

The results imply that hypothesis 5 is not supported, since management enforcement does not significantly modify the association between accident investigation processes and safety climate (B = -0.073, p = 0.382). This finding is consistent with study by Klijn et al. (2020), which emphasizes the greater influence of organizational culture over leadership enforcement. Despite this, effective safety leadership behaviors—such as open communication, site visits, and feedback—are still crucial in ensuring adherence to safety regulations (Oah et al., 2018). According to Profbst (2015), transactional leadership has the potential to enhance the safety climate by encouraging precise reporting of accidents. Furthermore, regular enforcement of rules fosters a strong safety culture, which lowers the number of workplace accidents (Aeknarajindawat, 2020). Hence, good leadership, communication, and culture are crucial for promoting workplace safety, even though management enforcement may not be able to directly mitigate the impact of investigation methods on safety atmosphere.

According to the findings, management communication considerably mitigates the association between safety climate and accident investigation processes (B = -0.144, p = 0.013), hence confirming hypothesis 6. This result is consistent with the research, which highlights how important leadership communication is in shaping safety behavior and creating a culture of safety. To guarantee that staff members comprehend the significance of safety protocols, such as accident investigations, and to reaffirm their dedication to safety, leadership communication must be effective (Rashid et al., 2023). According to Donovan et al. (2018), safety leadership has a significant role in shaping the overall safety environment and aids in the successful resolution of safety issues. This is especially true when it incorporates clear communication and engagement. Furthermore, Zhang et al. (2022) claim that proficient safety leaders uphold transparent communication and offer regular feedback on accident investigations, so directly impacting the safety practices of their staff. The impact of accident investigation procedures on the safety atmosphere is therefore enhanced by management's clear and proactive communication, underscoring the significance of this communication strategy in safety leadership.

The hypothesis is not supported by the results, which show that staff compliance does not significantly modify the association between accident investigation processes and safety climate (B = -0.032, p = 0.637). This finding is consistent with research showing that worker risks are increased and accidents are more likely when safety procedures are not followed (Wang & Yu, 2021). Compliance is hampered by obstacles like poor record-keeping and a culture that hides safety concerns (Arum et al., 2019). Safety management initiatives are further complicated by the widespread problem of noncompliance in the construction industry, especially among small and medium-sized businesses with low funding (Alawi et al., 2020). Furthermore, research indicates that social support and managerial commitment play critical roles in shaping construction workers' safety practices (Alfayez, 2021). Therefore, the results highlight the necessity of focused approaches to improve adherence, which mirrors the continuous difficulties reported in previous studies.

The hypothesis is supported by the results, which show that staff involvement considerably moderates the association between accident investigation processes and safety climate (B = -0.123, p = 0.020). This emphasizes how important employee involvement is to improving workplace safety and developing a

culture of safety. Employees who actively participate in accident investigations, especially those in the construction sector, can learn more about the root causes of occurrences and use this knowledge to adopt targeted preventive measures (Adesi, 2023; Bayraktar et al., 2016). Research repeatedly demonstrates that employee participation in safety initiatives improves safety outcomes and boosts morale by fostering an atmosphere that places a high value on workers' rights to safety (Laurent et al., 2021; Sankar et al., 2022). Organizations can foster a proactive and collaborative safety culture by involving employees in the accident investigation process. This will help to create a more robust and efficient safety environment.

The results show that the link between accident investigation methods and safety climate is not significantly moderated by staff awareness (B = 0.047, p = 0.599), which refutes the hypothesis. This is consistent with the body of research that has been done on the complexity of human variables in accident investigations and the importance of comprehending worker behavior (Bridger, 2021). Workers in the construction industry frequently overestimate their familiarity with safety precautions, highlighting the necessity of increased training and awareness campaigns (Yılmaz, 2021). Furthermore, supervisory support increases safety motivation, and perceived organizational safety support has a beneficial impact on adherence to safety protocols (Hu et al., 2016). These results highlight the significance of true employee knowledge in creating a strong safety climate and point to a direction for further study and educational initiatives.

## Conclusion

The present study underscores the significance of accident investigation protocols in augmenting the safety environment in construction firms. The link between accident investigations and safety climate was dramatically attenuated by management communication alone, despite the fact that management commitment and enforcement had a beneficial impact on safety. A robust safety culture and accident prevention are fostered by employee involvement and compliance, which also performed important moderating roles. Despite the lack of a discernible moderating effect, increasing employee awareness of safety precautions is still essential. All things considered, sustaining a favorable safety climate requires combining exhaustive investigations, efficient management techniques, and engaged staff involvement.

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