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The Moderating Roles of Safety Communication on the Relationship between Safety Practices and Safety Performance in Nigeria Construction Companies

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Abstract

When compared to other industries, the construction business has a higher workplace death rate. In addition, achieving zero accidents requires substantial effort. This study therefore aims to investigate how safety communication influences the relationship between key safety practices and safety performance in Nigeria construction companies. Safety management involvement, risk perception, safety training, safety culture, and safety motivation as the key safety practices considered in this study are to be moderated by safety communication respectively with respects to safety performance. Questionnaires were distributed to Nigerian construction employees from the selected construction companies located in Lagos state, Nigeria using simple random and convenience sampling while structural equation modelling was employed as the analysis technique. The results showed that, perceived management commitment, safety training, safety motivation and risk perception have direct significant relationship with safety performance with the exception of safety culture. However, the study revealed that safety communication moderates the relationship between safety motivation only from all the safety practices and safety performance. By highlighting the importance of safety communication for any effective and strategic implementation in improving safety performance through the deployment of the considered safety practices, the tenets of the behavior-based safety (BBS) theory are validated.

Keywords: *Safety Performance, Perceived Management Commitment, Risk Perception, Safety Communication, Safety Training.*

JEL Classifications codes: O320 Management of Technological Innovation and R&D; L74 Industry Studies—Primary Products and Construction

Introduction

In the context of globalization, workplace safety is the primary focus across all industries. It is intended that putting in place a safety management system would help to create a safe environment and a good safety culture, which can be measured by the number of accidents that occur, employee behavior, and support for one's own and co-workers' safety (Khasanah, 2019). Meng and Chan (2020) state that although the quantity and scope of construction projects have increased significantly globally, accidents in the sector still happen frequently and have detrimental effects on communities, businesses, and employees. According to Chen, McCabe, and Hyatt (2017), the construction sector has reached a point where there is no further improvement in safety performance. First, research on safety culture has been done very infrequently in the construction sector, despite the fact that it is thought to be a leading indication of safety performance. The concept of safety culture may be sensitive to regional factors; therefore, it is important to look at how it is defined and applied to enhance safety in various areas. Notably, Luo (2020) noted that safety practices are components of safety atmosphere, which is the culmination of workers' collective impressions of the safety-related rules, guidelines, and practices in their workplace.

Peiró, Nielsen, Latorre, Shepherd and Vignoli (2020) state that safety training is a key component of improving workplace safety by promoting behavioral change. It is essential to get an awareness of

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how accidents and injuries happen and how to prevent them. In their comprehensive study of safety management studies in the construction sector, Zhou, Goh, and Li (2015) emphasized that safety training is a crucial technique for reducing accidents. Attitudes to occupational health and safety (OHS), beliefs, and knowledge are shown to be significantly impacted by OHS training, according to a meta-analysis conducted by Ricci et al. (2016). Also, safety training is a crucial component of job intervention meant to improve the safety climate, which is commonly believed to have a favorable effect on employee performance in terms of safety (Clarke, 2013; Lee, Huang, Cheung, Chen & Shaw, 2019).

Latan, Jabbour, de Sousa Jabbour, Wamba and Shahbaz (2018) similarly posit that, a planning process that can integrate corporate strategy with safety issues, the application of safety practices, and the commitment of top management are all necessary to achieve a world-class safety performance. According to Spencer et al. (2013), a firm that prioritizes environmental sustainability (Hassan et al., 2019; Akanmu & Nordin, 2022) is often reliant on the support of safety practices, which can eventually lead to the attainment of a stronger competitive edge.

According to Umar and Egbu (2018), as the main components of a strong safety culture, management commitment, expertise for safety, and effective safety communication must be taken into account when determining the safety environment. The study posits that in addition to management commitment, other factors that must be taken into account are worker training, on-site safety communication, and worker motivation and behavior. In the same view, Umar (2020) reported that the most important components of a safe workplace environment are management commitment, employee engagement, training, conduct, safety communication, accountability and justice, and leadership. Thus, social engagement and communication are essential for the development of safety constructs (Umar & Wamuziri, 2016).

Literature Review

Safety Practices and Performance

Hinze et al. (2013) state that safety performance has traditionally been assessed using total recordable injury frequency rate (TRIFR), accident rate and death rates. Nonetheless, these actions have drawn criticism for their reactive character and inability to offer early disaster warnings (Guo, Yiu & González, 2015). However, there has been a shift in favour of measuring safety performance via leading indicators. As effective measures of safety performance, for instance, safety participation and safety compliance are often employed (Guo, Yiu & González, 2016). Adhering to regulations in essential safety tasks is the definition of safety compliance. This entails strictly following safety protocols and doing tasks in a manner that prioritizes safety. Safety participation encompasses actions that contribute to the establishment of a safety-oriented environment. This frequently entails assisting colleagues, advocating for the workplace safety program, exhibiting proactivity, and dedicating oneself to enhancing workplace safety. According to Chen, McCabe, and Hyatt's (2017) findings, safety climate has a dual impact on construction workers. It directly influences their safety performance and also indirectly affects their psychological stress levels.

Consequently, there are several dimensions and metrics for safety performance in the workplace. These dimensions and measurements have been used as substitutes for assessing safety performance at the organizational level, according to different definitions. Multiple literary studies have demonstrated that the most reliable indicators of safety performance are the rates of injuries and accidents (Mearns et al., 2003). Nevertheless, these safety performance measurements present issues due to their inadequate sensitivity and disregard for risk exposure. As a result, several studies increasingly support the use of subjective methods, such as assessing the psychological experience of safety (Martha, Sanchez & Gomà-i-Freixanet, 2009).

However, at the organizational level, several researchers have utilized alternative dimensions to examine safety performance. Moreover, scholarly investigations have uncovered that experts hold varying viewpoints about the dimensions and metrics of safety performance. Feng et al. (2014) observed that there is no definitive criterion for sustainable performance that is universally better to others. The selection of a rule relies on the specific aim of evaluating the resources at hand.

Workplace injuries and accidents are rare occurrences that are often studied by workplace safety experts as the last outcomes in a series of causes and effects. Modern theories on work-place safety, such as the one proposed by Brondino et al. (2012), emphasize the significant influence of safety performance on crucial work place results. Griffin and Neal (2000) proposed that safety performance encompasses both safety compliance and safety participation. Safety participation involves voluntary

actions, such as assisting colleagues in enhancing workplace safety (referred to as safety citizenship behaviors). On the other hand, safety compliance entails adhering to essential activities that ensure safety, such as wearing personal protective equipment (Neal et al., 2004). Safety compliance refers to the degree to which personnel follow safety procedures and perform their job duties in accordance with established safety regulations, rules, and policies (Neal et al., 2004).

In the same vein, the importance of safety within an organization is better demonstrated via actions rather than just words. Probst and Brubaker (2001) suggested that the enforcement of safety measures by supervisors, known as extrinsic safety motivation, would be associated with employee safety compliance to safety protocols in the workplace. In their study, Fugas et al. (2012) examined the influence of cognitive and social factors on workers' compliance with safety regulations. They found that supervisors' expectations regarding safety and workers' perceived ability to manage their behavior were significant predictors of compliance with safety measures. A further meta-analysis conducted by Clarke (2013) found that transactional safety leadership, characterized by an emphasis on supervisor enforcement, is a stronger predictor of safety compliance compared to transformational leadership, which is more associated with discretionary safety behaviors. Thus, this study specifically selected safety compliance and participation as dependent variables of relevance within the context of safety performance.

Nicholas, M. Dickson, and Okeke (2022) determined the reported reasons of buildings that fell in Lagos, Nigeria between 2009 and 2019 as illustrated in Table 1. Data were evaluated using content analysis, descriptive statistics, and percentages. According to research findings, most incidents were caused by the use of inferior construction materials, with a small number being caused by natural occurrences.

Table 1. Records for Building Collapse from 2009 To 2019 in Nigeria

S/N	Location	Date of Collapse	Type of Building	Causes of Collapse	Casualty
1	Lagos	Jun-09	Two storey building	Not reported	7
2	Isopakodowo street, Cairo oshodi Lagos	26th April 2010	Residential building under construction	Use of substandard material	4 died 12 were injured
3	Adenike Street off new market oniru estate VI Lagos	2nd June 2010	Uncompleted storey building	Use of substandard materials1	1 died 2 injured
4	Tinubu street VI Lagos	28th September 2010	4-Storey Building	Structural defect	3
5	No 9B Adenubi close ikeja Lagos State	13th March 2011	5- storey hotel under construction	Poor quality concrete	2
6	No 6 Magaji close idumota Lago	Jul-11	3-storey building	Not reported	18
7	Aderibigbe street, Maryland Lagos	Oct-11	A penthouse	Structural failure	2
8	Muri Okunola street Eti-Osa LGA of Victoria Island Lagos	4th November 2012	Collapsed of a building (in use)	Structural Failure2, Occupants ignored governments safety warning	3
9	74 Corporation drive Dolphin Estate, Ikoyi Lagos	20th November 2012	Collapsed of a building	Structural Failure	-
10	Ojodu, Lagos	8th May 2013	2-storey Building under construction Illegal approval	Structural failure	1

11	Ojodu, Lagos	May-13	Three storey building	Not reported	2
12	Agege motor road, Mushin Lagos	11th June 2013	Three storey building	Unauthorized conversion. Use of quacks	1
13	Ishago road, Surulere Lagos	21st July 2013	2-storey uncompleted building under construction	Non-compliance to regulatory authority warnings4 Inferior Building materials	4
14	Ebeute-meta, Lagos	11th July 2013	Residential Building	Structural Defect	7
15	Lagos Island	25th September 2013	Three storey building fell on a bungalow	Not reported	2
16	Pedro police station, somolu Lagos	30th June 2014	2-storey barrack building	Not reported	-
17	Bucknor estate, Jakande-Isherioshun Rd.Ejigbo/isolo Lagos State	30th July 2014	The collapse of three storey building	Structural failure	-
18	Lagos	12th September 2014	The collapse of a warehouse at synagogue church	Demolition process	4
19	Ebute Meta Lagos	15th July 2015	3-storey Residential Building	Structural defects	4 rescued
20	Swamp street Odunfa Lagos island	21st October 2015	3-storey Residential Building	Structural defects	4 rescued
21	Lekki, Lagos	9th March 2016	Five storey Building Under	Heavy rainfall, foundation failure	34
22	Mile 12, Lagos	19th March 2016	Two storey building	Structural defects	1 dead, 1 injured
23	Lagos Island	27th August 2017	Residential Building	Heavy downpour, Vibration	8
24	Lagos	February 3rd, 2019	3-storey Building	Not reported	2 dead, 1 injured
25	Ita-faji, Lagos Island	13th March 2019	3-storey building	Old age Non-compliance to regulatory authority warnings	20 dead, 41 Injured

Source: Nicholas et al. (2022)

Following the annual report on the 10,000,000 occupational injuries that happen, Liu et al. (2015) investigated the connections between occupational injuries among manufacturing workers and three safety behavior dimensions—personal protective equipment, safety initiatives, and safety compliance—as well as four safety climate dimensions—management commitment, safety supervision, coworker support, and safety training. The study demonstrated that safety behavior significantly mediates the link between safety climate and unintended injuries and identified a substantial correlation between various safety practices, safety behavior, and unintentional injuries.

According to Agyekum, Simons and Botchway (2018), effective site safety procedures protect people, cut costs, and increase staff morale—three advantages in one. Karakhan and Gambatese (2018) added that part of the risk management process, exercising control over safety risks entails putting policies, procedures, and practices in place to lessen the likelihood that employees will be

exposed to risks and/or lessen the severity of the fallout from an occurrence. Consequently, it is critical to look at the key safety procedures that affect the level of safety performance in the construction sector.

Hypotheses Development

The behaviour-based safety BBS has been employed for workers to reporting unsafe behaviours, near misses, and incidents, especially if it is related to penalties and punitive measures. However, BBS approaches may not be sustainable and in some cases fall back to the baseline when "reinforcers" are removed, explicitly indicating that the modified behaviour was controlled. Regardless of the criticisms of BBS, this study considers it to be an invaluable approach that can be utilised to inspire construction workers to be self-accountable and take responsibility for their unsafe actions through a process of reflection and learning. Thus, the hypotheses are developed as follows:

Relationship between Perceived Management Commitment and Safety Performance

The association between production pressure and social support and management commitment is substantial. Management commitment is shown to be a crucial element that significantly and directly affects safety knowledge, safety compliance, and employee motivation and employee involvement. The impact of social support on safety behaviour is shown to follow the same trajectories as management commitment, with the exception that it has a negligible effect on safety involvement. Safety engagement is substantially and favourably correlated with safety knowledge and safety motivation (Guo, Yiu & González, 2016).

Compliance with safety procedures, employee participation in safety, and attitudes toward safety are all positively and significantly connected with management leadership focusing on safety (Mullen, Kelloway & Teed, 2017). Additionally, leadership acted as a moderator; that is, there is a larger association between perceived employer safety requirements and safety performance (i.e., safety engagement, safety compliance, and safety attitude) when safety-specific transformational leadership is high compared to low. Therefore, it can be hypothesized that:

Hypothesis 1: Perceived management commitment has a positive and significant effect on safety performance

Relationship between Safety Culture and Safety Performance

Safety performance statistically favourably correlated with both the safety culture (SC) and the safety management system (Otitolaiye et al., 2019). A positive SC is necessary to ensure organizational safety results, according to past empirical investigations on occupational safety (e.g., Hajmohammad & Vachon, 2014; McFadden, Henagan & Gowen, 2009). The SC setup provides high rate of employee safety behavior and employee safety compliance which helps to reduce injuries and accidents (Hofmann & Stetzer, 1996). Empirically, hospital organizations see improved safety outcomes when they strengthened their safety culture (McFadden et al., 2009).

According to Trinh and Feng (2020), safety culture is a reflection of the visible level of effort that all members of a company put in to improve safety on a daily basis. Psychological, environmental, and behavioral safety-related aspects make up a helpful framework for assessing safety culture and offering insights into the link between safety culture and safety performance metrics, according to previous research (Choudhry, 2017; Fang & Wu, 2013) that attempted to explain the idea of SC. Building a SC may help a company become more adept at handling unforeseen occurrences, human error on the part of personnel, and project dangers. This will help the company to maintain a high level of safety performance in the construction sector (Trinh, Feng, & Jin, 2018; Trinh, Feng, & Sherif, 2019).

In a related study, Canadian enterprises with important factors influencing the firm's safety performance in place has better SC ratings (Hajmohammad & Vachon, 2014). Companies with a SC that have management that is dedicated to and interested in safety often do well (Fernandez-Muniz, Montes-Peon & Vazquez-Ordas, 2009). This study therefore proposed that:

Hypothesis 2: safety culture has a positive and significant impact on safety performance

Relationship between Safety Training and Safety Performance

Alruqi, Hallowell and Techera (2018) state that there is a strong relationship between safety management commitment, supervisory safety standards, safety regulations and procedures, training and personal accountability for safety and health and occupational injuries. The supervisory safety function is found to have a moderate impact on injuries at both the individual and group levels, among other dimensions. A moderate association is found between self-reported injury and management

commitment to safety. There is a minor impact on injuries from both individual responsibility and safety regulations and procedures. Thus, the association between injury and individual training and group management commitment is less.

Studies (such as O'Connor, Loomis, Runyan, Abboud dal Santo & Schulman, 2005; Trajkovski & Loosemore, 2006) show that between two thirds and three quarters of the selected migrant workers got some sort of safety training. However, safety training may not be pursued at all. These particular dangers and difficulties also show how important it is to develop customized standards for assessing how well safety training affects the safety performance of construction workers. Prior systematic reviews of the literature on OHS training have mostly concentrated on the belief, attitude, bahaviour, and knowledge effects of the program (Ricci et al., 2016; Robson et al., 2012). Also, the study of Asari and Leman (2015) examined how safety training is now assessed using the 4-level training assessment model of Kirkpatrick and came to the conclusion that it is seldom assessed in connection to safety performance.

According to Asari and Leman (2015), most of the time, just the first level of safety training—reactions to training—is examined. As a result, evaluation provides minimal guidance on how to develop future safety performance. This study, therefore, hypothesised that:

Hypothesis 3: Safety training has a positive and significant association with safety performance

Relationship between Safety Motivation and Safety Performance

The safety scale of Neal, Griffin and Hart (NGH) have strong cross-group support according to the study of Neal et al. (2000). Additionally, it is shown that, the impacts of safety climate on safety knowledge and motivation are consistent across national boundaries, and that these factors positively correlate with both compliance and participation (Barbaranelli, Petitta & Probst, 2015). Similar to this, safety regulations and work practices are found to be the most disregarded element, whereas safety promotion and safety enforcement is recognized as a novel safety culture factor (Zahoor, Chan, Utama, Gao & Zafar, 2017).

Theories of work performance state that motivation and knowledge interact to affect performance (Campbell et al., 1990). According to the study, three factors determine performance components: motivation; procedural knowledge; and declarative knowledge. Safety scientists such as Neal et al. (2000) and Vinodkumar and Bhasi (2010) sometimes combined the first two components into a single one (i.e., safety knowledge) when explaining safety behavior. For instance, safety performance is found to be closely correlated with safety knowledge and safety motivation by Christian et al. (2009). Similarly, Brown et al. (2000) discovered a substantial association between employee safety behavior and their safety efficacy and attitude. Neal and Griffin (2006) discovered that safety compliance and involvement are predicted by safety motivation and safety knowledge. Therefore, it can be hypothesized that:

Hypothesis 4: Safety motivation has a significant and positive effect on safety performance

Relationship between Risk Perception and Safety Performance

According to Li, Ji, Yuan and Han (2017), increasing working pressure would be more beneficial for enhancing employees' self-perception of safety than would their awareness of and attitude toward safety. According to Chen et al. (2019), there is a big difference in "risk decision making" and the strong convergence between the management and laborer groups in the area of "workmate care of each other." In a similar vein, Chen, McCabe and Hyatt (2017) claimed that the safety atmosphere has an indirect impact on construction workers' psychological stress in addition to their safety performance. Furthermore, it is discovered that while individual resilience has no effect on physical safety results, it directly and negatively impacts psychological stress.

Although it is often acknowledged that creating a good safety atmosphere has advantages, the impact of safety procedures hazard identification and safety risk perception has not been studied. Few studies have investigated whether safety risk perception can impact safety performance levels, building on the previously stated data (Christian, Bradley, Wallace, & Burke, 2009; Lingard et al., 2012) that relates safety risk perception with safety outcomes. Hazard identification is often followed by safety risk perception. In another vein, workers cannot comprehend the related safety risks if they are unable to identify construction dangers. Improvements in danger detection abilities may therefore result in increased perceptions of safety risk. Thus, this research posits that:

Hypothesis 5: Risk perception has a significant and positive impact on safety performance

The Moderating Effect of Safety Communication between Safety Practices and Safety Performance

Guo et al. (2012) developed game-based visualization settings that expose workers to risks similar to those anticipated on site in order to help workers overcome the gap in transforming information learned during remote collaboration into specific site activities and appropriate attitudes by using simulation and visualization that enhances safety communication. During risk communication, this sensory exposure to simulated risks in immersive virtual environments stimulates workers' perceptions and recollection of the same threats in real-world settings (Guo et al., 2020). Under ideal circumstances, computer-based simulation and visualization's dynamic representations of the building process provide great chances to evaluate risks and communicate potentially hazardous areas in an intuitive manner that may not be easily seen with conventional 2D drawings (Dainty et al., 2007).

Research emphasizes how important communication is in creating mutually agreed-upon group norms since social interaction can only happen when there is communication, and norms cannot exist when there is no contact among the members of a construction group. In addition, safety communication is the means by which group members create, comprehend, and share norms (Lingard et al., 2019). Within organizational safety procedures, communication takes place at several levels and has been connected to worker-management safety performance (Conchie & Burns, 2008) as well as workers' willingness to raise safety problems (Kath et al., 2010). When many workers are engaged in small subcontracted groups, intra-group communication may have a bigger impact on employee engagement in building projects and adherence to safety standards than do H&S policies and procedures developed by the management of the organization. Therefore, the management's safety communication strategies in subcontracted workgroups working in the company are the target subject of this study.

Mattila et al. (1994) posit that when discussing safety performance with workgroup members, management commitment is crucial. The study of Alsamadani et al. (2013) examined supervisor-worker communication in construction work teams. The crews with the greatest relative health and safety performance get formal safety communication from management at least once a week, as determined by study on the health and safety performance of nine work crews. There is little to no formal safety communication between management and employees among the bottom three performers.

In order to improve site safety performance, intelligent monitoring—which combines prior safety knowledge and regulations with methods like wearable sensing, computer vision and machine learning—has been the subject of several research lately. In order to enable risk communication, rapid detection and possible accident among the stakeholders, this is done to offer automatic hazardous scenario recognition (Soltanmohammadlou et al., 2019; Zhang et al., 2022). Examples of technologies created to deploy as safety management in workplace include real-time computer vision, geographic information systems (GIS), global positioning systems (GPS), and 3G network tracking of site workers and elements (Seo et al., 2016). Therefore, it can be hypothesized that:

Hypothesis 6: Safety communication has a significant and positive moderating impact on safety practices and safety performance

Methodology

This study focuses on Nigerian construction companies and data collection were conducted from the individuals within the selected 330 construction companies in Lagos, Nigeria. Because of the magnitude of the current population, the approach to sustainable urban mobility, and the future of architectural structure in accordance with international norms, this study looks at the current status of the Lagos state building system. Furthermore, Lagos State, home to an estimated 20 million inhabitants, is the fifth-largest metropolis in Africa (Buhari, Aponjolosun, Oni, & Sam, 2020). The respondents can be drawn from the organization's technical staff that work at the field and who are capable to represent the company in providing precise information. Using the active administrative employees as the targeted population, a non-probability sampling shall be employed and the G-Power analysis shall determine the eventual sample size.

Owing to the intricate questionnaire structure that covers a wide range of topics, directors in charge of various departments, including operations management, R&D, exports, legal and secretarial matters, finance, human resources, marketing, and other related departments, may jointly answer the questionnaire) at the company's discretion. In a similar vein, the Smart PLS by Ringle et al. (2015) is employed in this study as the tool of analysis. Smart PLS is a powerful and multivariate technique that entails special case of specified version of number of other analyses approaches.

Result and Analysis

Construct Validity

The assessment of the construct validity is done through the content, convergent, and discriminant validity (Hair et al., 2019).

Content Validity

According to Hair et al. (2010), content validity is the extent to which suggested items to assess the constructs appropriately measure the ideas that they are intended to measure. The designed items are meant to measure the constructs with high loading than the loading on the other construct respectively; this is enforced by how the items are generated. All items are accurately allocated to their respective constructs based on the principle of factor analysis. Table 2 displays the measurements' content validity: First, in comparison to other goods, the items with their associated constructs have the largest loading. The second method, according to Chow and Chan (2008), is when the items strongly load on their respective constructs, demonstrating the measures' content validity.

Table 2. Factor Loading (Outer Loading)

	PMC	RP	SCO	SCU	SM	SP	ST
PMC1	0.571						
PMC2	0.731						
PMC3	0.766						
PMC4	0.533						
PMC5	0.577						
RP1		0.735					
RP2		0.792					
RP3		0.784					
RP4		0.816					
RP5		0.819					
RP6		0.741					
SC1						0.851	
SC2						0.836	
SC3						0.837	
SC4						0.855	
SCO1			0.822				
SCO2			0.487				
SCO3			0.549				
SCO4			0.816				
SCO7			0.431				
SCU1				0.537			
SCU2				0.734			
SCU3				0.665			
SCU5				0.619			
SM1					0.653		
SM2					0.661		
SM3					0.843		
SM4					0.847		
SP1						0.739	
SP2						0.834	
SP3						0.824	

SP4						0.819	
ST1							0.693
ST2							0.789
ST3							0.811
ST4							0.809
ST6							0.587
ST7							0.647

Note: PMC: Perceived Management Commitment; RP: Risk Perception; ST: Safety Training; SCU: Safety Culture; SM: Safety Motivation; SCO: Safety Communication; SP: Safety Participation; SC: Safety Compliance

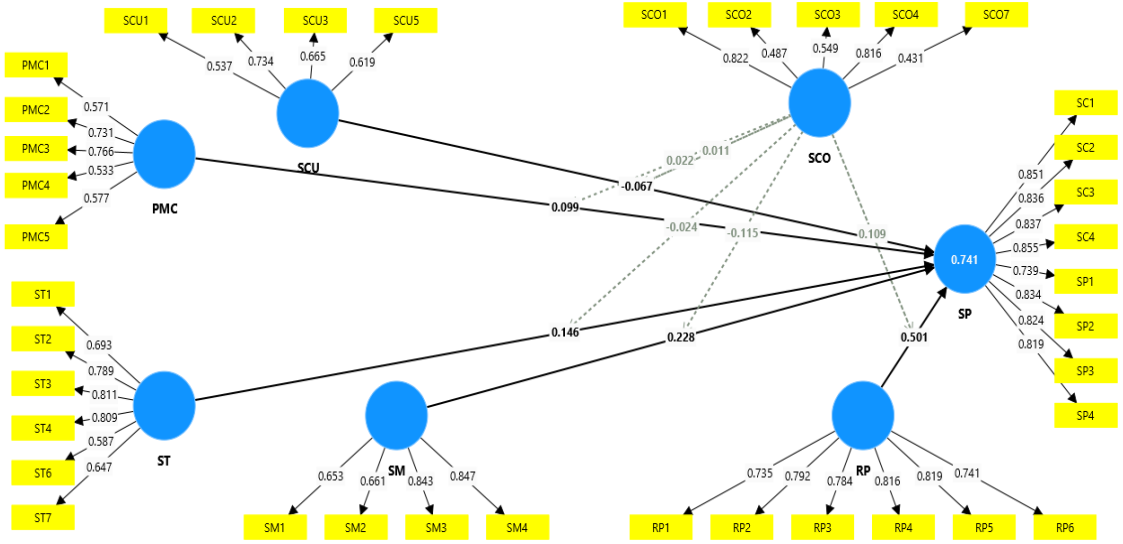

Figure 1. Measurement Model

The Convergent Validity

Convergent validity is the degree to which a group of variables appears to assess a notion. (Hair et al., 2021). There are three requirements that tested concurrently to confirm the convergent validity: factor loading; AVE; and composite reliability. Following the multivariate analysis, the values are acceptable - they are more than 0.4 when all the items loading are examined. As presented in table 3, all the factors are said to be significant at a (significant) level of 0.01. Composite reliability, which measures the extent to which sets of items consistently display the latent variable, is another method used to verify the convergent validity (Hair, 2014). The values of the Cronbach's Alpha and composite dependability are shown in Table 3. The threshold value of 0.70 and 0.50 is exceeded by the values of the composite reliability and Cronbach's Alpha, which respectively range from 0.735 to 0.944 and 0.552 to 0.933 (Fornell & Larcker, 1981). The outcomes validate the convergent validity of the outer model.

To determine the convergent validity of the outer model, the AVE values are analyzed. It displays the items' AVE in relation to the measurement errors shared variance. In comparison to the measurement error variance, the AVE calculates the variation covered by the indicators. When the AVE is more than 0.50, Barclay et al. (1995) state that these items have sufficient convergence to assess a specific concept. The values of AVE were examined to determine the convergent validity of the outer model. It displays the average extracted variance for the set of elements of the variance shared with the measurement error. AVE measures the variation covered by indicators in comparison with the variance attributed to measurement mistakes. The required threshold values for the parameters are Average Variance Extracted (AVE) ≥ 0.5. However, AVE equal to 0.4 can be accepted if the composite reliability is higher than 0.6 for the particular constructs (Fornell & Larcker, 1981).

Table 3. Measurement Modelling After Deleting

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
PMC	0.680	0.709	0.775	0.413
RP	0.872	0.876	0.904	0.611
SCO	0.663	0.760	0.767	0.413
SCU	0.552	0.557	0.735	0.413
SM	0.760	0.817	0.841	0.573
SP	0.933	0.934	0.944	0.681
ST	0.821	0.845	0.870	0.530

Note: PMC: Perceived Management Commitment; RP: Risk Perception; ST: Safety Training; SCU: Safety Culture; SM: Safety Motivation; SP: Safety Performance; SCO: Safety Communication

The Discriminant Validity

Establishing the discriminant validity of the model is crucial before looking at its construct validity. Thus, before the hypotheses are verified using route analysis, the discriminant validity must be assessed. The measure reveals that level in which items are different among the constructs. In the same vein, the discriminant validity shows no overlap from the items with different constructs. Additionally, Compeaus, Higgins and Huff (1999) stated that variance between the constructs are shared through the discriminant validity. The construct's variance should be lower when compared to the discriminant values.

As a result, the method of Fornell and Larcker (1981) is used in this study to verify the measure's discriminant validity. The square root of the AVE for each construct that was substituted at the correlation matrices' diagonal elements is shown in Table 4. As a result, the discriminant validity of the outer model is confirmed in cases when the values of the table's diagonal elements are higher than those of the other components in the row and column in which they are displayed. From the test carried out on the construct validity, the result is reliable and highly validated for the outer model.

Table 4. Fornell-Larcker Criterion

	PMC	RP	SCO	SCU	SM	SP	ST
PMC	**0.642**						
RP	0.217	**0.782**					
SCO	0.208	-0.300	**0.643**				
SCU	0.310	-0.127	0.450	**0.643**			
SM	0.250	0.727	-0.266	-0.022	**0.757**		
SP	0.265	0.827	-0.287	-0.130	0.725	**0.825**	
ST	0.140	0.764	-0.250	-0.117	0.647	0.714	**0.728**

Assessments of the Inner Model and Test of the Hypothesis

The hypotheses developed for the variables were be tested after the model goodness had been validated and were examined through Smart PLS-SEM algorithm and the path coefficient was generated. For this reason, a separate structural model was run to evaluate the proposed assumptions of this research.

Table 5. The Assessment of the Inner Model and Hypotheses Testing Procedures

	Original sample (O)	Sample mean (β)	Standard deviation	T statistics	P values	Results
H1: PMC -> SP	0.099	0.102	0.037	2.696	0.007	Supported
H2: SCU -> SP	-0.067	-0.072	0.044	1.511	0.131	Not supported

H3: ST -> SP	0.146	0.147	0.051	2.866	0.004	Supported
H4: SM -> SP	0.228	0.226	0.057	4.035	0.000	Supported
H5: RP -> SP	0.501	0.501	0.070	7.118	0.000	Supported

Note: PMC: Perceived Management Commitment; RP: Risk Perception; ST: Safety Training; SCU: Safety Culture; SM: Safety Motivation; SP: Safety Performance

The bootstrapping technique is embedded in smart PLS 4.0 to determine if the path is or not statistically significant. Table 5 reports the values of T-statistics with each path coefficient that are evaluated through consistent bootstrapping while subsequently generating the P-value. In hypothesis H1, the PMC has significant impact on safety performance (β = 0.102, t=2.696, p-value = 0.007). In contrast, safety culture for H2 (β = -0.072, t =1.511, p-value = 0.131) is not significantly related to safety performance. For the H3 (β = 0.147, t =2.866, p-value = 0.004), safety training has significant impact on safety performance; hence, the third hypothesis is supported.

Also, the result of H4 (β = 0.226, t =4.035, p-value = 0.000) showed that safety motivation significantly impacts safety performance, making hypothesis H4 supported. Similarly, risk perception with the results H5 (β = 0.501, t =7.118, p-value = 0.000) significantly impacts safety performance. This shows that H5 is supported. The results show that the respondents consider perceived management commitment, risk perception, safety training, and safety motivation as practices that do influence their safety performance in the construction companies. Additionally, the small values of the standard errors show that perception is the same and agreed upon by the employee of the selected construction companies in Nigeria

Moderation Effect of Communication

The theoretical model proposes the moderation of safety communication between perceived management commitment, risk perception, safety training, safety culture and safety motivation and safety performance. The Smart PLS examines the moderation of safety communication between the independent and dependent variables. The results from the hypotheses are presented in table 6. The results show no mediation of safety communication between perceived management commitment and safety performance (β = 0.022, t =0.697, p-value = 0.486). Although, the direct relationship between perceived management commitment and safety performance is significant as presented in table 5, the hypothesis is not supported. Similarly, the result (β = 0.010, t =0.342, p-value = 0.732) of safety culture is not significant as moderated by safety communication to safety performance and not significant likewise through direct relationship. The relationship between safety training (β = -0.020, t = 0.483, p-value = 0.629) and safety performance with the moderating effect of safety communication is also insignificant, however the direct path is significant.

The result (β = -0.109, t = 2.286, p-value = 0.022) similarly showed that safety communication does mediate the association between safety motivation and safety performance. Therefore, the moderation is supported. However, risk perception has values (β = 0.106, t= 1.452, p-value = 0.147) that have no significant impact on safety performance as moderated by safety communication. As a result, the relationship is not supported.

Table 6. Hypothesis Testing on Moderation of Communication

Hypotheses	Original sample (O)	Sample mean (M)	Standard deviation	T-statistics	P values
SCO x PMC -> SP	0.022	0.022	0.031	0.697	0.486
SCO x SCU -> SP	0.011	0.010	0.034	0.342	0.732
SCO x ST -> SP	-0.024	-0.020	0.049	0.483	0.629
SCO x SM -> SP	-0.115	-0.109	0.050	2.286	0.022
SCO x RP -> SP	0.109	0.106	0.075	1.452	0.147

Conclusion

Construction companies are putting a lot of effort into reducing occupational accidents for a variety of reasons, including cost, personnel, and competitiveness. While some have effectively put safety

systems into place and are working to further enhance, others may have implemented good safety programs but have not been able to reduce accidents. Practically speaking, this study enlightens Nigerian construction companies—particularly those in the more urban areas—more about safety management systems and how to use them to lower workplace accidents. This is significant because putting in place a safety management system may help businesses meet organizational safety objectives. Furthermore, by examining current safety management practices and taking into account workers' conditions when implementing safety interventions, the study's findings may help managers, practitioners, and policymakers in the construction industry design and implement crucial measures to improve workplace safety with the introduction of rigorous safety communication. More so, it will be valuable for the managers since it will enhance their understanding to increase safety performance from specific safety practices rather than focusing on the broad term of the safety management system.

As this study intends to investigate the moderating role that safety communication plays in the connection between safety performance and safety practices in construction companies, this study is highly valuable in terms of theories and highlighting the significant impact of practices such as perceived management commitment, safety training, safety motivation and risk perception. Notably, there is still paucity of studies employing safety communication as a moderator to safety performance in the construction industry at the theoretical level; thus, this study revealed how safety motivation and performance. Furthermore, a large number of earlier national studies did not take place in high-risk industrial environments while this study selected Lagos, Nigeria being the most industrialized city in Nigeria. Once more, in the Nigerian context, there is essentially no literature on the subject of the current study. Thus, with a focus on the Nigerian context and the construction industry specifically, the current study will greatly advance understanding of how safety practices—such as safety motivation, safety culture, safety training, and perceived management commitment—relate to organizational safety performance and how working conditions can further explain this relationship. Also, this study is unique theoretically because it employs salient indicators as measures of organizational safety performance, primarily measured using safety participation, safety compliance, and other organizational safety metrics.

In addition, one of the purposes of this study is to hypothetically explore how safety procedures affect safety performance in Nigeria's construction sectors. Therefore, the study takes an employee-focused method to safety performance, in contrast to previous research that highlights external human factors as antecedents of safety performance. The link between safety practices and safety performance has been the subject of several research, but from a theoretical perspective; the majority of these studies have only acknowledged practices with a one-dimension structure and have ignored the implications of its sub-dimensions. This study is noteworthy and well-positioned to make theoretical contributions as it has given an evidence-based knowledge of how all aspects of safety practices affect safety communication, which in turn affects safety performance in organizations. This is a unique and noteworthy addition to the corpus of knowledge in the areas of safety management.

The study suggests that safety policies and regulations for construction companies should be strong and comprehensive in order to reduce site-related risks through a framework or mechanism. Government ministries and agencies must provide the necessary guidance, stringent oversight, and enforcement of personal protective equipment (PPE) for their employees. This study therefore can incite the relevant government authorities to consider enacting the Labour, Safety, Health and Welfare Bill 2012 (revised in 2016) Act. This study shows that due to the slack implementation of construction site safety in many locations, particularly in indigenous construction sites, government authorities concerned with approval and enforcement of construction site safety need to revive their duties.

There are certain limitations on the research. One of them is that, this study only focuses on a geographical region of the country; thus, effort should be made in the future to collect data in a large scale for a critical empirical analysis. Also, although gathering a sizable number of participants are expected from the companies, the study does not cover all construction companies in Lagos state, Nigeria as some of them are strict in giving out information regarding their companies. In addition, the study only focuses on the administrative and technical employees of the companies; thus, future studies can extend the research into site workers only in order to uncover the challenges of safety performance during construction.

Conflict of Interest: The authors declare no conflict of interest.

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