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Safety Management System and Safety Measure Implementation in Building Construction Companies in Lagos, Nigeria

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Abstract
The construction industry experiences high injury and fatality rates and is far from achieving a zero-injury goal. Thus, effective safety management systems are critical to ongoing efforts to improve safety. The purpose of this study was to investigate the relationship between elements of safety management system and safety measure implementation in building construction companies in Lagos State, Nigeria. The data utilized in this study were based on stratified sampling of construction workers representing the selected companies for this study. Out of the 285 copies of self-administered questionnaire, 262 were used for the study, representing a response rate of 91.96%. Data were analyzed by descriptive and inferential statistics and presented in tables and figures. Findings from the study show that there was a positive relationship between management leadership ($r=0.593$, $p<0.05$), employee participation ($r=0.462$, $p<0.05$), hazard identification ($r=0.491$, $p<0.05$), hazard prevention ($r=0.452$, $p<0.05$), safety training ($r=0.450$, $p<0.05$), safety evaluation ($r=0.428$, $p<0.05$), safety communication ($r=0.590$, $p<0.05$) and safety measure implementation in the construction companies studied. Considering the average implementation of safety management system in the construction industry under study, more stringent occupational safety and health measures are recommended in construction workplaces.

Keywords: *Safety management system, Safety measure implementation, Construction industry, Lagos State, Nigeria*

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1. Introduction

The construction industry is one of the most hazardous industries (Edwards and Nicholas, 2002). Despite the significant improvement since the Occupational Safety and Health Act of 1970, workers still experience high injury and fatality rates in comparison to other industries (Bureau of Labour Statistics, 2013; Jazayeri and Dadi, 2017). According to the Bureau of Labour Statistics (BLS), in 2012 alone, the construction industry experienced 856 fatalities, and accounted for 19% of all fatalities among all industries (BLS, 2013). There are more than 60,000 fatalities reported every year in the construction industry around the world (Lingard, 2013). In the United States, the number of fatal injuries in construction increased by 16% from 2011 to 2014 (BLS, 2015). According to Zhou et al. (2015), the construction industry is far from reaching the goal of zero injuries. The year 2014 was particularly a dangerous year. Fatalities increased 5% (or 40 individuals) to 885, which is the highest number since 2008 (BLS, 2015). Almost half of all fatalities in 2014 were contracted workers (415 workers) working on construction projects, which, 108 of them were labourers, 48 of them were electricians, 44 of them were first line supervisors, 42 of them were roofers, and 25 of them were painters and construction maintenance workers (BLS, 2015).

About 350 million workers currently work in this industry around the world (Biswas et al., 2017). While in developed countries approximately 6-10% of the workers are employed in the construction industry, about 20-40% of deaths are attributed to this industry (Raheem and Hinze, 2014). The International Labour Organization (ILO) estimates that approximately 6000 workers die each day world wide and 337 million people are victims of work-related accidents or illnesses arising from occupational injuries (Marras et al., 2000). In Nigeria, the construction industry loses at least 5% of its workforce annually to injuries and fatalities, while the influx of new blood has

reduced by 17% compared to that of 1970s (Oh and Sol, 2008).

The construction industry experiences high injury and fatality rates and is far from achieving a zero-injury goal. Thus, effective safety management systems are critical to ongoing efforts to improve safety and the elements included in a safety management system should be identified to be used by practitioners to improve safety. According to Choudhry et al. (2007), the benefits of a safety management system in the construction industry are: (1) Reducing the number of injuries to personnel and operatives in the workplace through the prevention and control of workplace hazards, (2) Minimizing the risk of major accidents, (3) Controlling workplace risks improve employee morale and enhance productivity, (4) Minimizing production interruptions and reducing material and equipment damage, (5) Reducing the cost of insurance as well as the cost of employee absences, (6) Minimizing legal cost of accident litigation, fines, reducing expenditures on emergency supplies, and (7) Reducing accident investigation time, supervisors' time diverted, clerical efforts, and the loss of expertise and experiences (Choudhry et al., 2007).

Given that there is no comprehensive and complete information based on actual recorded data on the relationship between the elements of safety management system and safety measure implementation in the construction industry in Nigeria, the purpose of this study was to identify the information gap on the relationship between the elements of safety management system and safety measure implementation among building construction industries in the Lagos State.

2. Materials and methods

2.1 Research design

The study uses a cross-sectional design, where data are gathered from a large sample at specific times with aim of describing them without manipulation of variables (Thomas, 2020). In the extant study, the researcher looked at collecting data from sample workers from various building construction companies in Lagos state to describe the relationship between elements of safety management system and effective implementation of safety measures in the building construction companies in the study area. To achieve this, survey method was used for data collection via questionnaire. The survey research method provides a means of accessing information on population at a point in time.

2.2 Study area

The study area is Lagos State, situated in the South-West zone of Nigeria. It is between latitudes 6°23′N and 6°41′N and between longitudes 2°42′E and 3°42′E. On its North and East boundary is Ogun State. On the West, is the Republic of Benin, and on its south is the Atlantic Ocean/Gulf of Guinea. The State encompasses an area of 358,861 hectares or 3,577sq.km. Lagos State plays host to quite a number of building construction companies, both big and small among which are Julius Berger Nigeria Limited, Reynolds Construction Company (RCC), Energo Building Construction Company Limited. Lagos state is a hub of industrial and commercial activities. Hence, construction activities are constantly ongoing for expansion and development of business activities. Consequently, the state was considered suitable for the study.

2.3 Study population

The target population for the study comprised safety personnel, project managers and directors, site engineers and foremen from major building construction companies that operate in Lagos State. These companies include: Adold Engineering Company Limited, Julius Berger Nigeria Limited, Reynolds Construction Company (RCC), Energo Building Construction Company Limited, China Civil Engineering Construction Company (CCECC), Cappa and D'alberto Plc, El-alan Construction Company (Nigeria) Ltd, Constain West Africa, I.T.B. Construction Limited, Buildstruct Advance Builder Company, Brunelli Construction Company (Nigeria) Limited and Oat Construction Nigeria Limited.

2.4 Inclusion and exclusion criteria

The target companies were construction companies that deal in building of roads, houses and bridges. Companies included were those ones actively engaged in projects at the time of the study. They were also companies that had at least 37 workers including safety personnel as well as professionals and practitioners in the building industry on site at the time of the study. These people were included because the researcher thought they would understand the safety needs and requirements in the building construction activities. On the other hand, companies with less than 37 onsite construction workers and did not have safety personnel as well as building professionals and

practitioners were excluded from the population frame of the study.

2.5 Data collection and quality control

Questionnaire was utilized for the data collection designed to measure independent and dependent variables. The independent variable comprised the core elements of safety and health practice recommended for construction activities by Occupational, Safety and Health Academy (OSHA, 2016). These include leadership by management, employee participation, identification and assessment of hazards, hazard prevention and control, education and trainings, evaluation and improvement of programme, communication and coordination. The dependent variable comprised the implementation of safety measures.

The questionnaire was subjected to face validity and its reliability coefficient was obtained through test and retest method. The reliability coefficient was determined by distributing 20 copies to 20 top personnel of building construction companies who are not part of the study twice at an interval of two weeks. Data obtained were then subjected to Pearson Product Moment Correlation formula to calculate the reliability. A reliability coefficient of 0.95 was obtained.

2.6 Data analysis

Pearson-Product-Moment-Correlation (PPMC) was used to analyse data gathered for the study based on the assumption that the relationships between variables is linear. A correlation matrix was generated and used to present the correlation coefficients (r). The coefficient of correlation obtained was used to ascertain the degree of the relationship between the independent and dependent variables. Results are presented in Figures and Tables.

3. Results and discussion

3.1 Relationship of management leadership and safety measures

The result from the scatter plot in Fig. 1 shows that $R^2 = 0.3513$. This indicates that 35.13% of the variation in implementation of safety measures can be explained by the linear relationship between management leadership and implementation of safety measures as described in the regression equation. Furthermore, the slope of the line shows that for every incremental change or improvement in management leadership, there is a corresponding increase or improvement in the level of implementation of safety measures by 0.5179.

3.2 Relationship of employee participation and safety measures

The result from the scatter plot in Fig. 2 shows that $R^2 = 0.2136$. This indicates that 21.36% of the variation in implementation of safety measures is explained by the linear relationship between employee participation and implementation of safety measures. Furthermore, the slope of the line shows that for every incremental change or improvement in employee participation, there is a corresponding increase or improvement in the level of implementation of safety measures by 0.4014.

3.3 Relationship of hazards identification /assessment and safety measures

The result from the scatter plot in Fig. 3 shows that $R^2 = 0.2412$. This indicates that 24.12% of the variation in implementation of safety measures is explained by the linear relationship between hazards identification/assessment and implementation of safety measures. Furthermore, the slope of the line shows that for every incremental change or improvement in hazard identification/assessment results in a corresponding increase or improvement in the level of implementation of safety measures by 0.5396.

3.4 Relationship of Hazards Prevention and Safety Measures

The result from the scatter plot in Fig. 4 shows that $R^2 = 0.2043$. This indicates that 20.43% of the variation in implementation of safety measures is explained by the linear relationship between hazards prevention and implementation of safety measures. Furthermore, the slope of the line shows that for every incremental change or improvement in hazard prevention results in a corresponding increase or improvement in the level of implementation of safety measures by 0.3653.

3.5 Relationship of safety training and safety measures

The result from the scatter plot in Fig. 5 shows that $R^2 = 0.2027$. This indicates that 20.27% of the variation in implementation of safety measures is explained by the linear relationship between safety training and implementation of safety measures. Furthermore, the slope of the line shows that for every incremental change or improvement in hazard prevention there is a corresponding increase or improvement in the level of implementation of safety measures by 0.3873.

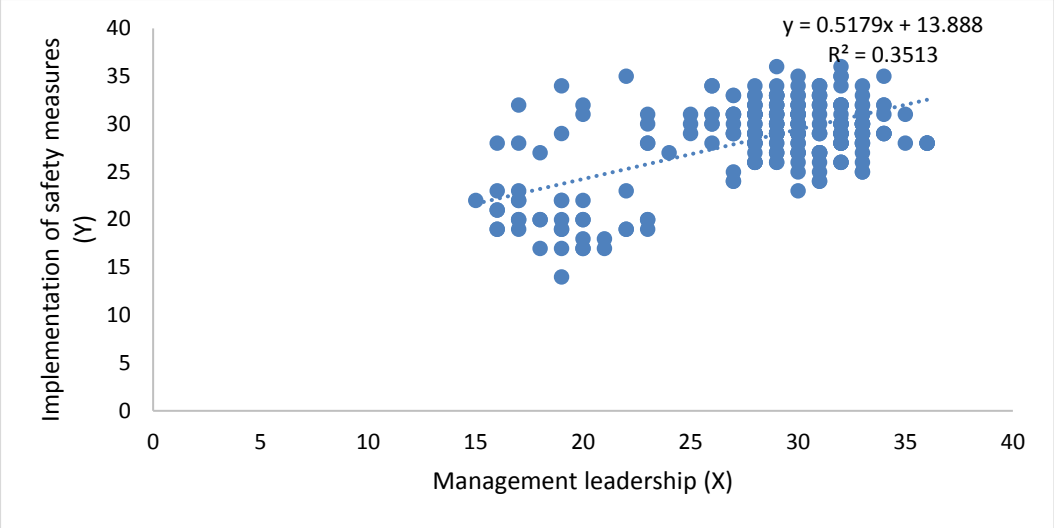

Fig. 1: Relationship between management leadership and safety measures

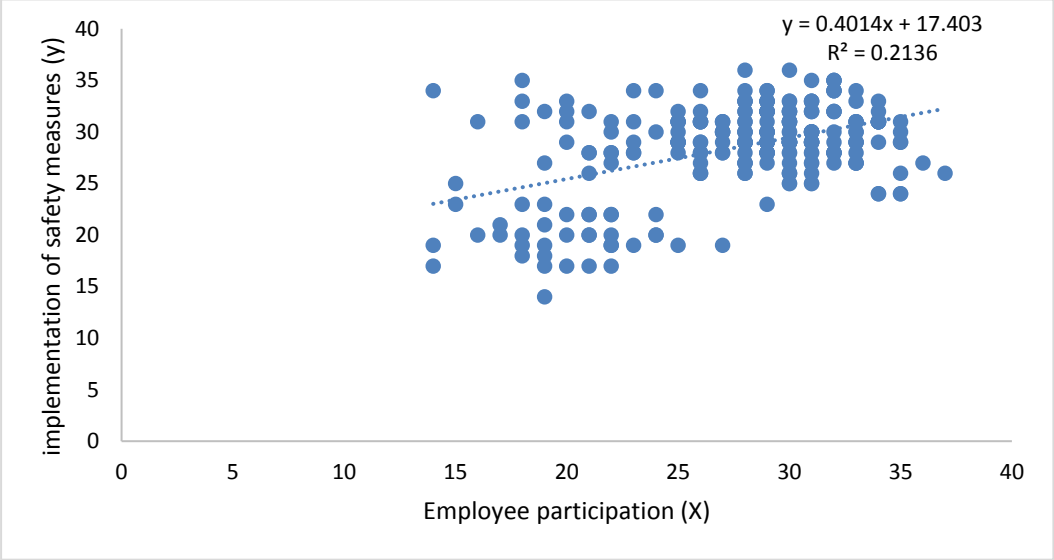

Fig. 2: Relationship between employee participation and safety measures

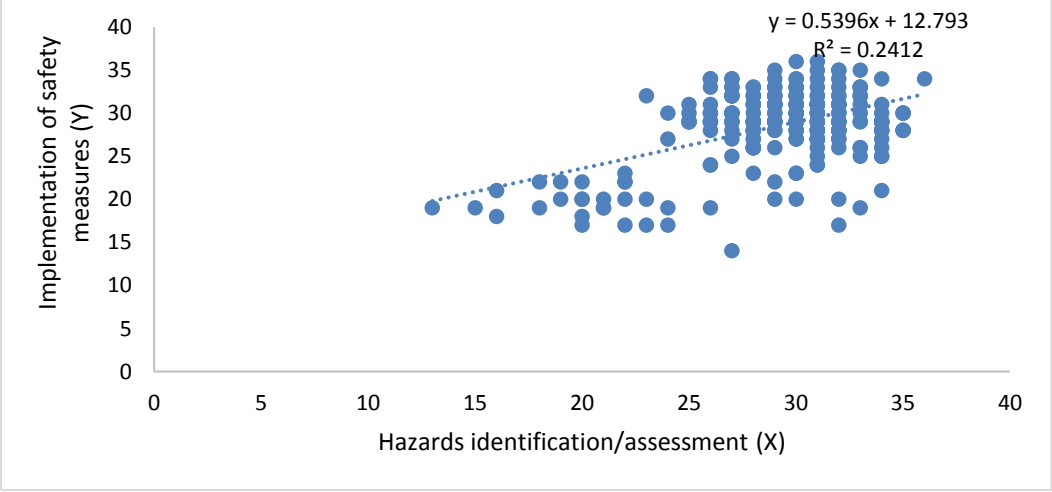

Fig. 3: Relationship between hazards identification/assessment and safety measures

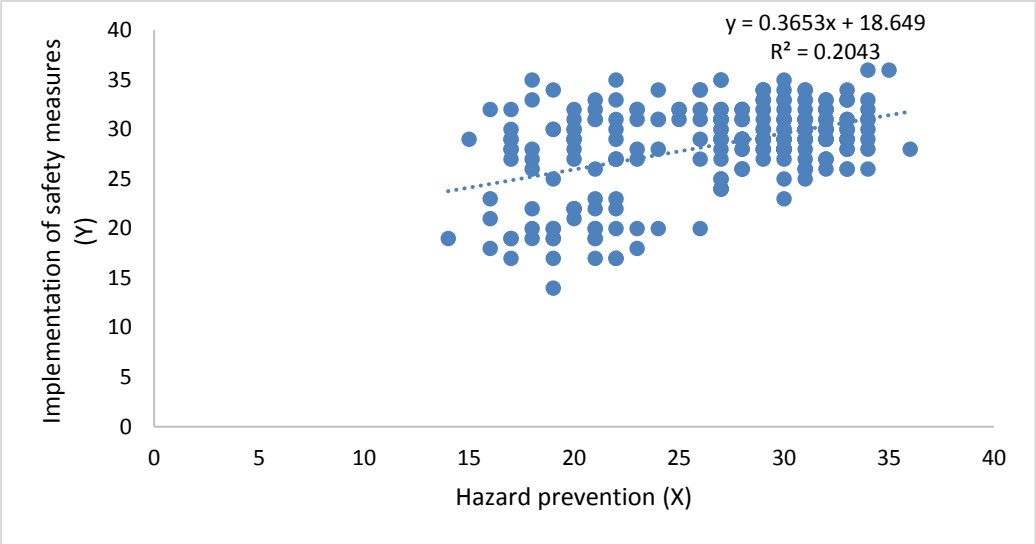

Fig. 4: Relationship between hazards prevention and safety measures

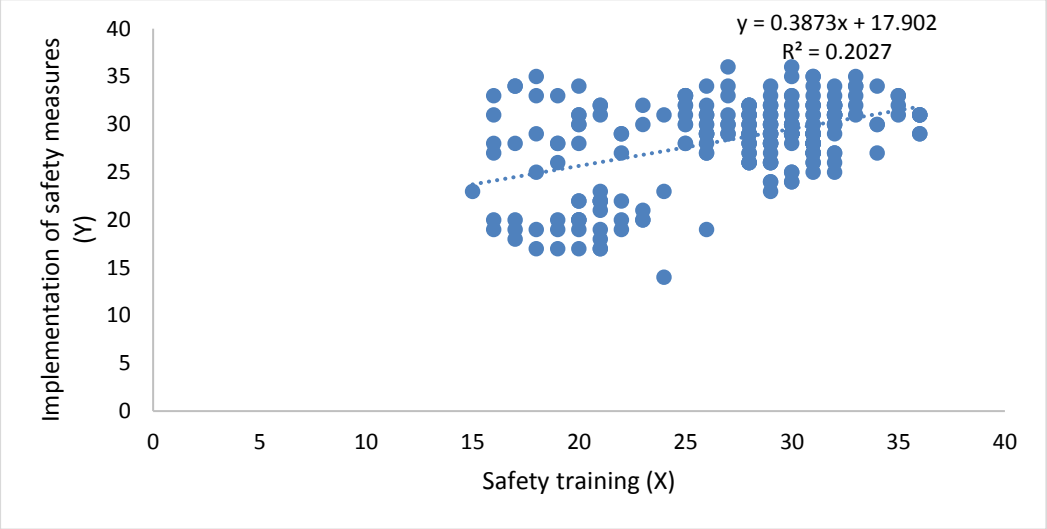

Fig. 5: Relationship between safety training and safety measures

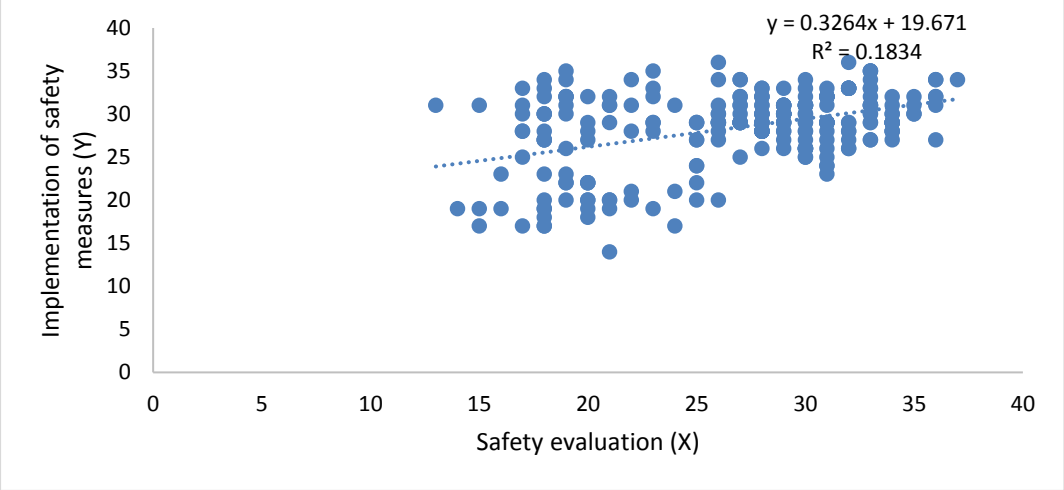

Fig. 6: Relationship between safety programme evaluation and safety measures

3.6 Relationship of safety programme evaluation and safety measures

The result from the scatter plot in Fig. 6 shows that $R^2 = 0.1834$. This indicates that 18.34% of the variation in implementation of safety measures is explained by the linear relationship between safety programme evaluation and implementation of safety measures. Furthermore, the slope of the line shows that every incremental change or improvement in hazard prevention there is a corresponding increase or improvement in the level of implementation of safety measures by 0.3264.

3.7 Relationship of safety communication and safety measures

The result from the scatter plot in Fig. 7 shows that $R^2 = 0.3476$. This indicates that 34.76% of the variation in implementation of safety measures is explained by the linear relationship between safety communication and implementation of safety measures. Furthermore, the slope of the line shows that every incremental change or improvement in safety communication results in a corresponding increase or improvement in the level of implementation of safety measures by 0.6329.

Data from Table 1 shows the correlation between management leadership, employee participation, hazard identification/assessment, hazard prevention/control, training, safety programme evaluation, safety communication and safety measure implementation system in building construction companies in Lagos State. To test for the significance of the relationship between management leadership, employee participation, hazard identification/assessment, hazard prevention/control, training, safety programme evaluation, safety communication and safety measure implementation system. The null hypothesis was tested at 0.05 alpha level stating no significant relationship between management-leadership, employee-participation, hazard identification/assessment, hazard-prevention, training, programme evaluation, communication and effective safety measures implementation in building construction companies in Lagos State. Result from Table 2 shows the coefficients of correlation between safety measure implementation and each of the elements of safety management system.

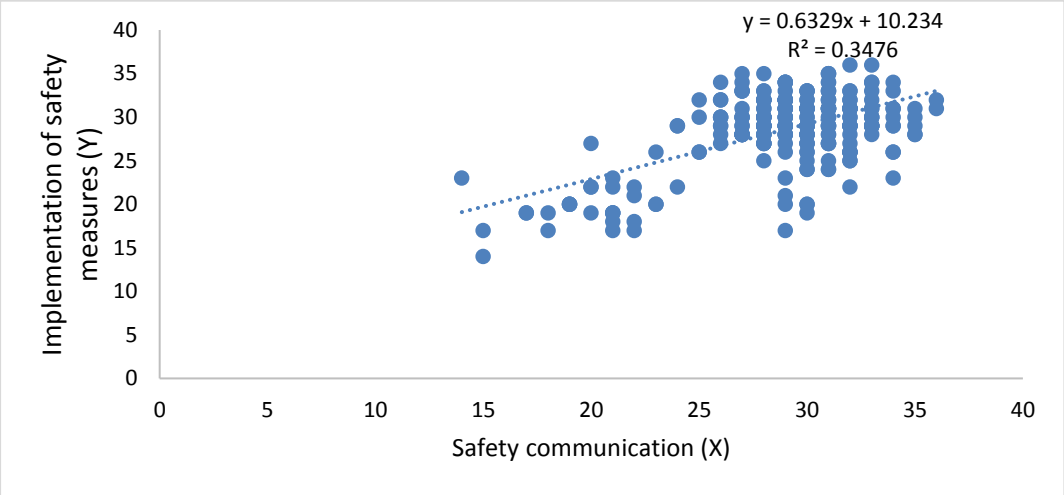

Fig. 7: Relationship between safety communication and safety measures

Table 1: Correlation matrix for the rudiments of safety and health practice and safety measure implementation

Variables	ML	EP	HI	HP	ST	SPE	SC	SMI
Management Leadership	1							
Employee Participation	0.565	1						
Hazard Identification	0.442	0.334	1					
Hazard Prevention	0.531	0.562	0.360	1				
Safety Training	0.543	0.765	0.339	0.649	1			
Safety Programme Evaluation	0.501	0.637	0.283	0.720	0.685	1		
Safety Communication	0.513	0.372	0.539	0.330	0.367	0.347	1	
Safety Measure Implementation	*0.593	*0.462	*0.491	*0.452	*0.450	*0.428	*0.590	1

*Indicate significance at 0.05 alpha level, ML = management leadership, EP = employee participation, HI = hazard identification, HP = hazard prevention, ST = safety training, SPE = safety programme evaluation, SC = safety communication, SMI = safety measure implementation

Table 2: Correlation coefficient between elements of safety management system and safety measure implementation.

Elements of Safety Management System	Correlation Coefficients (r)	Df	Level; of Significance	p-value	Remark
Management Leadership	0.593	260	0.05	0.000	Significant
Employee Participation	0.462	260	0.05	0.000	Significant
Hazard Identification	0.491	260	0.05	0.000	Significant
Hazard Prevention	0.452	260	0.05	0.000	Significant
Safety Training	0.450	260	0.05	0.000	Significant
Safety Evaluation	0.428	260	0.05	0.000	Significant
Safety Communication	0.590	260	0.05	0.000	Significant

4. Discussion

The result from Table 1 shows a positive and average relationship between management leadership and safety measure implementation. The implication is that as the management leadership level on safety increases, the safety measure implementation level also increases. Commitment of the management leadership to safety by enacting safety policy and goals, planning for goals achievement strategies, communicating safety policy, factoring safety into business decisions and construction processes, delegating safety responsibilities to employees, providing resources for safety management, and creating an environment to enhance safety communication, could create safety consciousness in construction workers. Consequently, the workers carry this consciousness and implement safety measures when carrying out their duties. This could have informed the result so obtained for this research question. This result corroborates the recommendation of Nawi et al. (2016) that commitment of top-level personnel in construction companies would enhance safety performance in industries. Similarly, Government of Alberta (2012) and Robotham (2012) viewed that management commitment to safety is a major factor in the success of safety implementation on construction sites. The result of this study corroborates the result obtained by Subramaniam et al. (2016) who from their study saw a substantial correlation between management commitment to safety and workers' compliance to safety in small/medium scale enterprise in Peninsular Malaysia.

The relationship of employee participation to safety measure implementation level in construction companies shows a positive and moderate relationship of both variables, implying that as employees gets more opportunity to partake in safety decision making, the safety measure implementation level also increases. From this result, it could be deduced that as indicators of employee participation (allowing workers to make input to safety and health programme, allowing workers to gain access to needed safety and health information, giving them opportunity to partake in designing and implementing safety and health programme, allowing them to raise safety concern, giving regular feedback to workers about resolutions on safety issues and concerns, involving workers in the process of resolving safety issues, giving workers the privilege to temporarily suspend suspected unsafe operation, assuring workers of confidentiality of any safety information provided) are well placed by management of construction companies under study. Therefore, employees would tend to comply to safety measures while undertaking their duties on construction sites. This result tallies with that of Subramaniam et al. (2016) who from their study saw a substantial correlation between involvement of workers in safety by management and workers' compliance to safety in small/medium scale enterprise in Peninsular Malaysia. The result tallies with Gaceri (2015) findings that employee participation influenced safety measure implementation to a high extent in supermarkets in Kenya.

Test of relationship of hazards identification/assessment to safety measure implementation in building construction companies in Lagos State shows positive and moderate relationship of both variables, implying that as the identification/assessment level of safety hazards increases, the safety measure implementation level also increases. This result implies that ensuring an effective safety hazards identification and assessment, such as routine inspection of jobsites, regular assemblage of information about identified hazards at jobsite, reviewing information about identified hazards, regular checks on foreseeable emergency conditions, paying attention to

identified foreseeable emergency conditions, setting up procedure for carrying out investigation on incidents, taking prompt action to investigate incidents when they occur, giving feedback to management on investigation of incidents, evaluating hazards to ascertain severity and probable impact, and prioritizing hazards to give due attention to priority areas, could enhance safety measure implementation in construction companies under study. This result aligns with Agwu et al. (2018) findings that safety management assessment influences success of building projects significantly. This means, putting appropriate mechanisms for identifying and assessing safety hazards will results in success of building projects (Fadun and Saka, 2018).

Test of relationship of hazard prevention to safety measure implementation level in construction companies, Lagos state shows a positive and moderate relationship between both variables. This implies that, as effort is intensified to prevent hazards (by consulting safety experts in handling complex hazards, ensuring availability of safety officers on site, considering safety standards in controlling for hazards, putting measures ready to eliminate/control hazardous conditions, regularly updating hazards control plans, displaying safety/caution signs at strategic positions, putting measures in place to handle emergencies, establishing control mechanisms on sites, and following up control plans to ensure effectiveness of safety programme), workers also make effort to implement safety measures during work activities. This result agrees with the result obtained by Wong and Soo (2019) that emergency planning is key in influencing safety performance in construction industries in Malaysia.

The test of relationship of training and safety measure implementation level in construction companies yielded a positive and moderate relationship of both variables. This indicates that as safety measure implementation among workers improves as management engages in safety training by organizing awareness training for staff and contractors, educating top management and other level of staff on the role in safety programme, training staff on hazards identification, how and when to use PPEs, conducting safety briefing before commencement of new projects, organizing safety training for new staff, documenting work procedure for ensuring safety and used for educating workers on operations. Consequently, well trained employees in construction companies would implement such knowledge in their work activities. This result aligns with Ogundipe et al. (2018) findings who found that training of staff is one of the factors that affect wearing of PPEs on construction sites among workers of construction companies, in South-Western Nigeria. The result also tallies with that obtained by Wong and Soo (2019) that education/training is a factor that greatly influence safety performance in construction industries in Malaysia.

The test of relationship between safety evaluation and safety measure implementation level in construction companies yielded a positive and moderate relationship between the two variables. This means that safety measure implementation among workers improves as the construction companies makes improvement in safety evaluation/improvement activities like operating with a laid down procedure for tracking safety performance, adhering to procedures for gathering performance safety performance by workers, documenting indicators for measuring exposure to hazards and accidents, documenting indicators for measuring implementation of prevention measures, conducting routine checks to ensure compliance to safety guidelines, involving employees in safety process evaluation, taking proactive measures to correct safety shortcoming, consulting various personnel on ways to make improvement on safety programme, making safety evaluation part of preliminary activities before any building construction project commences, and periodically checking safety performance indicators for relevance and update. This finding tallies with Agyekum et al. (2018) study that inadequate safety programme evaluation negatively impacted safety programme performance in construction companies in Kumasi and Greater Accra regions of Ghana.

The test of relationship between safety communication and safety measure implementation in building construction companies under the study area yielded an average and positive relationship. This implies that as the safety measure implementation in construction companies improves, elements of safety communication such as (establishing communication avenue for exchanging information about safety and health, planning job activities to prevent or control safety issues, getting workers acquainted of safety issues, adequately communicating safety measures to mitigate such safety issues, communicating action plans to workers in case of incidents, engaging in

on-site specific safety talks are organized to ensure all workers are abreast of their expectations among others) are effectively coordinated, implementation of safety measures by employees during work are enhanced. This result agrees with Nawi et al. (2016) findings who from their research disclosed that regular safety meetings on sites during projects serves as an avenue to create safety awareness among workers positively influences safety performance.

The test of null hypothesis stating no significant relationship between management-leadership, employee-participation, hazard identification/assessment, hazard-prevention, training, programme evaluation, communication and effective safety measures implementation in building construction companies in Lagos State shows that the relationships between each element of safety management system and safety measure implementation were all significant at 0.05 level of significance. This implied that management leadership, employee participation, hazard identification, hazard prevention, and safety training, safety evaluation and safety communication, all significantly related to safety measure implementation in the study area. This result aligns with result obtained by Skeepers and Mbohwa (2015) who found that leadership visibility and behaviour influences safety culture and performance in the construction companies. The result also agrees with the result of Lyu et al. (2018) who found a significant positive relationship between safety climate and safety behaviours. Further, the result corroborates that of Hassan et al. (2019) who found a significant correlation between safety rules and procedures and safety compliance among the workers. The study also found a significant correlation between safety communication and safety compliance among workers in the study area.

5. Conclusions

The findings of this research shows that there was a positive relationship between management leadership, employee participation, hazard identification, hazard prevention, safety training, safety evaluation, safety communication and safety measure implementation in the construction companies studied. The relationship between management leadership, employee participation, hazard identification, hazard prevention, safety training, safety evaluation, safety communication and safety measure implementation were significant at 0.05 level of significance.

Conflict of interest

The author(s) declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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