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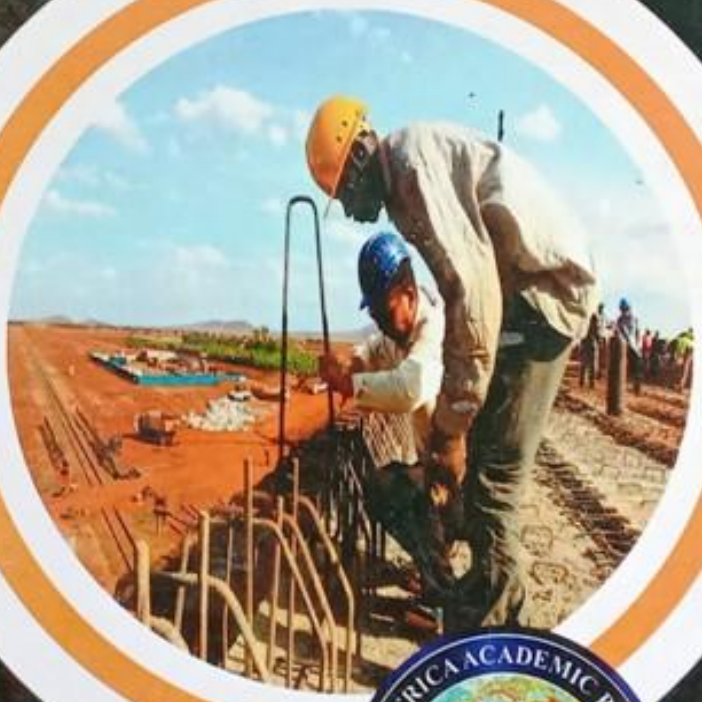

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ESTIMATING THE COSTS OF HEALTH AND SAFETY FOR BUILDING CONSTRUCTION PROJECTS IN ABUJA

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ABSTRACT

Accident records in the construction industry is so pronounced that it cuts across developed and developing economies and so the industry is known as one of the industries with very high rate of accident. The costs of accidents in any project impacts on the financial success of the construction organisations and affects the

Introduction

The construction industry has a great influence on both the economy and social policies in many developing countries. However, one of its most significant factors is the high number of fatalities that it suffers (Bilir and Gurcanli, 2018). Accident records in the industry is so pronounced that it cuts across developed and developing economies and so the industry is known as one of the industries with very high rate of accident (Okoye, 2016). Occupational accidents as losses that hinders business performance. The costs of accidents in any project impacts on the financial success of the construction organisations and affects the overall costs of construction (Aminbakhsh *et al.*, 2013). Hence, investing in accident prevention corroborates in the reduction of losses and providing a gain in competitiveness

overall costs of construction. The aim of the study is to estimate the costs of health and safety for building construction projects in Abuja. One hundred (100) well-structured questionnaire were distributed to quantity surveyors who prepared bills of quantities for the QS firms in Abuja. A total of fifty- three (53) questionnaire were retrieved making a response rate of 53% and fifty- three (53) bill of quantities was obtained. Findings on the Health and Safety cost item in construction project that was the most estimated for by all respondents was Scaffolding, Plant and Equipment, Temporary electricity, first aid and Temporary Water with frequency rate of 100%, 98.11% and 88.70%. Result revealed that the percentage of health and safety cost (HSC) to the total project costs was approximately 3.19% and health and safety cost per unit area was approximately N13,777.56/m². It is therefore concluded that if approximately 3.19% of project sum will save life and property, stakeholders should embrace the notion of budgeting for OHS in every project embark on.

KEYWORDS: *Accident Prevention, Building Construction, Estimate, Health and Safety, Safety cost,*

of the construction firm. Ferreira *et al.* (2012) believes that accident generates unplanned costs which reduces companies' product competitiveness and result's in the weakening of the nation's economies. The International Labour Organisation (ILO, 2012) revealed that losses from occupational accidents corresponds to nearly 4% of global Gross domestic product (GDP).

Study by Takala *et al.* (2014) indicates that 18% of deaths at workplace occurred in low and middle income countries, while 5% in high income countries. According to Occupational Safety and Health Authority (OSHA, 2017) construction is responsible for 21% of death at work in the United States of America. In Great Britain

construction is responsible for 28% of death at work (Health and Safety Executive (HSE, 2018). According to the report of Global Competitiveness 2020 (World Economic Forum, 2020) competitive companies tend to invest more resources in managing risks related to industrial and work processes in developed countries.

In most developing countries Nigeria inclusive, health and safety consideration in construction projects delivery is not given priority and the implementation of safety measures during construction is considered a burden (Windapo, 2013; Okoye & Okolie 2014; Udo *et al.*, 2016). This is due to the fact that the level of safety consciousness in the construction industry is unsatisfactory, since safety is perceived as extra cost and unnecessary expenditure Gurcanli *et al.* (2015); Yilmaz and Kanit (2018); Bilir and Gurcanli (2018). Construction managers tend to believe that safety come at a cost, by introducing and executing measures that ensure health and safety in construction sector will lead to higher cost, and hence lower profitability (Muiruri and Mulinge, 2014). However, it has been proved that investment in construction health and safety actually increases the profitability by increasing productivity rates, boosting employee morale and decreasing attrition (Ikpe, 2009; Windapo, 2013).

Gurcanli and Mungen (2009) observed that there is often insufficient data or inaccurate information available when safety assessments are required in construction sites. Lopez-Alonso *et al.* (2013) revealed that in most construction firms the costs of health and safety are not accounted for separately in the accounting system, as a result the items that comprises these costs are not identified and not being aware of how much would be adequate for H&S provision. However, determining the extent or how much is enough is the challenge. This is the gap the study intends to address, by estimating the costs of health and safety for building construction projects in Abuja, Nigeria. The objectives of the study is to identify the Health and Safety cost item in the bills of quantities

and to evaluate the costs of health and safety for building construction projects.

Literature review.

Costs of Health and Safety

Understanding the nature of health and safety costs in order to effectively address occupational risk prevention management is important. Lopez-Alonso *et al.* (2013) described health and safety costs on building construction sites as the cost of the resources, goods and services employed in order to improve working conditions and to reduce the rate of accident, together with those triggered by the occurrence of incidents or accidents. Lopez-Alonso *et al.* (2013) classified cost related to health and safety in the workplace into three groups as follows: safety costs, non- safety costs and other extraordinary costs.

Safety Costs

Safety cost is the costs incurred to maintain the company's health and safety standards, for instance the costs of resources required to implement the needed preventive actions, either under legal obligation or voluntarily. Safety cost is distinguished between prevention costs and evaluation and monitoring costs.

Prevention costs

Prevention costs are those incurred by the company in order to comply with legal requirements with respect to the prevention of accident, in other word it is the cost of the measures taken to implement a risk prevention policy during construction work and the sum needed to improve the health and safety conditions in the various work activities of the company.

Evaluation and Monitoring costs

Evaluation and Monitoring costs are costs derived from the action taken for appropriate testing and maintenance of health and safety measures adopted by the company in regards to every aspect of the

work to be executed. Aimed at reducing or minimizing the risk of occupational accident and disease.

Non- Safety Costs

These are expenses incurred by not ensuring health and safety at work such as, the expenditure a company must meet following occurrence of accidents as well as those that may possibly arise from breaches of health and safety regulations. These costs are differentiated between tangible costs of accidents and intangible costs of accidents. Tangible costs of accidents represents the costs related with the occurrence of an accident at work place, which can be computed using traditional cost accounting methods. While intangible costs of accidents are those costs which are not measurable in economic terms or which impact cannot be measured by any performance indices by the organisation, such as low employee morale, impaired company's image, loss of market or labour dispute.

Other Extraordinary Costs

These costs are losses triggered by events that cannot be prevented by the technical or human resources provided to construction works, or which are totally inevitable such as natural disasters. This costs type take account of all the items that are beyond the scope and control of organisation, and thus are classified as uncontrollable costs, which cannot be integrated into a structured model designed to control costs relating to safety at the workplace.

A Review of Authors on Health and Safety Costs to Project Costs in construction projects.

Studies on the costs of health and safety costs to project costs in the construction industry are very few common. Smallwood (2011) determined the perceptions and practices related to financial

provision for health and safety by general contractor utilizing Provisional sum and Preliminaries items in South Africa construction industry, result revealed that the cost for health and safety was 3.8% of the tender sum and 2.4% of the total cost of the construction project. Misan *et al.* (2012) determined the safety cost for construction project in Malaysia where he identified the common safety components and five types of safety costs for building construction projects. Findings revealed that the cost for health and safety was approximately 2% of the total value of the project for safety at construction sites.

Pellicer *et al.* (2014) developed a method for estimating OHS costs during the design phase of a specific construction project in Spain, OHS costs was classified into four categories insurance cost, prevention costs, accident costs and recovery costs. A mathematical model was created for computing each of the cost category. A further application of the method on a case study revealed, that the mean value for risk prevention cost for the 173 health and safety plan of projects sampled was 1.54% - 5% of the total cost of the budget. Hamid *et al.* (2014) investigated the cost and benefits of compliance with health and safety management among contractors identifying different approaches taken to implement health and safety in their organization. Result of the investigation revealed that the cost of compliance ranges from 0.15% to 1.08% with an average of 0.14% from the project value.

Gurcanli *et al.* (2015) developed a safety cost model by combining an activity based risk assessment and activity-based cost analysis in order to offer an approach for estimating the safety cost for early stages of construction bidding phase. They performed a cost analysis on 25 concrete residential building result of the study revealed that the percentage of safety cost to the total construction cost is 1.92% and OHS costs per unit area was approximately 5.68 USD/m2. Latib *et al.* (2016) investigated the implementation of occupational safety and health requirements in

construction project by qualitatively analysing seven contract documents to identify the extent of OSH requirements and budgeting. Their finding shows that the visible allocated budget for OSH requirements ranges from 0.21% to 1.99% of the contract value. Giessa *et al.* (2017) designed a cost model for health and safety in the Egyptian building construction projects for clarifying the cost of applying safety regulations in constructing building projects, three case studies were used. Their discovery disclosed that the cost for health and safety was approximately 1.22% total cost of the budget. Yilmaz and Kanit (2018) developed a tool for estimating compulsory OHS costs for small and medium scale of residential building construction projects. Findings revealed that the percentage of compulsory OHS costs to the direct construction costs is 5.15% and OHS costs per unit area is approximately 8.47 USD/m^2. Ghousi *et al.* (2018) determined the effect of safety costs on safety risk in a commercial building by designing a flexible method of building construction safety risk assessment and investigating financial aspects of safety program. Result revealed that investment of 1.5% of construction budget on safety program will decrease 75% of safety risks. Yilmaz and Ugur (2019) conducted a comparison of estimated OHS costs with the actual costs in maintenance and repair projects of public buildings in Turkey and developed a computer software as a calculation model. Their result showed that the ratio of actual and estimated OHS costs to the approximate cost was 3.98% and 3.58% respectively.

Research Methodology

A mixed method was employed for the study, Qualitative data was in form of a well-structured questionnaire, which was designed to identify the Health and Safety cost item estimated in the preliminary section of the bills of quantities. Quantitative data was in the form of bill of quantities. The population of the study were quantity surveyors who prepared bills of quantities for the QS firms

in Abuja. The study used a population size of 100 QS firms registered with the Nigerian Institute of Quantity Surveyors as at 2021. Non-Probability sampling technique was adopted and purposive sampling technique was chosen based on certain criteria. The criteria for the selection of the firms were those that provided bill of quantities in which the cost of the preliminary section was broken down for building projects completed within three years or are on-going. As a result one hundred (100) copies of questionnaire were distributed across the targeted QS firms. A total of fifty- three (53) questionnaire were retrieved making a response rate of 53%. In addition fifty- three (53) bill of quantities was obtained.

Method of Data Collection

Data collection for the study was carried out using a well-structured questionnaire divided into two sections, the first section captured information about the respondent's background which includes: Academic qualification, Professional membership and working experience. The second aspect of the questionnaire focused on 24 health and safety cost items in the preliminary section of the bills of quantities. Respondents were asked to tick from their wealth of experience the items in which they estimated for in their firms.

Archival data were extracted from the bill of quantities for 53 projects completed within three years to date. A format for the collection of data was designed containing the following information: construction area, total cost of project and total preliminary cost and health and safety cost items which was extracted from the bill of quantities.

Method of Data analysis

The data was analysed using descriptive statistics which involved the use of frequencies distribution tables and simple percentage. Microsoft excel (spreadsheet) was used to analyse the data.

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Results and Discussion

Respondent's Profile

This section offers basic information concerning the background of the respondents. The profile of respondents is given in Table 1.0. Table 1.0 present's information on the background of the respondents, on the academic qualification result reveals that 56.60% of the respondents are HND/ Bachelor degree holders, 24.53% are Master degree holders, 7.55% have other certificate 5.66% are OND and PhD holders respectively. The respondents are well knowledgeable to provide appropriate data for the study. On the professional membership, 32.08% of the respondents are Probationer members, 45.28% are corporate members, 16.98% are fellows and 5.66% of the respondents have other professional membership. This indicates that the respondents are competent to provide reliable information for the study. Result on working experience of respondent, 32.08% had 10-14years' experience, 18.87% had 20years and above, 16.98% of respondent had 5-9 years and 15-19years respectively and 15.09% had 0-4years working experience. This implies that the respondents are well experienced and suitable for the study.

Table 1.0: Background information of respondents

Academic Qualification of respondent	No of respondents	Percentage (%)
OND	3	5.66
HND/ Bachelor degree	30	56.60
Master degree holders	13	24.53
PhD.	3	5.66
Others	4	7.55
Total	53	100
Professional membership of respondent		
Probationer	17	32.08

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Corporate member	24	45.28
Fellow	3	16.98
Others	9	5.66
Total	53	100
Working experience of respondent		
0-4	8	15.09
5-9	9	16.98
10-14	17	32.08
15-19	9	16.98
20 years above	10	18.87
Total	53	100

Identification of the Health and Safety cost item estimated in the bills of quantities

This section provides result of the questionnaire survey concerning 24 Health and Safety cost item identified from literature which were found in the preliminary section of the bills of quantities, as shown in Table 2.0.

Table 2.0 illustrates result on of respondent responses in their respective organisation, result revealed that Scaffolding, Plant and Equipment, Temporary electricity, first aid and Temporary Water, Cleaning rubbish and Temporary fencing with frequency rate of 53(100%), 52(98.11%), 47(88.70%), 45(84.91%) and 43(81.13%) are the Health and Safety cost item in construction project that was the most estimated for by all respondents. While fire point was the least with 2 (3.77%).

Table 2.0 Identification of Health and Safety Cost items in Estimated for by respondents

S/N	Health and Safety Cost items in BOQ	SCORE	%	RANK
1	Scaffolding, Plant and Equipment	53	100	1

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2	Temporary Electricity supply	52	98.11	2
3	Temporary Water	47	88.70	3
4	First Aid	47	88.70	3
5	Clearing rubbish	45	84.91	5
6	Temporary Fencing	43	81.13	6
7	Watching and lighting (Security staff)	42	79.25	7
8	Temporary hut, store, material storage	41	77.36	8
9	Cleaning on Completion	41	77.36	8
10	Temporary lab, workshop & shed	38	71.70	10
11	Welfare and Safety (Toilet/Latrines/drying room)	38	71.70	10
12	Protection of works	37	69.81	12
13	Temporary Access Roads, crossovers, gangways, gate entrance and the likes	36	67.92	13
14	Insurance Declaration (Contractor's All-Risk)	36	67.92	13
15	Hoardings and Barriers	30	56.60	15
16	Temporary Storm water Drainage	28	52.83	16
17	Pest control (Exterminate and Prevent pests)	23	43,39	17
18	Protection Against Damage	21	39.62	18
19	Control of pollution (prevention of nuisance)	18	33.96	19
20	(PPE)	15	28.30	20
21	Protection of works (Existing Installation)	14	26.42	21
22	Temporary Works	13	24,53	22
23	Other safety measures (Access for Workmen)	10	18.87	23

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24	Fire point	2	3.77	24

Evaluating the cost of health and safety in the Bill of quantities for building construction projects.

This section present the result of the health and safety cost items extracted from the preliminary section of the bill of quantities for 53 building construction projects. The share of safety expenditure against the total project cost (TPC), the construction area (CA) and the total preliminary costs (TCP) was computed in this study.

Table 3.0 present the percentage of safety cost to total construction costs. Result revealed that the percentage of health and safety cost (HSC) to the total project costs was approximately 3.19%. The percentage of health and safety cost to the total preliminary costs was estimated to be approximately 68.09%. A further calculation was carried out to determine the health and safety cost to the construction area which was approximately N13, 777.56/m².

Table 3.0 summarised information of the cost items calculated for in the study

PROJ	CA	TPC	TCP	HSC	HSC/ CA	HSC% TCC	HSC% TCP
1	1127	421.900.658.55	7.000.000.00	4.700.000.00	4.171.60	1.11	67.14
2	1340	271.783.781.85	7.000.000.00	5.700.000.00	4.253.73	2.10	81.43
3	673	263.619.794.82	12.000.000.00	7.827.700.00	11.625.30	2.97	65.23
4	920	295.671.087.96	30.377.717.16	15.680.768.16	17.044.31	5.30	51.62
5	2047	741.404.557.05	76.173.081.74	39.320.014.58	19.211.73	5.30	51.62
6	2047	767.011.860.89	79.240.074.72	36.856.364.12	18.008.00	4.81	46.51
7	1313	225.757.397.25	10.000.000.00	7.200.000.00	5.482.23	3.19	72.00
8	1560	125.394.507.00	6.000.000 00	4.250.000.00	2.724.36	3.39	70.83
9	884	261.065.710.75	12.950.000.00	7.750.000.00	8.766.97	2.97	59.85
10	927	391.433.539.89	24.250.000.00	14.150.000.00	15.269.78	3.61	58.35
11	1860	697.688.335.24	24.064.000.00	20.714.000.00	11.136.56	2.97	86.08
12	1400	243.283.404.79	35.172.475 10	15.950.020.00	11.392.87	6.56	45.35
13	700	186.704.270.84	16.400.000.00	12.775.000.00	18.250.00	6.84	77.90
14	6047	1.350.517.336.75	74.600.000.00	70.667.500.00	11.687.02	5.23	94.73
15	1500	217.791.870.49	7.549.970.00	5.066.970.00	3.377.98	2.33	67.11

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16	2627	969,766,039.70	40,180,000.00	16,350,000.00	6,224.62	1.69	40.69
17	593	269,092,892.75	12,000,000.00	4,160,000.00	7,011.24	1.55	34.67
18	655	169,840,969.00	29,960,000.00	19,670,000.00	30,030.53	11.58	65.65
19	990	2,625,326,180.02	101,728,578.02	84,314,900.01	85,166.57	3.21	82.88
20	1640	982,856,744.36	38,075,917.36	30,994,656.96	18,899.18	3.15	81.40
21	1293	823,679,438.38	31,909,467.88	25,753,662.27	19,912.63	3.13	80.71
22	1030	666,623,420.10	25,825,032	13,688,721.96	13,290.02	2.05	53.01
23	440	115,425,377.94	6,759,633.96	3,555,245.02	8,080.10	3.08	52.60
24	593	269,092,892.75	1,236,156.15	5,333,672.11	8,989.34	1.98	431.47
25	1427	353,727,445.95	12,200,000.00	7,100,000.00	4,976.64	2.01	58.20
26	553	1,274,776,759.63	88,334,269.71	57,417,275.31	103,766.16	4.50	65.00
27	1287	228,305,474.78	5,950,000.00	3,927,000.00	3,052.07	1.72	66.00
28	1020	195,950,245.40	5,600,000.00	3,640,000.00	3,568.63	1.86	65.00
29	1607	181,880,725.74	4,935,415.00	3,208,019.75	1,996.69	1.76	65.00
30	2007	1,183,939,020.82	32,099,500.00	20,543,680.00	10,237.71	1.74	64.00
31	1413	142,043,382.73	4,768,893.23	3,815,956.20	2,699.97	2.69	80.02
32	980	122,232,133.81	3,927,887.01	1,571,501.40	1,603.57	1.29	40.01
33	1033	125,734,353.21	4,040,430.06	1,616,528.55	1,564.38	1.29	40.01
34	1720	165,821,449.11	5,328,616.63	2,131,916.85	1,239.49	1.29	40.01
35	1253	128,804,911.11	4,139,110.91	1,656,009.60	1,321.28	1.29	40.01
36	1973	255,002,560.40	8,586,021.00	7,150,000.00	3,623.31	2.80	83.27
37	333	179,168,916.18	7,500,000.00	5,750,000.00	17,250.00	3.21	76.67
38	1187	688,126,228.94	45,000,000.00	33,277,650.00	28,042.96	4.84	73.95
39	1293	506,056,330.96	10,739,112.50	6,266,327.50	4,845.10	1.24	58.35
40	678	647,361,909.45	10,597,345.16	6,769,000.00	9,979.94	1.05	63.87
41	2047	631,980,919.67	64,655,757.27	25,613,448.88	12,514.71	4.05	39.62
42	2453	759,955,377.51	31,584,136.55	18,216,228.79	7,425.09	2.40	57.68
43	920	212,307,474.46	21,720,435.08	8,324,953.59	9,048.86	3.92	38.33
44	2027	1,253,308,886.37	93,509,989.33	61,716,592.96	30,452.27	4.92	66.00
45	2047	804,083,695.02	76,004,280.00	40,699,675.84	19,885.84	5.06	53.55
46	3300	1,115,910,245.02	30,954,514.43	20,429,979.50	6,190.90	1.83	66.00
47	2047	630,898,120.05	64,544,979.82	25,569,564.28	12,493.27	4.05	39.62
48	920	268,173,831.31	25,348,554.00	13,438,526.68	14,607.09	5.01	53.01
49	3827	1,179,859,664.31	31,258,338.00	20,630,503.08	5,391.25	1.75	66.00
50	2047	805,005,376.95	76,091,400.00	40,746,327.91	19,908.63	5.06	53.55
51	2593	1,158,850,565.88	32,099,500.00	21,185,670.00	8,169.28	1.83	66.00
52	4900	2,883,968,720.00	119,859,224.00	66,620,664.78	13,596.05	2.31	55.58
53	2000	898,130,605.85	38,690,859.79	21,505,318.59	10,752.66	2.40	55.58
AVE					13,777.56	3.19	68.09

PROJ=Projects; CA=Construction Area; TCC=Total Cost of Construction; TCP=Total Cost of Preliminary; HSCBOQ=H&S Cost in

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BOQ; HSC%TC =H&S cost in BOQ AS % of total project cost; HSC/TCA= H&S cost in BOQ to construction area; HSC%TCP= H&S Cost in BOQ as % of Total Cost of Preliminary

Discussion of Findings

Result revealed that out of the twenty four (24) health and safety cost items identified in the preliminary section of the bills of quantities, result revealed that all of the respondent making 100% agreed that scaffolding, plant and equipment are the health and safety cost item in construction project that was the most estimated for by all respondents. This is in line with Malan and Smallwood 2018 who identified Scaffold among the top five most important health and safety item that should be included in the health and safety preliminaries section. Temporary electricity was the second with 98.11% most estimated Health and Safety cost item in construction project by respondents. While 88.70% of the respondents agreed that first aid and Temporary Water were the third Health and Safety cost item. This is in line with Malan and Smallwood 2018 who identified first aid as the first important health and safety item that should be included in the health and safety preliminaries section in addition Gurcanli *et al.* (2015); Ghousi *et al.* (2018) also earmarked first aid as a necessary item for all work activities in building construction project.

Result on the share of total safety cost to the total construction cost revealed that the percentage of safety cost to the total project cost is approximately 3.19% this was this in line with Gurcanli *et al.* (2011);Yilmaz and Kanit (2018); Yilmaz and Ugur (2019) who estimated that the cost for implementing H&S systems within a construction company to be between 3.62%, 5.15% and 3.58% of total costs of project respectively. Result on the determination of the safety cost per unit of construction area was discovered to be approximately N21271.98/m^2. Finding from Gurcanli *et al.* (2011); Gurcanli *et al.* (2015); Yilmaz and Kanit (2018) revealed that an

approximately 8.08 USD/m², 5.68 USD/m²; 8.47 USD/m² was expended for safety cost per unit of construction area in building projects respectively. The result of the study when compared to other studies, the ratio of OHS costs to total costs of buildings did not express the same value, this could be as result of variations of different OHS costs components estimated for by the companies sampled by the researchers. And several assumptions made especially during the calculation of total costs of the building which could involve direct construction costs, project services fees, and general field expenses. It should be noted that this study only took into account the cost of OHS costs in the preliminary section of the bill of quantities

Conclusion and Recommendation

This study estimated the cost of safety expenditure along with the cost of project, in addition the safety cost per unit area was determined. This offers great advantages in the bidding, budgeting, planning of managerial activities for the contractor. It is therefore concluded that earmarking as low as approximately 3.19% of project sum for accident prevention will save life and property, stakeholders in the construction industry should embrace the notion. It was recommended that for accurate estimation and efficier t results projects of similar construction area, project cost, projec: characteristics (such as building height, material qualities) and OHS regulation policy be chosen for comparison. A tool that is accurate and efficient in estimating the OHS cost at the beginning of a construction project implementation will help develop a safety culture among stakeholders in the construction industry, and will provide a better understanding of safety costs which in turn will lead to the application of voluntary OHS measures on site. In order to carry out further research, researchers should focus on how to develop a direct calculation model that can be used to calculate the

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health and safety cost for construction projects before the tender stage.

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