ASSESSMENT OF PRE-CONSTRUCTION HEALTH AND SAFETY ELEMENTS FOR PUBLIC BUILDINGS IN NIGERIA

Ebenezer O. Adekunle and Polycarp O. Alumbugu

Department of Quantity Surveying, Federal University of Technology, Minna, Niger State, Nigeria
Corresponding author: adekunle.oluvan@gmail.com

ABSTRACT

Accidents and fatalities on construction sites impact construction project performance and construction stakeholders negatively. Studies indicated that accident prevention measures undertaken before the start of construction work can reduce workplace accidents and increase workers' safety. Therefore, the research assesses the extent to which health and safety (H&S) elements are considered in the pre-construction stage of public building projects. Data were collected from 300 construction industry professionals through well-structured questionnaires. The data were analysed using Relative Important Index (RII) and One-way analysis of variance (ANOVA). The result shows that identification of possible needs for projects, alignment of H&S policies for projects, and identification of H&S hazards were the most considered H&S elements in the concept phase. In the feasibility phase, feasibility study considering H&S risks, cost evaluation of specific H&S items, and preparation of project brief including H&S objectives and milestones were most considered. For the design phase, review of construction strategy and H&S strategy update, development of H&S milestones for project programme, and prevention through design were the most considered. The study also found that the views of the respondents on the various H&S elements at the three phases of pre-construction – concept phase, feasibility phase and design and planning phase – were affected by their professional disciplines. Overall, H&S is given low priority in the pre-construction stage of public building projects. Based on the findings, the study recommends that the government should develop a standard approach to increase the level of H&S considerations among major stakeholders in the pre-construction stage of public projects.

Keywords: building phases, elements, health and safety, pre-construction, public building.

INTRODUCTION

Construction projects are considered technologically and organisationally complex (Lingard, 2013). About 60,000 fatal accidents occur each year on construction sites around the world, which account for one fatal accident every 10 minutes (Lingard, 2013). In comparison to other industries, the likelihood of workers engaged in construction-related activities being injured or subject to fatalities is 3 to 4 times more than other industries (ILO, 2022a). The accidents and fatalities rate are forecasted to be worse in developing countries due to numerous non-fatal accidents in workplaces that are not reported (Colak *et al.*, 2004). Manu *et al.* (2018) added that the poor condition of occupational H&S in developing countries could get worse without the implementation of appropriate remediation measures. Idoro (2008) found that lack of concern, accurate records, and statutory regulations make the Nigerian construction industry worse than the developed countries in terms of safety issues. Idoro (2011) also found that larger contractors within the Nigerian construction industry record high numbers and rates of injuries on their sites. Further, Dodo (2014) discovered that many Nigerian construction firms with more than a decade of operations scarcely comply with any H&S plan during construction. The study concluded that the implementation of H&S practices is yet to be embraced in Nigeria among construction firm.

The scope of H&S issues is not limited to the construction stage but encompasses all stages of a construction project from the beginning to the operation stage (Boadu *et al.* 2021). The major focus of this paper is on the level of consideration of H&S elements during the pre-construction stage of public buildings. Both in construction and other industries, the consideration of H&S requirements at the early stages has been widely recognised as a beneficial approach for effective H&S performance of construction projects because it is an effective way of either eliminating or minimising hazards at their sources (DOSH, 2008; Lee *et al.* 2011). However, the construction industry is tagged with poor H&S performance, which could be attributed to the failure to prioritise H&S at the pre-contract stage of public building projects (Dodo, 2014). Umeokafor (2018b) found that out of the 6,241 papers published in conference proceedings over 36 years only 49 relate to construction H&S in Nigeria. Researchers focused more on H&S awareness and the causes of accidents, regulation and standards, and safety performance, without any single study on designed for safety at the pre-construction stage. Therefore, this research focused on the H&S practices in the Nigerian construction industry, with a specific concentration on pre-construction. The objectives of this research are to identify the H&S elements during the pre-construction stage of public building projects and to assess the extent to which they are considered.

LITERATURE REVIEW

Health and Safety Issues in Construction

Health and safety address both the physical and psychological well-being of workers on construction sites and other persons whose health is likely to be adversely affected by construction activities. It is an economic and humanitarian concern that involves employers, employees, governments, and project participants; and requires proper management control (Muiruri and Mulinge, 2014). Construction activities are conducted in a risky environment, and any workplace's H&S programme is key to reducing hazards, both legally and ethically (Twort and Rees, 2011). There is an agreement in literature that construction activities are extremely dangerous and accident-prone (Mansir, 2014; Otham, 2012; Twort and Rees, 2011). When compared to other industries, the accident rate in the construction industry is disproportionate to the number of workers (Tanko and Anigbogu, 2012). This condition is also verifiable in advanced countries. Based on HSE (2021) provisional statistics report, the construction industry in the United Kingdom, like many other countries, has the highest fatality rate when compared to other main industry groups, with 39 fatal injuries recorded in 2020/2021, ahead of agriculture, manufacturing and transportation, and storage. According to ILO 2022b, about 6,300 people die every day as a result of poor workplace safety, culminating in 2.3 million yearly deaths, and 317 million accidents of various types occurring each year. Although occupational injuries and illnesses are widespread in the construction sector globally, the situation is more critical in developing countries in comparison to developed countries. In Malaysia, 239 occupational fatalities were recorded in 2016, of which the construction sector was responsible for 106 fatalities, which is 44.4% of the total fatalities. However, 123 worker fatalities were recorded in the UK in 2021/2022 (HSE, 2022; DOHS, 2016). Gonzalez-Delgado *et al.* (2015) noted that this incessant occurrence contributes to the high human cost and the rise in the economic load of weak occupational safety and health practices by about 4% of the annual global gross domestic product (GDP). Thus, the integration of safety into the construction plan is important to increase value, minimize costs and protect workers' health (Nordlöf *et al.* 2015; Tayeh *et al.* 2020). Twort and Rees (2011) added that it is important to develop appropriate safety activities and strategies, taking into account the possibility of major H&S issues.

The performance of construction projects in Nigeria has been negatively impacted by high death tolls, permanent disability, partial disability, and other critical environmental threats through the collapse of buildings and major operational accidents (Orji *et al.* 2016). Although Nigeria has been a signatory to the Geneva Occupational Safety and Health Convention 1981, for over three decades, OSH in Nigeria has remained weak and in its infancy for almost three decades (Diagwu *et al.* 2012; Okolie and Okoye, 2012; Adeogun and Okafor, 2013). This is widely blamed on the unregulated nature of the Nigerian construction industry where there is an absence of local H&S legislation covering the industry and thus encouraging the adoption and implementation of H&S laws and standards from developed countries, the local National Building Code, which has no legislative backing, and H&S standards used in the oil and gas sector (Idoro, 2008; Diugwu *et al*. 2012; NBC, 2006; Omeife and Windapo, 2013). An investigation by Umeokafor (2018) into public and private clients' attitudes, commitment, and impact on construction H&S in Nigeria showed that despite the poor attitudes of clients to H&S, public clients' commitment and attitude are better than that of private clients. Evidently, improved H&S practice contribute to the welfare of construction workers and the success of the project. Thus, adequate attention must be given to H&S issues during the early stage of construction project.

Health and Safety in Construction Management

Although H&S management is considered important by all stakeholders in the construction industry due to the continuous occurrence and impact of accidents on construction sites there is no specific way to develop and implement a system except it is based on general issues on which management can be anchored. There is a divergent view in literature on the meaning of H&S management system and its elements (Muiruri and Mulinge, 2014). In a review by Jazayeri and Dadi (2017) on construction safety management systems and methods of safety performance measurement, it was noted that the definition and elements used in executing safety management systems differ from one organisation to another. According to the review, elements of a safety management system have been developed from various perspectives including a comparison between high and low-accident companies, good safety performance based on case studies of the most reliable companies, and analysis of accidents. The integration of organisational elements engaged in the continuous cycle of planning, implementation, assessment, and continuous improvement aimed toward the abatement of occupational risks on construction sites is the focus of the H&S management system. Organisational H&S policies, technological resources, accountability structures and practices, hazard controls, quality assurance practices, evaluation practices, and organisational learning practices are just a few of these elements (Institute of Work and Health, 2005). Olutuase (2014) concluded that the existing management system in Nigeria is poorly organised and characterised by ineffectiveness and poor documentation. Diugwu *et al.* (2012) however, argued that statutory regulations to ensure the proper adoption and implementation of H&S management systems are either inadequate or ineffective. It was further revealed that organisations are unwilling to give enough attention to H&S management. Waziri *et al.* (2015) also faulted the strength of regulations and the level of compliance which ought to account for the effectiveness of H&S measures and performance in Nigeria. Therefore, incessant injury and fatalities on construction sites can be hinged on poor H&S management, especially at the pre-construction stage.

Health and Safety Elements in Pre-construction

The pre-construction stage is one of the three sections of construction project management, which covers inception & feasibility, design, and tendering (KS., 2002; Tregenza, 2004). Any accident prevention measures undertaken before the start of a construction work can help to reduce workplace accidents and increase workers' safety (Lee *et al.* 2011). Gibb (2004) and Toole *et al.* (2008) also noted that accident risk prevention is most effective during the design phase of the construction process. Studies have shown that the construction sector has made considerable progress in accident prevention and risk management, but several issues within the industry, including a lack of design for safety, are impeding the achievement of a long-term goal of zero injuries. The construction safety design process addresses site safety and health issues in the design and planning stage of a project, which is a key phase for effectively addressing H&S concerns (Rwamamara and Holzmann, 2007). The majority of construction injuries occur during the pre-construction phase of work, and failures can occur in the technical parts of the design, which are by their very nature tied to planning and organization concerns (Giessa *et al.* 2017). According to Behm *et al.* (2014), designers are in a unique position to spot and eliminate hazards at their source, as well as reduce unnecessary risk throughout the business. The identified hazard is established through design decisions, and construction management professionals and workers are allowed to handle the risk as best they can. According to Office for Government Commerce (OGC,2002), as cited by Hare and Cameron (2012), the UK (OGC) “Gateway” model for construction procurement has flexibility which allows various procurement routes to be adopted; and it is primarily for general construction management purposes. This OGC model had been used to build the H&S elements. In Nigeria, specific assessment of safety elements during the pre-construction stage is limited (Umeokarfor, 2018b), however, researchers in other countries have made significant contributions to the existing body of knowledge. Kamar and Ahmad (2016) identified safety elements during the pre-construction and construction stage, while Saifullah and Ismail (2012) identified H&S elements during the pre-construction stage only. The summary of safety elements involved in the pre-construction stage is documented as presented in Table 1.

Table 1: Health and safety in pre-construction

Stages	Health and Safety Elements	Focus
Concept Phase	i. Possible need for projects	Client's role in H&S throughout project; supply information, time allowed, and budget required for project.
	ii. Define user needs	Align H&S policies for project; how the supply chain will be informed of H&S requirements, the expertise required, and criteria for evaluating competence, resources, and commitment. Identify H&S hazards (risk register). Review feedback from the previous project.
Feasibility Phase	i. Options to meet user needs	Include H&S performance, materials, and components specified by output performance that can meet functional and H&S requirements. Option evaluation chart to include H&S.
	ii. Prepare business case	Input from end user's operation and maintenance at this stage: include format for H&S file and budget for maintenance strategy. Initial H&S box information during concept designs. H&S objectives, H&S milestones included. Evaluate the cost of specific H&S items. Assess risks, decide management arrangements and control procedures, and update the risk register.
	iii. Project brief	H &S objectives included, decide project H&S Performance Indicators, and agree on the format for H&S file.
	iv. Feasibility study option	Consider H&S risks on each site via option evaluation chart.
	v. Procurement strategy	Agree on H&S criteria for selection of supply chain. Seek advice on maintenance and access issues during operation and maintenance period to prevent H&S problems. Prepare Handover Strategy and Risk Assessments.
Design & Planning Phase	i. Contract preparation	Develop H&S milestones for project program. Review specifications for prescriptive items that may generate H&S risks during construction, operation, and maintenance.
	ii. Expression of interest/vetting	Use H&S criteria previously outlined to vet the supply chain.
	iii. Partner/contractor selection	Include current H&S file. Cooperation between parties involved in the negotiation/ tender process regarding H&S issues. Ensure H&S criteria are sufficiently weighted in decision.
	iv. Award contract	Confirm H&S duties. H&S hazard workshop and integrated responsibility chart with H&S included.
	v. Outline design	Identify H&S hazards/risks on drawings. Cross-reference H&S plan to program. H&S milestones on programme.
	vi. Detailed design	Site issues regarding residual risk have been addressed by the contractor ahead of completing the construction H&S plan. Identify H&S hazards/risks on drawing. Review Construction Strategy, including sequencing, and update Health and Safety Strategy.

Source: Adapted from Kamar and Ahmad (2016)

RESEARCH METHODOLOGY

This research employed the quantitative research approach to assess the extent of H&S element considerations during the pre-construction stage of public building projects. Generally, quantitative research permits the collection of data and its statistical analysis to ascertain the veracity of theories or hypotheses (Creswell, 2009). The method allows for a broader investigation and enables generalisation of findings. Thus, the quantitative approach was appropriate to explore how well H&S elements are considered during the pre-construction stage of public building projects in Nigeria. The sampling frame involved a population of construction industry professionals who have direct and indirect involvement in the procurement process for public projects. The purposive sampling method under non-probability sampling techniques was used to select participants. These participants were drawn from various organisations, including, contractors, consultants, and government institutions. A total of 300 survey questionnaires were distributed to participants and 121 were collected and deemed valid for analysis, thus, resulting in a response rate of 40%. This is relatively high, considering that the response rate in construction management research is widely acknowledged to be low (Root and Blismas, 2003). A higher response rate is appropriate in a survey; however, it does not necessarily result in the most accurate conclusions (Keeter *et al.* 2006). The structured questionnaires were designed to investigate the extent of H&S elements considerations in the pre-construction stage of public building projects in Abuja, Nigeria. The respondents were guided on a five-point Likert scale, ranging from 1 to 5, where 1 = very low, 2 = low, 3 = moderate, 4 = high, and 5 = very high. The Cronbach's alpha test was conducted to verify the internal consistency and reliability of the design requirements in each phase. Usually, Cronbach's alpha offers the appropriate test to assess reliability across items, because it estimates the reliability based on the correlations between the items (Hair *et al.* 2009). Besides, internal consistency ranging from 0.50 to 0.70 is acceptable, 0.70 to 0.90 shows high internal consistency, and 0.90 and above represents excellent reliability (Hinton *et al.* 2004).

Descriptive methods including, percentage and Relative Important Index (RII) were used to analyse the collected data, while the inferential method used was a One-way analysis of variance (ANOVA). The use of ANOVA is based on the study of Carifio and Perla, who argued that parametric techniques like ANOVA are suitable to analyse Likert scales. The Statistical Package for the Social Sciences (SPSS) software was used for data processing. The RII was used to determine the importance of the identified H&S elements. The decision rule for the outcome of the RII was decided on the following: 0.911-0.979 for very high; 0.841-0.910 for high; 0.772-0.840 for moderate; 0.702-0.771 for little; and 0.632-0.701 for very little. This type of decision rule was used by Atilola *et al.* (2019). The ANOVA was employed to test the null hypothesis that there are no differences between the mean of the various group of respondents (architects, builders, quantity surveyors, civil & structural engineers and electrical engineers).

RESULTS AND DISCUSSION

Respondents' profile

The study involved the participation of various professionals within the construction industry including architects, builders, civil and structural engineers, and electrical engineers. The profile of the respondents is presented in Table 2 below and includes the nature of their organization, profession, range of contract sums involved, years of experience, and highest academic qualification. Table 2 shows that 75.21% of the respondents work in government organization, while 13.22% work with consultant and 11.57% were with contractors. This indicates that most of the respondents are capable of providing valid information for the research.

Table 2: Demographic profile of respondents

Category	Classification	Frequency	Percentage
Respondent Organization	Consultant	16	13.22%
	Contractor	14	11.57%
	Government	91	75.21%
	TOTAL	**121**	**100%**
Respondent Profession	Architects	13	10.74%
	Builders	16	13.22%
	Civil and Structural Engineers	7	5.79%
	Quantity Surveyors	56	46.28%
	Electrical Engineers	29	23.97%
	TOTAL	**121**	**100.00%**
Highest range of contract sums handled	1M - 10M	3	2.48%
	11M - 50M	17	14.05%
	51M - 100M	23	19.01%
	101M - 500M	35	28.93%
	Above 500M	43	35.54%
	TOTAL	**121**	**100.00%**
Years of experience	Less than 5 years	27	22.31%
	5 - 10 years	40	33.06%
	11 - 15 years	24	19.83%
	16 - 20 years	8	6.61%
	Above 20 years	22	18.18%
	TOTAL	**121**	**100.00%**
Highest academic qualification	National Diploma (ND)	1	0.83%
	Higher National Diploma (HND)	28	23.14%
	Bachelor's Degree	57	47.11%
	Master's Degree	29	23.97%
	PhD	6	4.96%
	TOTAL	**121**	**100.00%**

Table 2 further shows the respondents profession. 46.28% were Quantity Surveyors, 23.97% were Electrical Engineers, 13.22% were Builders, 10.74% were Architects, and

5.79% were Civil and Structural Engineers. The major professions within the construction industry are well represented in the study. The highest range of contract handled by most of the respondents was above 500 million (35.54%), followed by 101 to 500 million (28.93%). This indicates that most of the respondents have handled construction projects involving significant sums, hence they are capable of providing reliable information. Table 2 also shows the respondents working experience. 33.06% had 5 – 10 years of working experience, 22.31% had less than 5 years, 19.83% had 11 – 15 years, and 18.18% had above 20 years. The lowest being 16 – 20 years of experience, comprising 6.61% of the respondents. This shows that the respondents are well experienced in providing valuable information for this study. As shown in Table 2, National Diploma holders account for 0.83%, which is the least of the respondents. 47.11% had Bachelor's Degree, 23.97% had Master's Degree, 23.14% had Higher National Diploma and 4.96% were PhD holders. This reveals that the respondents are satisfactorily educated to give insightful information for the research.

Health and Safety Elements Consideration during the Pre-construction Stage

This section presents and discusses the RII results of the 22 H&S elements, identified from literature, in each of the pre-construction phases of public building projects according to the level of their considerations. Table 3 shows that the major H&S elements considered at the concept phase include: identification of possible needs for project including the client's role in health and safety, alignment of health and safety policies for projects, and identification of health and safety hazards, with RII of 0.802, 0.795 and 0.785, respectively. Identification of the client's business case and strategic brief and other core project requirements, and review of feedback from previous project (CP5) were among the least H&S elements at the concept phase, with RII values of 0.762 and 0.694, respectively.

The result shows that most of the elements were considered moderately, except CP5 with very little consideration. It was also revealed from Table 3 that the H&S elements mostly considered at the feasibility phase are feasibility study considering health and safety risks, cost evaluation of specific health and safety items, and preparation of project brief including health and safety objectives and milestones, with RII values of 0.772, 0.764 and 0.760, respectively. Among the least H&S elements at the feasibility stage are formulation of project health and safety performance indicators, preparation of handover strategy, and agreement on health and safety criteria for selection of supply chain, with RII values of 0.729, 0.727 and 0.702, respectively. The result shows that little consideration is given to most of the H&S elements at the feasibility phase. Table 3 further shows that review of construction strategy and health and safety strategy update, development of health and safety milestones for project programme, and prevention through design are the main H&S elements considered at the design and planning phase, with RII values of 0.760, 0.736 and 0.732, respectively. The least ranked H&S elements at the design and planning phase include confirmation of health and safety duties; organising safety training for designer; and identification of hazards/risks on drawings, with RII values of 0.707, 0.691 and 0.676. The result indicates that very little consideration is given to organising safety training for designers and identification of hazards/risks on drawings. The findings of this analysis confirm that the practice of the professionals at the pre-construction stage is consistent with the recommendations of HSE

2015, which required that a client must make available pre-construction information within a short while to every project designer and contractor appointed, or being considered for appointment. In addition, the document stated that the designer must be convinced that the client is aware of their obligations under H&S regulations before the commencement of work. The results confirm findings of previous studies (such as Gambatese, 1996; Gambatese, 2000; Huang, 2003; Haywood, 2004; Hare and Cameron, 2012) that identified the H&S elements in pre-construction stage.

Table 3: Health and safety elements during the pre-construction stage of public building projects

Code	Pre-construction Phases	RII	Rank	Decision
	Concept Phase			
CP1	Identification of possible needs for project including the client's role in health and safety	0.802	1	M
CP2	Alignment of health and safety policies for projects	0.795	2	M
CP3	Identification of health and safety hazards	0.785	3	M
CP4	Identification of the client's business case and strategic brief and other core project requirements	0.762	4	L
CP5	Review of feedback from the previous project	0.694	5	VL
	Cronbach's alpha = 0.838			
	Feasibility Phase			
FP1	Feasibility study considering health and safety risks	0.772	1	M
FP2	Cost evaluation of specific health and safety items	0.764	2	L
FP3	Preparation of project brief including health and safety objectives and milestones	0.760	3	L
FP4	Risk assessment, management arrangement and control procedure	0.747	4	L
FP5	Inclusion of health and safety in option evaluation chart	0.736	5	L
FP6	Development of health and safety file format and budget for maintenance strategy	0.729	6	L
FP7	Formulation of project health and safety performance indicators	0.729	6	L
FP8	Preparation of handover strategy	0.727	7	L
FP9	Agreement on health and safety criteria for selection of supply chain	0.702	8	L
	Cronbach's alpha = 0.914			
	Design and Planning Phase			
DPP1	Review of construction strategy and health and safety strategy update	0.760	1	L
DPP2	Development of health and safety milestones for project programme	0.736	2	L
DPP3	Prevention through design	0.732	3	L
DPP4	Selection of contractor on the basis of health and safety criteria set	0.727	4	L
DPP5	Vet supply chain using health and safety criteria previously outlined	0.716	5	L
DPP6	Confirmation of health and safety duties	0.707	6	L
DPP7	Organise safety training for designer	0.691	7	VL
DPP8	Identification of hazard/risk on drawings	0.676	8	VL
	Cronbach's alpha = 0.895			

Notes: CP = Concept Phase, FP = Feasibility Phase, DPP = Design and Planning Phase

ANOVA and Posthoc Test of the H&S Elements Consideration at the Concept Phase

ANOVA was executed on the responses from different professionals, namely, architects, builders, quantity surveyors, civil & structural engineers and electrical engineers to verify whether the views of the respondents were influenced by the nature of their profession, and the results are presented in Table 4 below. The data were tested for normality and homogeneity of variances prior to conducting the ANOVA (see Table 4). The normality of the data was identified by skewness and kurtosis indices. With skewness values ranging between –1.025 to –0.341 and kurtosis values between –0.498 to –0.785, the assumption of normality was established to be fulfilled. Byrne (2016) asserted that, if skewness values range between 2 to +2 and the kurtosis values fall between –7 to +7, then the assumption of normality is fulfilled. Levene’s F test was used to assess the assumption of homogeneity of variances and the results showed that the assumption of homogeneity of variances needed for a regular ANOVA test was violated by one element (see CP2) and Welch ANOVA was used. From Table 4, the results of the Welch ANOVA test indicate that there was a significant difference in the mean responses for the identification of possible needs for project including clients’ role in health and safety (CP1), alignment of health and safety policies for projects (CP2) and identification of client's business case and strategic brief and other core project requirements (CP3). Further, the source and nature of the differences in the statistically significant ANOVA were determined by performing the Games–Howell’s posthoc multiple comparison test, and the results are presented in Table 4.

For CP1, there was no sufficient data to make pair-wise differences; however, the posthoc comparison on CP2 showed that the difference between the mean responses for the following pairs was statistically significant: architects/quantity surveyors (MD = 0.683, p = 0.028), builders/quantity surveyors (MD = 1.000, p = 0.000), quantity surveyors/civil and structural engineers (MD = —1.232, p = 0.000), and electrical engineers/civil and structural engineers (MD = —0.926, p = 0.007). While architects, builders and civil and structural engineers felt that they considered alignment of health and safety policies for projects, the quantity surveyors felt that they had not considered it adequately. The civil and structural engineers also showed more consideration for alignment of health and safety policies for projects than the electrical engineers. Also, the posthoc test on CP4 revealed that the difference between the mean responses from builders/quantity surveyors (MD = 0.643, p = 0.038) and builders/electrical engineers (MD = 0.754, p = 0.031) was statistically significant. This shows that the builders have more consideration for the identification of the client's business case and strategic brief and other core project requirements than the quantity surveyors and electrical engineers.

Table 4: One-way ANOVA and posthoc test of H&S elements consideration at the concept phase

	Test of Normality		Homogeneity Test		Welch ANOVA	
S/n	**Skewness**	**Kurtosis**	**Levene**	**Sig.**	**Statistic**	**Sig.**
CP1	—0.851	0.322	1.353	0.255	2.812	0.042
CP2	—0.841	0.560	3.762	0.006	12.270	0.000
CP3	—1.025	0.785	1.634	0.170	1.659	0.185
CP4	—0.341	0.092	0.182	0.947	2.923	0.039
CP5	—0.365	—0.498	1.769	0.140	1.003	0.423
Post hoc test (Games-Howell)					**Mean Diff.**	**Sig.**
CP2	Alignment of health and safety policies for projects		Architects/Quantity Surveyors		0.683*	0.028
			Builders/Quantity Surveyors		1.000*	0.000
			Quantity Surveyors/Civil and Structural Engineers		—1.232*	0.000
			Electrical Engineers/Civil and Structural Engineers		—0.926*	0.007
CP4	Identification of the client's business case and strategic brief and other core project requirements		Builders/Quantity Surveyors		0.643*	0.038
			Builders/Electrical Engineers		0.754	0.031

*The mean difference is significant at the 0.05 level.

ANOVA and Posthoc Test of the H&S Elements Consideration at the Feasibility Phase

Table 5 shows the ANOVA test to check for any significant differences in the mean responses between the professionals. Two H&S elements (see FP4 and FP5) violated the assumption of homogeneity of variance needed for a regular ANOVA. From Table 5, the results of the Welch ANOVA test indicate that there was a significant difference in the mean responses for feasibility study considering health and safety risks (FP1), cost evaluation of specific health and safety items (FP2), preparation of project brief including health and safety objectives and milestones (FP3), formulation of project health and safety performance indicators (FP7), and agreement on health and safety criteria for selection of supply chain (FP9). Further, the source and nature of the differences in the statistically significant ANOVA were determined by performing the Games–Howell's posthoc multiple comparison test and the results are presented in

Table 5. The posthoc comparison on FP1 showed that the difference between the mean responses from the builders and electrical engineers was statistically significant (MD = 1.030, p = 0.002). The result shows that while builders felt that they considered feasibility study considering health and safety risks to an extent, the electrical engineers felt that they had not considered it adequately. The posthoc comparison on FP2 shows that the difference between the mean responses for the following pairs was statistically significant: quantity surveyors and builders (MD = —0.804, p = 0.021), quantity surveyors and civil and structural engineers (MD = —0.875, p = 0.024), civil and structural engineers and electrical engineers (MD = 1.261, p = 0.003), electrical engineers and architects (MD = —0.920, p = 0.028), and electrical engineers and builders (MD = —1.190, p = 0.002). While builders and civil and structural engineers felt that they considered cost evaluation of specific health and safety items, the quantity surveyors felt that they had not considered it adequately. The electrical engineers also showed more consideration for FP2 than the civil and structural engineers and architects. However, builders felt they considered FP2 more than the electrical engineers. Also, the posthoc comparison on FP3 shows that the difference between the mean responses for the following pairs was statistically significant: builders and quantity surveyors (MD = 0.696, p = 0.038), builders and electrical engineers (MD = 1.328, p = 0.000), quantity surveyors and civil and structural engineers (MD = —0.911, p = 0.011), and electrical engineers and civil and structural engineers (MD = —1.542, p = 0.000). This indicates that while builders felt that they considered preparation of project brief including health and safety objectives and milestones to an extent, the quantity surveyors and electrical engineers felt that they had not considered it adequately.

The civil and structural engineers also showed more consideration for FP3 than the quantity surveyors and electrical engineers. Table 5 further shows the posthoc comparison on FP7, which confirmed that the difference between the mean responses for the following pairs was statistically significant: builders and quantity surveyors (MD = 0.893, p = 0.002), builders and electrical engineers (MD = 1.099, p = 0.001), quantity surveyors and civil and structural engineers (MD = —1.089, p = 0.005), and civil and structural engineers and electrical engineers (MD = 1.296, p = 0.002). This indicates that while builders felt that they considered formulation of project health and safety performance indicators to an extent, the quantity surveyors and electrical engineers felt that they had not considered it adequately. The civil and structural engineers also showed more consideration for FP7 than the quantity surveyors and electrical engineers. Similarly, the posthoc test on FP9 reveals that the difference between the mean responses from builders and electrical engineers was statistically significant (MD = 1.147, p = 0.010). This shows that the builders have more consideration for agreement on health and safety criteria for the selection of supply chain than the electrical engineers.

Table 5: One-way ANOVA for H&S elements consideration at the feasibility phase

	Test of Normality		Homogeneity Test		Welch ANOVA	
S/n	**Skewness**	**Kurtosis**	**Levene**	**Sig.**	**Statistic**	**Sig.**
FP1	—0.845	0.295	1.373	0.248	3.903	0.012
FP2	—0.682	—0.087	1.843	0.125	7.129	0.000
FP3	—0.607	—0.401	1.296	0.276	9.364	0.000
FP4	—0.682	—0.086	2.939	0.023	2.082	0.110
FP5	—0.577	0.092	2.983	0.022	1.004	0.422
FP6	—0.639	—0.265	0.162	0.957	2.333	0.081
FP7	—0.819	0.146	2.258	0.067	8.766	0.000
FP8	—0.570	—0.395	1.220	0.306	2.643	0.055
FP9	—0.334	—0.348	0.702	0.592	3.403	0.021
	Posthoc test (Games-Howell)				**Mean Diff.**	**Sig.**
FP1	Feasibility study considering health and safety risks		Builders/Electrical Engineers		1.030*	0.002
FP2	Cost evaluation of specific health and safety items		Quantity Surveyors/Builders		—0.804*	0.021
			Quantity Surveyors/Civil and Structural Engineers		—0.875*	0.024
			Civil and Structural Engineers/Electrical Engineers		1.261*	0.003
			Electrical Engineers/Architects		—0.920*	0.028
			Electrical Engineers/Builders		—1.190*	0.002
FP3	Preparation of project brief including health and safety objectives and milestones		Builders/Quantity Surveyors		0.696*	0.038
			Builders/Electrical Engineers		1.328*	0.000
			Quantity Surveyors/Civil and Structural Engineers		—0.911*	0.011
			Electrical Engineers/Civil and Structural Engineers		—1.542*	0.000
FP7	Formulation of project health and safety performance indicators		Builders/Quantity Surveyors		0.893*	0.002
			Builders/Electrical Engineers		1.099*	0.001
			Quantity Surveyors/Civil and Structural Engineers		—1.089*	0.005
			Civil and Structural Engineers/Electrical Engineers		1.296*	0.002
FP9	Agreement on health and safety criteria for selection of supply chain		Builders/Electrical Engineers		1.147*	0.010

*The mean difference is significant at the 0.05 level.

ANOVA and Posthoc Test of the H&S Elements Consideration at the Design and Planning Phase

Table 6 shows the ANOVA test to check for any significant differences in the mean responses between the professionals. Three H&S elements (see DPP3, DPP4 and DPP6) violated the assumption of homogeneity of variance needed for a regular ANOVA. From Table 6, the results of the Welch ANOVA test indicate that there was a significant difference in the mean responses for DPP8. Further, the source and nature of the differences in the statistically significant ANOVA were determined by performing the

Games–Howell's posthoc multiple comparison test and the results are presented in Table 6. However, the posthoc comparison shows that only confirmation of health and safety duties (DPP6) was statistically significant between builders and electrical engineers (MD = 0.856, p = 0.045). The result shows that while builders felt that they considered confirmation of health and safety duties to an extent, the electrical engineers felt that they had not considered it adequately.

Table 6: One-way ANOVA for H&S elements consideration at the design and planning phase

	Test of Normality		Homogeneity Test		Welch ANOVA	
S/n	**Skewness**	**Kurtosis**	**Levene**	**Sig.**	**Statistic**	**Sig.**
DPP1	—0.865	0.283	2.340	0.069	1.874	0.144
DPP2	—0.496	—0.345	0.716	0.583	1.660	0.188
DPP3	—0.456	—0.184	2.609	0.039	0.893	0.481
DPP4	—0.632	—0.332	4.295	0.003	1.677	0.185
DPP5	—0.529	—0.405	0.911	0.460	1.312	0.292
DPP6	—0.339	0.129	2.869	0.026	2.303	0.084
DPP7	—0.336	—0.838	1.995	0.100	1.714	0.174
DPP8	—0.237	—0.785	1.219	0.306	3.089	0.031
Posthoc test (Games-Howell)					**Mean Diff.**	**Sig.**
DPP6	Confirmation of health and safety duties		Builders/Electrical Engineers		0.856*	0.045

*The mean difference is significant at the 0.05 level.

Overall, the findings revealed that the views of the respondents on the various H&S elements during the three phases of pre-construction – concept phase, feasibility phase and design and planning phase – were affected by the nature of their professions. The involvement of these professionals across the three phases of pre-construction is consistent with the study of Saifullah and Ismail (2012), which identify architects, engineers, quantity surveyors and other specialists as construction professionals involved throughout the pre-construction stage. However, this study further shows the level of consideration of H&S elements among the identified construction professionals.

Conclusion

This study has elaborated on the extent to which H&S elements are considered during the pre-construction stage of public building projects in Nigeria. Through a quantitative research approach, the study found that little consideration is given to H&S elements during the pre-construction stage of public building projects, especially at the feasibility and design and planning phases. The findings suggest that construction stakeholders on public building projects do not review feedback from previous projects, organise safety training for designers or identify hazards/risks on drawings. Consequently, these limitations contribute to poor H&S performance in public sector projects in the country. The results of the ANOVA showed clearly that the level of commitment to H&S requirements at the pre-construction stage varies from one profession to another within the construction industry. The findings draw attention to the need for the development of national policies and guidelines relating to H&S elements to be considered during the pre-construction stage of public building projects. It can also help inform the industry and its stakeholders on the areas they need to focus more on to increase H&S performance within the Nigerian construction industry, especially during the pre-construction stage. Despite the contribution of this study, there is a limitation that must be acknowledged. This research was confined to the capital city of Nigeria, Abuja. As such, generalization to other states and other countries should be considered cautiously.

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