Critical Success Factors for Health and Safety Performance Indicators

ABSTRACT

Proper management of health and safety has been a recurring challenge in Nigeria where stakeholders have been accused of ineffective implementation of the health and safety scheme and regulation. This non performance of health and safety requires an investigation into factors that could determine the success of health and safety of construction project performance. Current literatures in construction project performance have not been able to adequately treat the critical success factors (CSFs) for health and safety as a performance indicator for construction projects. The study determine the CSFs for health and safety performance indicator for construction project performance for improved decision making in the context of diagnosing construction project performance.The data for this research were collected through literature review, interviews and survey questionnaire in a form of data generation triangulation. A total of One Hundred and ninety four (194) responses were collated as properly completed, giving a 57 percent acceptable response rate with subject to item ratios of above 5:1 thus acceptable for the required factor analyses. Two components of CSFs for Health and Safety performance indicator were foundwhich includeEffective Finance of Site Management for Health Safety Implementation, and Capacity of Contractor for Project Management and Safety Programme. Although, the research has provided a different perspective to the way the critical success factors should be assessed as different factors that are reported separately in literatures are linked as associates in this research indicating structure of an underlying relationship.

Introduction

Federal Ministry of Labour and Employment (FMLE) (2016) in Nigeria reported that the construction industry has the highest number of work related accidents/injuries, accounting for over 39% and with the highest recorded number of disablements standing at 83, the highest of the total figures where other industries like the ICT and Telecom industry reported the least at 0.26%.The degree to which the general

conditions surrounding a construction project, promote the completion without major injuries or injuries to persons directly and indirectly connected to the project is a measure of health and safety performance of the project (Chan, 2003). Although, several researchers rated safety behind cost, quality and time (Dawood, *et.al.*, 2006; Alumbugu, *et.al.*, 2015) yet, its importance cannot be overlooked. An accident-free construction promotes on-time completion and eliminates claims from injured or dead site workers. This means that quality health and safety programme on construction sites ensures that time and cost overrun are reduced to the barest minimum. Umeokafor, Isaac, Jones, and Umeadi (2014) reported the sad experience of ineffectiveness of enforcement authority despite the less attention being paid to health and safety by stakeholders. Accidents or injuries on construction sites can cause litigation and/or penalties or damages that may alter construction programmes thereby leading to delay in project delivery as well as addition to project costs in terms of compensations paid to injured workers or families of deceased workers, fines paid due to non-compliance with health and safety policies and extra interests on loan obtained to execute the projects due to time extension (Muhammad, Abdulateef&Ladi, 2015). This shows the direct relationship between cost performance and health and safety performance on construction projects. Also, productivity and quality can be adversely affected by the state of health and safety programme on construction sites. Accidents and/or injuries could lead to decline in morale of workers on site thereby reducing their productivity as well as commitment which could eventually lead to poor project outcome.

FMLE (2016) promotes and encourages up to date capacity building and a preventive culture to health and safety in Nigerian workplaces. Thus, there is need to determine the factors that improves performance of health and safety in construction industry. Application of health and safety factors in construction organization, safety of project location, reportable accident rate in project and assurance rate of project are success factors attributed to health and safety performance of construction project (Enshassi, *et. al.*, 2009). Muhammad, et al,. (2015) asserted the importance of health and safety

programme as a determinant of construction project performance. Although, proper implementation of health and safety policy on construction sites does come at a cost yet, it cannot be compared with the cost associated with its neglect, the delay it could cause and potential reduction in quality of the project output.

Safety of project location is a factor that can be categorised under the external success factors. Construction project location may be safe due to absence of civil unrest such as industrial actions, protests, commotion amongst others. Flooding, earthquake and other natural events on construction sites and its environs could negatively affect the safety of construction projects, construction workers and, makes accessibility to the sites very difficult (Enshassi, *et. al.*, 2009). Assurance rate of success on construction projects is a function of multiple factors such as the competence of project participants, project complexity and effective project management practices such as training and organisation of workshops on safety practices on construction sites. Also, guiding against future reoccurrence of site accidents depend largely on the feedback got from the records of past accident therefore, keeping proper safety/accidents record is key to achieve successful project in terms of health and safety (Chan, *et.al.*, 2004). Therefore, it can be deduced that project-related, project management, project participants and external success factors predicts the health and safety performance of construction projects.

The interest to achieve successful performance of health and safety on construction projects requires a study into the CSFs that determine performance on health and safety. Aksorn and Hadikusumo (2008) found management support as the most

influential factor for safety programme performance. An objective of creating a safety program was identified by Rowlinson (2003) as critical to safety at construction sites. In achieving good results with health and safety performance on construction projects, factors found, in literatures, as important are: management support, teamwork, appropriate safety education and training, appropriate supervision, clear and realistic goals, safety equipment acquisition and maintenance, continuing participation of employees, safety meetings, delegation of authority and responsibilities, good communication, personal attitude, personal competency, sufficient resource allocation, effective enforcement scheme, program evaluation, personal motivation and, positive group norms (Shirouyehzad, et. al., 2011; Memon, *et. al.*, 2012).Other CSF for Health and safety developed for the study include Clear Objectives on Project Outcomes (e.g. Time, cost, health and safety), The condition of the equipment (state of repair), Collaborative Supervision/inspection on the project (Consultants with Client), Construction methods adopted on the project such as use of only precast building, Management support, Management capacity and Competence of project manager, Technical Competence and Management capacity of the contractor, Experience of contractor, Employment of Skilful Workforce, Site Management on Effective enforcement scheme, Healthy Financial Condition and stability of contractor, Client's Project Financing for regular cash flow, Appropriate safety education and training, Information Coordination, communication and relationship among project parties, Safety equipment acquisition and maintenance, Government's institutional and administrative influence e.g. regulations, permits, Physical work environment such as weather, public disturbance (area boys), Program evaluation of State of Health and Safety e.g. Accident cause delay (Chan, 2003; Chan, *et. al.*, 2004; Dawood, *et. al.*, 2006; Aksorn and Hadikusumo, 2008;Enshassi, *et. al.*; 2009; Shirouyehzad, et. al., 2011; Memon, *et. al.*, 2012; Mashood, *et. al,* 2014; Alumbugu, *et. al.;* 2015). These factors were statistically analysed to establish groups of CSFs for health and safety performance.

Research Method

A literature review was carried out to identify the CSFs that affect project performance and with a focus group interview 18 factors were generated for health and safety indicator for project performance. The sample size for the research was influenced by the number of CSFs identified in the literature and clustered by expert opinion. A total of one hundred and ninety-four (194) responses were collated as properly completed, giving a 57 percent acceptable response rate with subject to item ratios of above 10:1 thus acceptable for the required analyses (Costello and Osborne, 2005). All respondents are well experienced members of various professional bodies in construction industry to establish level of confidence in data generated for this study as the responses supplied were a reflection of their knowledge and exposure in the construction industry. The survey was carried out to determine the critical factors that affect successful health and safety performance and subsequently group them appropriately as CSF for health and safety performance. The completed questionnaires were properly checked for suitability and reliability for research purpose.

Reliability Test for CSF for Health and Safety

In order to assess the degree to which items that make up the scale 'hang together', the internal consistency of these items was evaluated using Cronbach's Alpha which is an important recommendation for researchers in ascertaining whether they measure the same construct (Pallant, 2005; NunnallyandBernstein,2007; Field,2013;). The Cronbach's alpha ranges from 0 to 1; the benchmark that is acceptable for consistency among researchers is an overall value of 0.7 which represents an acceptable consistency. The data for this work were fed into SPSS version 24; the overall Cronbach's alpha coefficient for CSFs for Health and Safety data set is 0.789, this confirms a very good reliability and internal consistency. This is presented in Table 1.

Table 1: Reliability Test Statistics for CSFs for Health and Safety Indicators

Reliability Statistics		
Cases	Valid	192
	Excluded	2
	Total	194

Statistics	Cronbach's Alpha	0.789
	No of Items	18

This indicates that the data set used for the research for CSFs for Health and Safety as a KPI is internally consistent and the respondents had provided responses based on clear and common understanding of the questions in the questionnaire and thus the results for the research findings are reliable. Notwithstanding the result of the reliability, the Chronbach's alpha of the individual item in the data set was subsequently assessed to check for those that could still be questionable. This is discovered to indicate items with Cronbach's alpha above the established value, in this case 0.789, which would be deleted from the list of variables for good internal consistency. Table 2 shows that one variable out of 18 variables was discovered to have its Chronbach's alpha (Ca) value above 0.789 with low item-total correlation of 0.069 as will be stated (less than 0.2), and it was therefore removed from further analysis. The deleted outlier is: Management capacity and Competence of project manager [HS4] (4.8021; Ca, 0.794). The outlier was ranked 4th. After deleting this outlier, the Cronbach's alpha coefficient improved to 0.794. Therefore, the remaining items are the CSFs that 'hang together' to determine Health and Safety performance of construction projects in Nigeria.

Mean Score of Critical Success factors for Health and Safety

From the analysis of the descriptive statistics presented in Table 2, the mean values of the individual factors and their rankings from the most influential factors to the lowest are shown. The Critical Success Factors for Health and Safety performance indicators were ranked using the mean score and where variables had the same mean score, standard deviation was used to determine which variable was stronger than the other. The research employed the Likert scale of 1 to 5, and interestingly the results, after removing the outlier, were divided into three influential divisions thus 3 factors from the remaining 17 factors (4 less 1 outlier at 18 items) while the second division were 7 factors from the initial 18 factors, and the remaining 7 factors from the 18 factors, scaled between 3, 4 and 5 respectively. Majority of these factors tend to scale 4 which is very significant thus critical. As depicted in the Summary item statistics Table 2, the Mean of

all the Means of these items is 4.19 which explains that they are all very significant. Healthy Financial Condition and stability of contractor is ranked first with a Mean of 4.90 and the next top three Critical Success Factors for Health and Safety are, Site Management on Effective enforcement scheme, Client's Project Financing for regular cash flow, and Employment of Skilful Workforce as presented in Table 2. It is fascinating to note that the next seven factors were in the 4.00 range, and the following seven factors in the next 3.00 range. The result is creating a pattern and one of the focuses of the research is to assess the interrelationship among these CSFs variables in influencing KPI.

Table 2: Mean Score of Critical Success factors for Health and Safety Performance

S/N	Critical Success factors	Mean	SD	Cronbach's Alpha if Item Deleted	RANK
HS1	Healthy Financial Condition and stability of contractor	4.90	0.38	0.784	1
HS2	Site Management on Effective enforcement scheme	4.88	0.49	0.783	2
HS3	Client's Project Financing for regular cash flow	4.85	0.51	0.783	3
HS4	Management capacity and Competence of project manager	4.80	0.56	0.794	4
HS5	Employment of Skilful Workforce	4.45	0.90	0.785	5
HS6	Program evaluation of State of Health and Safety (e.g. Accident cause delay)	4.34	0.82	0.778	6
HS7	Government's institutional and administrative influence e.g. regulations, permits	4.30	0.93	0.771	7
HS8	Physical work environment such as weather, public disturbance (area boys)	4.28	0.90	0.768	8
HS9	Appropriate safety education and training	4.08	0.65	0.781	9
HS10	Clear Objectives on Project Outcomes (e.g. Time, cost and quality)	4.07	0.71	0.781	10
HS11	Experience of contractor	4.07	1.02	0.774	11
HS12	Safety equipment acquisition and maintenance	3.98	0.98	0.780	12
HS13	Construction methods adopted on the project such as use of only precast building	3.97	1.05	0.766	13
HS14	Technical Competence and Management capacity of the contractor	3.95	0.93	0.774	14
HS15	Experience of Project Manager	3.88	1.04	0.765	15
HS16	The condition of the equipment (state of repair)	3.88	0.78	0.789	16
HS17	Collaborative Supervision/inspection on the project (Consultants with Client)	3.67	0.93	0.782	17
HS18	Information Coordination, communication and relationship among project parties	3.67	0.79	0.785	18

In addition to having a very significant Mean for the overall of all these Items that influence health and safety, the descriptive mean testing has also been used to determine three key CSFs for the health and safety KPI. These top three most significant Critical Success Factors that affect health and safety as a KPI in Nigeria construction industry are related to Contractor and Client capacity to deliver the project.

Kruskal-Wallis test

A non-parametric test for independent samples was carried out on the data set to compare the variables across the three categories of parties involved on projects that the respondents had experienced. Kruskal-Wallis test was chosen as an alternative to the one-way between groups analysis of variance which is non-parametric test of null hypothesis that is used to evaluate whether different categories of respondents differ by comparing scores of a particular hypothesis (Gupta, 1999; Pallant, 2005). In this research, the difference among respondents of clients, consultants and contractors' organisations were assessed to determine the disparity between the Mean ranks. P-value below 0.05 in Kruskal-Wallis test indicates that there is a significant difference between the groups of participant about the affected variable at 95% confidence level. Any p-value above 0.05 indicates that there is no significant difference among the groups. In Table 2, one CSF was having a p-value (sig) less than the traditional 0.05. This is item HS10 (Clear Objectives on Project Outcomes [e.g. Time, cost and quality]). This implies that there could be underlying facts about the distribution of the mean ranking of the affected item by the respondents.

Exploratory Factor Analysis.

In order to establish a coherent subscales of grouping of the CSFs for Health and Safety indicator, factor analysis was employed based on the aim of this research, which is to determine critical success factors for a healthy and safe project delivery in Nigeria from the relationship between the variables that could be used to conceptualise the dynamic relationship of CSFs and KPIs for performance. This requires the

establishment of key underlying measures from the established sets ofidentified factor. The 17 factors so far established can be reduced to smaller number of groups of critical factors for ease of assessing performance of construction projects. There are three main steps required in conducting factor analysis include: assessment of suitability of the data, factor extraction and factor rotation.

Table: 3 Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy

KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.721
Bartlett's Test of Sphericity		Approx. Chi-Square	1459.332
		Df	153
		Sig.	.000

Assessing the data and extracting the factors was the first step explored using SPSS version 24. The output of the Factor analysis shows an impressive result as all the factors have correlation coefficients that are above 0.3. Also, the Kaiser-Meyer-Olkin (KMO) in Table 3 Measure of Sampling adequacy is above 0.6, and the Bartlett's test of sphericity is 1459.332, which is significant (i.e. Sig. value should be .05 or smaller. Therefore, factor analysis is appropriate having satisfied these preliminary requirements.

In order to determine the number of components or (factors) to 'extract' (Pallant, 2011) that will suitably represent the whole factor, the 'Total Variance explained' table from the SPSS version 24 was looked into and the Initial Eigenvalues above 1 for each of the component variables that are listed. Only six components recorded Eigen values above 1 (4.220, 2.875, 1.627, 1.553, 1.255, and 1.201). These six components explain a total of 70.730 per cent of the variance. The scree plot was run to determine the number of components as Kaiser criterion often extract too many components. Thus, the Scree

plot is assessed for possible guide (i.e. the elbow change point) in the shape of the plot. Only components above this point are retained in the analysis. Nunnally and Bernstein (2007) recommended retaining minimum Eigenvalue of 1. Using our Scree plot it is clearly observed that there is a break between components 2 and 3 and therefore it is logical to retain two components.

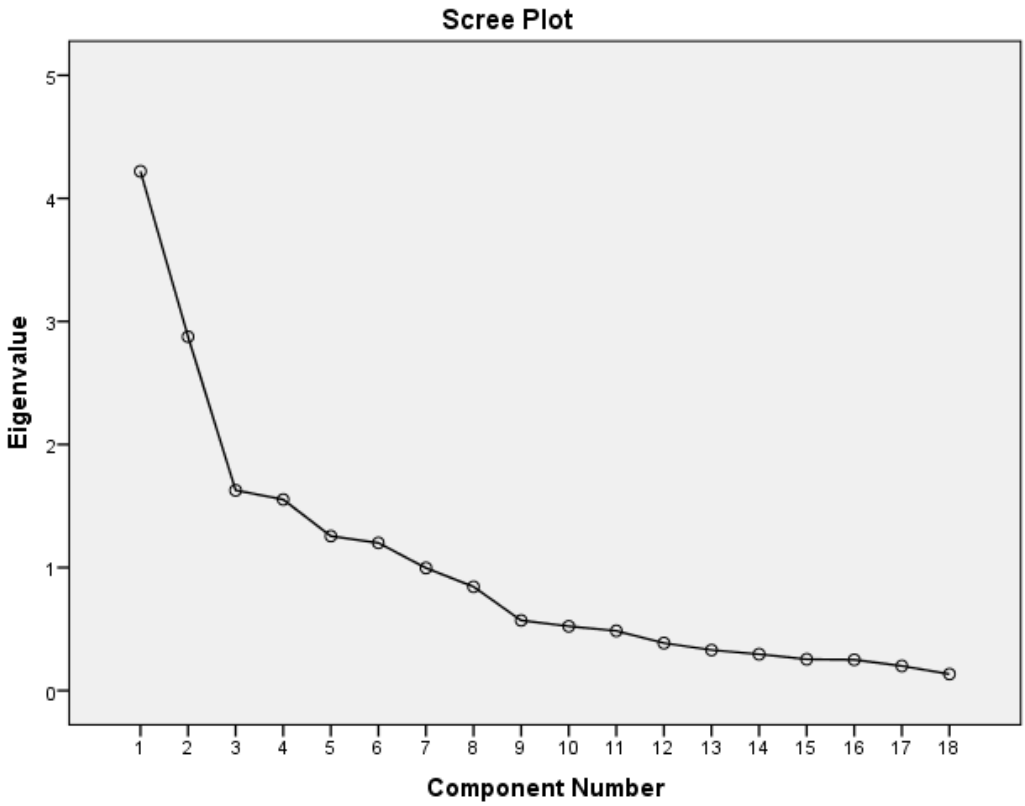

Figure 1: Scree plot of the Eigenvalue for Establishing Component Number

The factor rotation and interpretation was carried out for the two components. It was observed that the distribution of the variance explained has also been adjusted after rotation. Component 1 (Comp1) now explains 22.001percent of the variance; Comp2, 19.344percent. The total variance explained is 41.346.These two established components were subjected to further analysis using Varimax with Kaiser Normalization rotation method. This retained the two components but with more redistribution of the components, Eigen value and percentage variance for each component. Out of these components, cross loadings were checked for variables that load on more than one component. The analysis was rerun for one less and one more (Pallant, 2005, 2011) and thus, 1 extracts and 3 extract components were tried to check the cross loadings

again. It was observed that three variable factors were cross loading in two components. These are (HS8 Physical work environment such as weather, public disturbance area boys); HS7, (Government's institutional and administrative influence e.g. regulations, permits, and HS6, Program evaluation of State of Health and Safety (e.g. Accident cause delay) as highlighted in Table 4. Tabachnick and Fidell (2000) suggested the removal of such cross loading items from the analysis thus; these three factors were subsequently dropped.

Table 4: Pattern/Structure Coefficient of Extracted Components of CSF for Health and Safety Performance

	Extracted and rotated components	1	2	**Eigen**	**%varian**
Comp	**Client's Design and Project Management Capacity**			**3.740**	**22.001**
HS2	Site Management on Effective enforcement scheme	0.841			
HS3	Client's Project Financing for regular cash flow	0.814			
HS1	Healthy Financial Condition and stability of contractor	0.785			
HS9	Appropriate safety education and training	0.618			
HS7	Government's institutional and administrative influence e.g. regulations, permits	0.558	0.330		
HS8	Physical work environment such as weather, public disturbance (area boys)	0.553	0.367		
HS12	Safety equipment acquisition and maintenance	0.537			
HS18	Information Coordination, communication and relationship among project parties	0.474			
Comp	**Construction Resource Management**			**3.289**	**19.344**
HS14	Technical Competence and Management capacity of the contractor		0.720		
HS11	Experience of contractor		0.710		
HS15	Experience of Project Manager		0.686		
HS13	Construction methods adopted on the project such as use of only precast building		0.637		
HS10	Clear Objectives on Project Outcomes (e.g. Time, cost and quality)		0.561		
HS5*	Employment of Skilful Workforce		0.558		
HS17	Collaborative Supervision/inspection on the project (Consultants with Client)		0.429		
HS16	The condition of the equipment (state of repair)		0.395		

HS6	Program evaluation of State of Health and Safety (e.g. Accident cause delay)	0.346	0.365

Table 5.40 Pattern/Structure Coefficient of Extracted Components of CSF for Health and Safety Performance

	Extracted and rotated components	1	2	**Eigenva**	**%varia**
Comp1	**Effective Finance of Site Management for Health Safety Implementation**			**3.740**	**22.001**
HS2	Site Management on Effective enforcement scheme	0.841			
HS3	Client's Project Financing for regular cash flow	0.814			
HS1	Healthy Financial Condition and stability of contractor	0.785			
HS9	Appropriate safety education and training	0.618			
HS7	Government's institutional and administrative influence e.g. regulations, permits	0.558			
HS8	Physical work environment such as weather, public disturbance (area boys)	0.553			
HS12	Safety equipment acquisition and maintenance	0.537			
HS18	Information Coordination, communication and relationship among project parties	0.474			
Comp2	**Capacity of Contractor for Project Management and Safety Programme**			**3.289**	**19.344**
HS14	Technical Competence and Management capacity of the contractor		0.720		
HS11	Experience of contractor		0.710		
HS15	Experience of Project Manager		0.686		
HS13	Construction methods adopted on the project such as use of only precast building		0.637		
HS10	Clear Objectives on Project Outcomes (e.g. Time, cost and quality)		0.561		
HS5*	Employment of Skilful Workforce		0.558		
HS17	Collaborative Supervision/inspection on the project (Consultants with Client)		0.429		
HS16	The condition of the equipment (state of repair)		0.395		
HS6	Program evaluation of State of Health and Safety (e.g. Accident cause delay)		0.365		

The 17 items of Critical Success Factors for Health and Safety Key Performance Indicator were subjected to principal components analysis (PCA) using SPSS version 24. Prior to performing PCA, the suitability of data for factor analysis was assessed.

Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. The KaiserMeyer-Olkin value was 0.721, exceeding the recommended value of .6 (Kaiser 1970, 1974) and Bartlett's Test of Sphericity (Bartlett 1954) reached statistical significance, supporting the factorability of the correlation matrix. Principal components analysis revealed the presence of two components with eigenvalues exceeding 1, explaining **22.001**%, and **19.344**% of variance respectively. An inspection of the scree plot revealed a clear break after the second component. Using scree test, following Pallant's suggestion (2005, 2011), it was decided to retain two components for further investigation. The two-component solution explained a total of **41.346**% of the variance, with Component 1 contributing 22.001 %, and Component 2 contributing 19.344%. To aid in the interpretation of these two components, oblimin rotation was performed. The Oblimin rotation for the two-component solution explained an improved total of **39.418**% of the variance, with Component 1 contributing 23.44%, and Component 2 contributing 15.974%. The rotated solution revealed the presence of simple structure (Thurstone 1947), with component one alone showing two loadings under pattern and component one showing three loadings and component two showing one loading under structure. The interpretation of the two components was consistent with previous research on the PANAS Scale, with positive affect items loading strongly only on Component 1. There was weak positive correlations between the two Components (r =1.000, 0.124 and 0.124, 1.000).

Labelling the Components of CSFs for Health and Safety KPI

Having established 17 clean outputs without cross loading variables in the Varimax rotation for establishing two components thus, it is unnecessary to run Oblimin rotation for the data set of Health and Safety KPI. To identify and label the Components, the highest loading items on each component drives the labelling. Thus, Component 1 (Comp1) was labelled Effective Finance of Site Management for Health Safety Implementation and Comp2 was labelled Capacity of Contractor for Project Management and Safety Programme. Both Comp1 and 2 are positive affect. The two

groups established in this analysis correspond with some of the success factors that had been reported in literature. Although, the research has provided a different perspective to the way the success factors should be assessed as different factors that are reported separately in literatures are linked as associates in this research indicating structure of an underlying relationship.

Effective Finance of Site Management for Health Safety Implementation

Information Coordination, communication and relationship among project parties
This factor component has the highest percentage of the total variance (22.00%), and it consists of eight policy suggestions as presented in Table 5.38. The factor name was so labelled because the determining variables; Site Management on Effective enforcement scheme, Client's Project Financing for regular cash flow, Healthy Financial Condition and stability of contractor, Appropriate safety education and training, Government's institutional and administrative influence e.g. regulations, permits, Physical work environment such as weather, public disturbance (area boys), Safety equipment acquisition and maintenance are measures that made up the group suggest measures that could only be achieved through effective site management effort on health and safety implementation. All these are key to the success of project health and safety management process.

Capacity of Contractor for Project Management and Safety Programme

The second group factor is Capacity of Contractor for Project Management which has nine measures of CSF for health and safety performance indicator and they contributed a total variance of 19.34%. The factor component suggests that achieving Health and Safety performance requires the Contractor to have capacity that flows in tune with project management principle for safety performance, incorporating the experience of project manager within its fold. The variable items under this group are, Technical Competence and Management capacity of the contractor, Experience of contractor, Experience of Project Manager, Construction methods adopted on the project such as

use of only precast building, Clear Objectives on Project Outcomes (e.g. Time, cost and quality), Employment of Skilful Workforce, Collaborative Supervision/inspection on the project (Consultants with Client), The condition of the equipment (state of repair), Program evaluation of State of Health and Safety (e.g. Accident cause delay). These factors clearly show the capacity of the contractor's management but that is not all, it requires that there is an oversight on the contractor management as a well managed company could strategically desire to not to take health and safety needs of the site seriously if the project manager and even the client did not emphasise punitive measures for not carrying it out. The skilful workforce and condition of equipment go together in determining the performance of health and safety of a construction project.

Health and Safety Performance Forecasting Variables

Frequency of occurrence of ill health, injuries and accidents on construction sites is an indication of safety performance of such projects (Memon, *et. al.*, 2012). The extent of damage to property experienced on construction project is also an indication of how safe the project is (Muhammad*, et. al.*, 2015). Causes ascribed to these health and safety failure events are non-availability of safety equipment, defective equipment and noncompliance with health and safety policy of construction organizations. Two component factors were established for health and safety performance. The first factor is the "Effective Finance of Site Management for Health Safety Implementation" it consists of eight policy suggestions including; Site Management on Effective enforcement scheme, Client's Project Financing for regular cash flow, Healthy Financial Condition and stability of contractor, Appropriate safety education and training, Government's institutional and administrative influence e.g. regulations, permits, Physical work environment such as weather, public disturbance (area boys), Safety equipment acquisition and maintenance are measures that made up the group suggest

measures that could only be achieved through effective site management effort on health and safety implementation. All these are key to the success of project health and safety management process. The second group factor is “Capacity of Contractor for Project Management and Safety Programme” which has nine measures of CSF for health and safety performance indicator. The variable items under this group are, Technical Competence and Management capacity of the contractor, Experience of contractor, Experience of Project Manager, Construction methods adopted on the project such as use of only precast building, Clear Objectives on Project Outcomes (e.g. Time, cost and quality), Employment of Skilful Workforce, Collaborative Supervision/inspection on the project (Consultants with Client), The condition of the equipment (state of repair), Program evaluation of State of Health and Safety (e.g. Accident cause delay). These factors clearly show the capacity of the contractor’s management but that is not all, it requires that there is an oversight on the contractor management as a well managed company could strategically desire to not to take health and safety needs of the site seriously if the project manager and even the client did not emphasise punitive measures for not carrying it out. The dynamic model of Health and Safety Performance is displayed in Figures 6.6a and b.

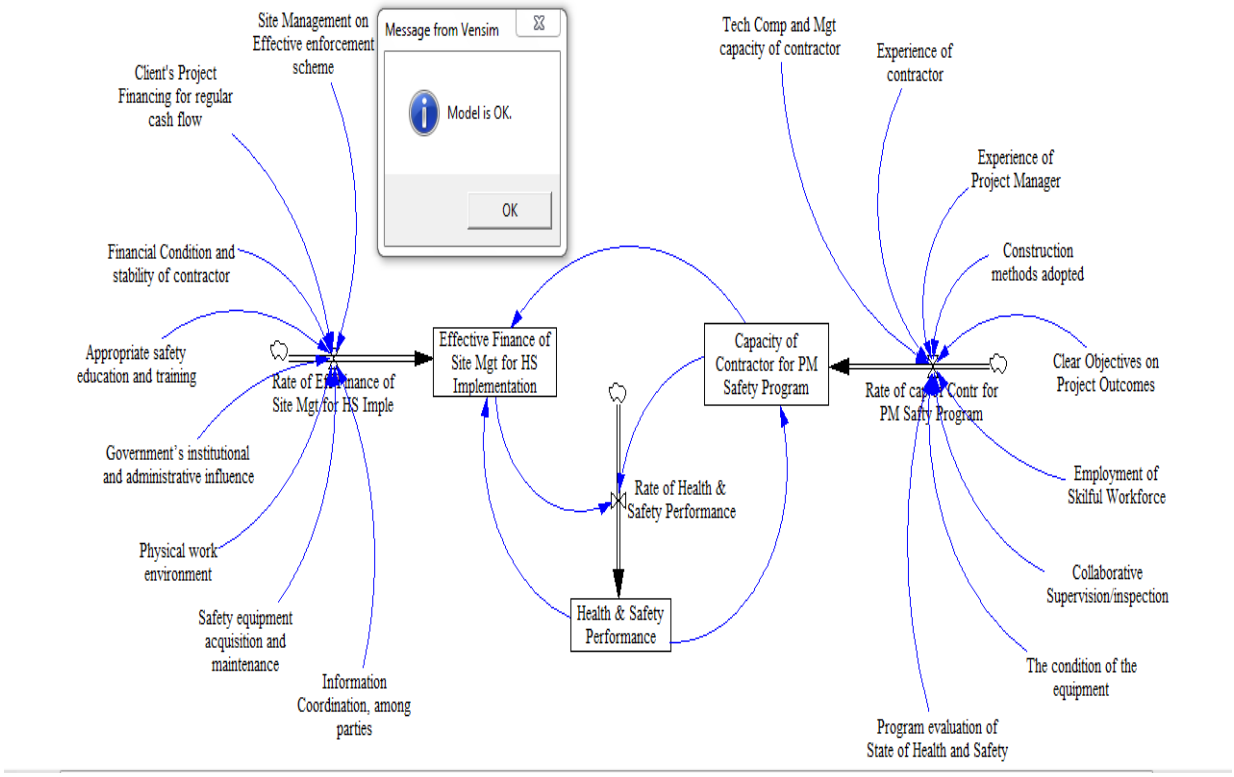

Fig. 6.6a: System Dynamic Model of Health and Safety Performance of Construction Projects

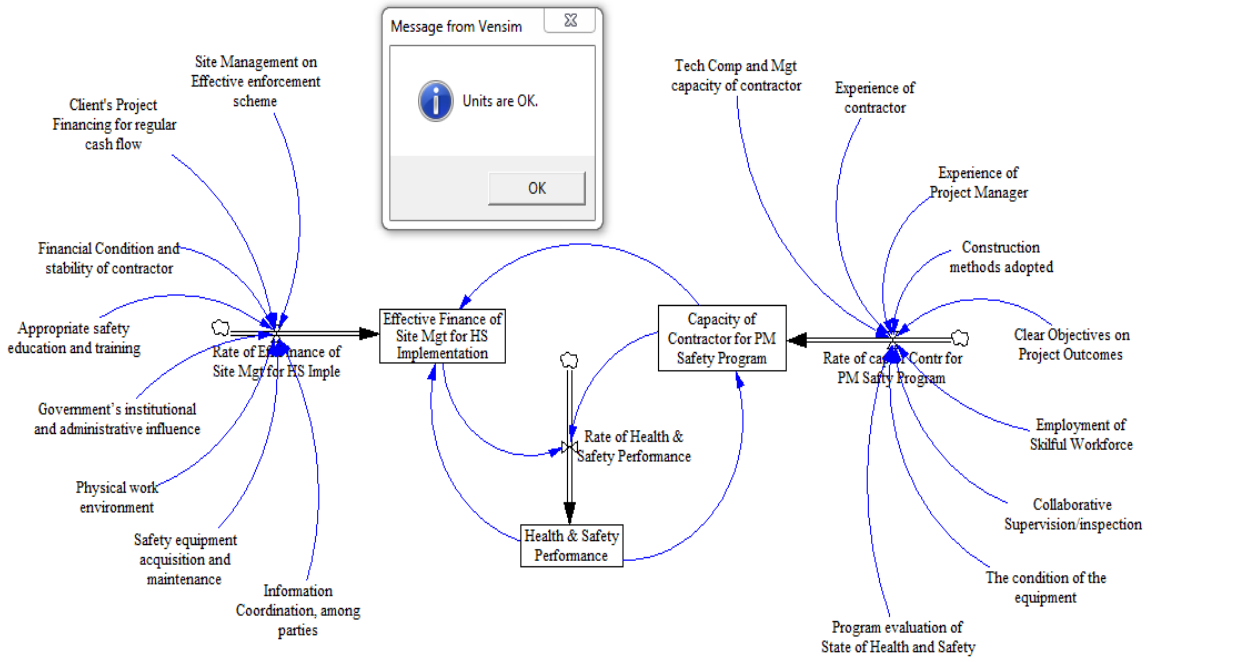

Fig. 6.6b: System Dynamic Model of Health and Safety Performance Dimensional

Consistency Check.

Fig. 6.6.1: Tree Diagram from the SD Model of Quality Performance

Figure 6.6.1 is the Tree Diagram showing the variables causing the Health and safety performance of Construction projects through the auxiliary variables that drives the health and safety rate or rate of health and safety performance from the causal loop

diagram of the stock and flow in Figure 6.6a and b. The equation from the model shows that;

"Health & Safety Performance"= INTEG("Rate of Health & SafetyPerformance"^0.5,0)

Units: "%"*"%" [0,100]

The SD models developed for the KPIs of Time, Cost, Quality and Health and Safety have shown the dynamic workings of the endogenous variables interactions and thus, CSFs operate in a dynamic relationship and from this underlying dynamic relationships a causal relationship is established beyond the correlation established previously through factor analysis technique. This has suggested that modelling CSFs for KPIs in assessing causal relationship, through the process of stock and flow feedback system has been confirmed and thus would be suitable for construction project performance diagnostic that will be useful for assessing effective construction project delivery in Nigeria. This outcome leads the research to the main aim of the dissertation and the last and final objective 5 which is to conceptualise the development of a system dynamics Project Performance Diagnostic Model (PPDM) from the KPI models for diagnosing project performance based on the project variables.

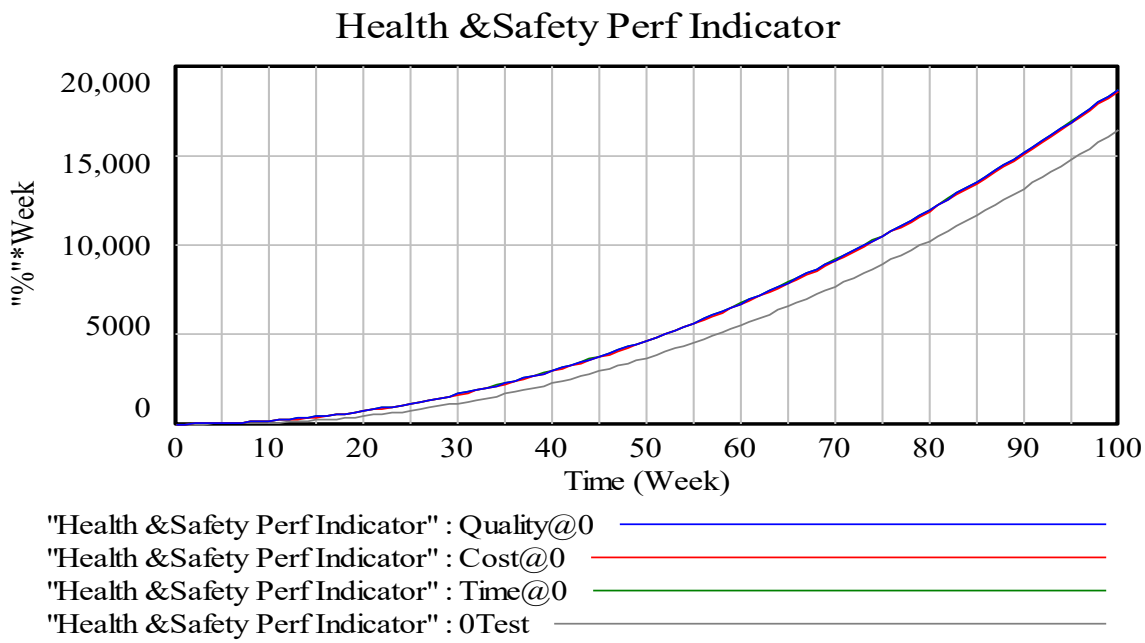

Fig. 6.22: Graph of the Dynamic Impact of Quality@0% on Health/Safety Performance.

Health and Safety performance remains relatively the same impact irrespective of the poor performance of all the other three performance indicators.

and their impacts did not drop much from the 100% reference line.

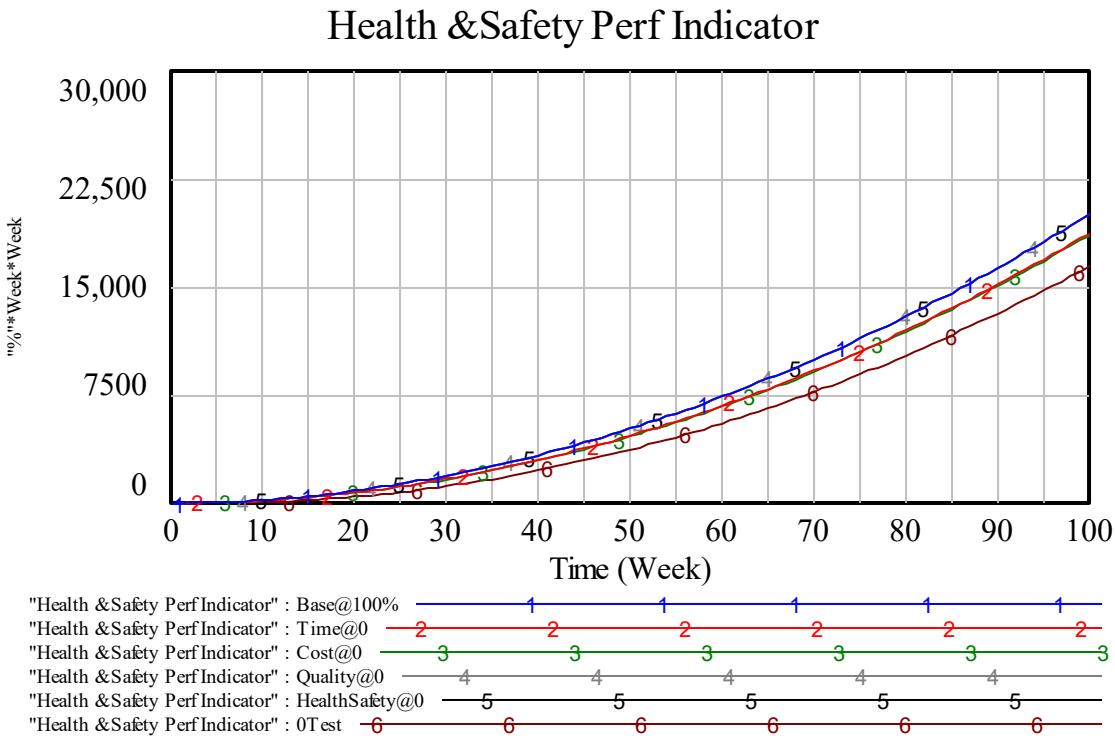

Fig. 6.32: Graphs of the Dynamic Impacts within the two extremes for Time Performance

Figure 6.32 shows how the worst health/safety performance impacts health/safety similar to quality impacts, just like other KPIs. And performance would not drop much from the 100% baseline reference.

Conclusion

On health and safety performance, Healthy Financial Condition and stability of contractor is ranked first and the next top three Critical Success Factors for Health and Safety are, Site Management on Effective enforcement scheme, Client's Project Financing for regular cash flow, and Employment of Skilful Workforce. Aksorn and Hadikusumo (2008) found management support as the most influential factor for safety programme performance. Whereas, (Aksorn and Hadikusumo, 2008; Shirouyehzad, et.

al., 2011; Memon, *et. al.*, 2012) reported that to achieve good results with health and safety performance on construction projects, factors found in literatures, as important are: management support, teamwork, appropriate safety education and training, appropriate supervision, clear and realistic goals, safety equipment acquisition and maintenance, continuing participation of employees, safety meetings, delegation of authority and responsibilities, good communication, personal attitude, personal competency, sufficient resource allocation, effective enforcement scheme, program evaluation, personal motivation and, positive group norms.

The contractors' healthy financial condition and stability greatly improves the project performance regarding health and safety and the clients' financial commitment to the project are critical success factors CSFs for health and safety programme performance. Information coordination and communication relationships between project parties indicated that it is the least factor that can affect the health and safety programme performance. This is in agreement with Aksorn and Hadikusumo (2008) that management support has the most influential factor for safety programme performance.

Health and Safety were organized into two components. The first component is Effective Finance Management for Health and Safety Implementation which consists of eight determining variable factors to include; Site Management on Effective enforcement scheme, Client's Project Financing for regular cash flow, Healthy Financial Condition and stability of contractor, Appropriate safety education and training, Government's institutional and administrative influence e.g. regulations, permits, Physical work environment such as weather, public disturbance (area boys), Safety equipment acquisition and maintenance. Capacity of Contractor for Project

Management and Safety Programme is the second CSF element for Health and Safety Performance requires the Contractor to have capacity that corroborate the project management principle for safety performance, incorporating the experience of project manager. The variable items under this group are, Technical Competence and Management capacity of the contractor, Experience of contractor, Experience of Project Manager, Construction methods adopted on the project such as use of only precast building, Clear Objectives on Project Outcomes (e.g. Time, cost and quality), Employment of Skilful Workforce, Collaborative Supervision/inspection on the project (Consultants with Client), The condition of the equipment (state of repair), Program evaluation of State of Health and Safety (e.g. Accident cause delay). The skilful workforce and condition of equipment go together in determining the performance of health and safety of a construction project. Therefore, the capacity of the contractor's management with dedicated oversight function by project manager (by extension client's interest) would results in better health and safety performance.

Umeokafor, Nnedinma; Isaac, David; Jones,Keith; and Umeadi, Boniface (2014). Enforcement Of Occupational Safety And Health Regulations In Nigeria: An Exploration. *European Scientific Journal vol.3 1857 – 7881* 93-104

FMLE - Federal Ministry of Labour and Employment (2016). Nigeria Country Profile on Occupational Safety and Health accessed07/02/2018 at:www.ilo.org/wcmsp5/groups/public/---africa/---ro.../wcms_552748.pdf

It is pertinent to note that „Others" category reported the second highest contribution but had the most recorded number of disability recorded.

Sadly enough, the impact of the enforcement authority is ineffective, as the key stakeholders pay less attention to OSH regulations; thus, rendering the OSH scheme dysfunctional and unenforceable, at the same time impeding OSH development. For optimum OSH in Nigeria, maximum enforcement and compliance with the regulations must be in place

Umeokafor, Isaac, Jones, and Umeadi (2014) reported the sad experience of ineffectiveness of enforcement authority despite the less attention being paid to health and safety by stakeholders.

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