Social Approach to Sustainable Construction Practices Through Safety Culture

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Abstract:- Increasingly calls for more sustainable construction have occasioned more actions towards sustainability. A meaningful sustainable construction is inimical without significant cultural and behavioural change in how the construction industry manages its safety issues. It is based on these calls that this paper assesses the practical approach to sustainable construction practices through safety culture in Nigeria. It examined relationship between safety culture dimensions and sustainable construction practices in Nigeria. The paper provides a framework through which a sustained cultural and behavioural change in management of safety in construction can lead to sustainable construction practices. It employed a questionnaire survey which was conducted in South East Nigeria. Questionnaire was distributed to contractors, consultants and instructors in the built environment disciplines. The data collected were analyzed using Chi-square (X^2) statistical test, at ($\alpha = 0.05$). The results revealed that the computed chi-square (X^2) for all the four safety culture dimensions (management commitment = 34.04; belief and perception = 46.50; regulatory framework = 19.16; education and training = 20.63) were greater than $X^2_{0.05,8}$ (15.51). Based on this result, it was concluded that safety culture dimensions have significant relationship with sustainable construction practices. The study revealed that imbibing safety culture through management commitment to safety concerns of construction workers, workers perception and belief about safety issues, instituting regulatory framework that will ensure strict compliance to safety regulations by the relevant authorities and providing safety training and education to the construction workers, promote sustainable construction practices. The study recommends that safety training for all construction workers, both at management and operation levels; and institution of regulatory framework will ensure strict compliance to safety regulations.

Keywords:- Social Sustainability, Sustainable Construction, Safety Culture, Behaviour, Practices, Nigeria.

I.   INTRODUCTION

The construction industry is unarguably one of the most hazardous and risky industries in most countries of the world (Che Hassan, Basha & Wan Hanafi, 2007; Olatunji, Aje & Odugboje, 2007; Andi, 2008). Though, the construction sector, relative to its level of development, accounts for more than 60 percent of gross capital formation in most countries, and defines the physical infrastructure upon which effective growth and development is achieved (Ebohon & Rwelamila, 2002). Its safety status in developing countries such as Nigeria is very pathetic and worse than whatever prevails in the developed world. Some of the reasons include; lack of concern, unreliable and inaccurate records, and lack of statutory regulations on health and safety (Idoro, 2007; 2008; 2011a; 2011b). However, according to Mohd Saidin, Abul Hakin, Wan Yusoff, Syamsul and Mat Niiam (2008), the construction industry is unique as construction activities are performed at outdoor under conditions not conducive for safety and health of workers. Workers at construction sites have to face constant changes in the nature of work, work environment, work with new workers and new technology. The reputation of the industry then relies on the expertise of implementation and managing safety, while meeting the client's needs. This is because, according to Nierop (2008), health and safety is pivotal and cardinal success factor in the drive towards sustainable construction.

Over the years, the construction industry has been intensifying efforts towards finding a reasonable and efficient safety management system geared towards achieving sustainable construction. Mohd Saidin *et al.* (2008) note that the systems largely being used in preventive safety is not comprehensive and lack preventive measures. This is against the proposition of the International Civil Aviation Organization (ICAO, 2005) which advocates a shift towards a more modern and proactive safety management systems.

At the wake of the foregoing safety challenges, the United Nations under the World Commission on Environment and Development (WCED), in 1987 held the first ever Earth Summit which gave rise to

Brundtland's Report that bothered on sustainable development. In 1992 another Earth Summit was held in Rio, where Agenda 21 was formulated as the international blueprint for sustainable development. Since then, all sectors of society have been in the process of interpreting and pursuing sustainability and sustainable development within their specific contexts. Chapters 6 and 7 of Agenda 21 specifically refer to the issue of protecting and promoting human health, and the role of human settlements in sustainable development respectively. The ability to meet most of our basic human needs relates in one way or another to the creation of human settlements and protection of human life including their performance. Therefore, in 1996 a second international action plan, The Habitat Agenda, was formulated specifically to address the role of human settlements in sustainable development. The construction sector has a major role to play in terms of the sustainable development of human settlements, as is highlighted in Chapter 4, Section C of The Habitat Agenda. The construction industry and its activities are responsible for a substantial amount of global resource use and waste emissions. It also has an important role to play in socio-economic development and quality of life. Consequently, the need for an internationally agreed Agenda on Sustainable Construction was highlighted early on, and in 1999 the International Council for Research and Innovation in Building and Construction (CIB) published its Agenda 21 on Sustainable Construction (CIB Publication 237) after an extensive collaborative research process. This first agenda for the construction sector was intended as a global intermediary between the broader international agendas, and national/regional agendas for the built environment and the construction sector. Its main objectives were to create a global framework and terminology that would add value to all national or regional and sub-sectoral agendas, and to provide a source document for defining research & development activities related to sustainable construction. The document provides a detailed overview of the concepts, issues and challenges of sustainable development and sustainable construction, and poses certain challenges to the construction industry (Du Plessis, 2002; OSEC, 2010).

The big question however, is whether the quest to achieve a socially sustainable construction can be met without the corresponding behavioural and attitudinal changes towards safety (sustainable safety culture) in construction industry, because for a socially sustainable construction, health and safety must be at the fore front. However, when considering the quantum of losses incurred as a result of accidents on construction sites on daily basis, one wonders if Nigeria is still on the track of achieving sustainable construction and indeed sustainable development. Based on the forgoing, this paper assesses how behavioural and attitudinal changes towards safety (safety culture) among construction workers and stakeholders in the sector could lead to a socially sustainable construction practice which could bring about a meaningful sustainable development in Nigeria

1.1 RESEARCH HYPOTHESIS

To achieve the objective of determining the relationship between the promotion of health and safety on site and sustainable construction, a research hypothesis was postulated. The hypothesis is stated thus:

H_o: there is no significant relationship between safety culture dimensions and sustainable construction practices.
H_1: there is significant relationship between safety culture dimensions and sustainable construction practices.

The result of the hypothesis will establish whether or not the promotion of health and safety on construction sites could lead to sustainable construction practices in the Nigerian construction industry.

II. REVIEW

2.1 SAFETY CULTURE

It was observed that ever since the 1986 nuclear accident at Chernobyl, interest has been intensified in the concept of safety culture, especially in the high risk industries (Cox and Flin, 1998; Cooper; 2000; Peckitt, Glendon & Booth, 2002; Hinze, 2005; Andi, 2008; Faridah, Ahmad, Razidah & Muhd Zaimi, 2009; Fogarty & Shaw, 2010). In its simplest term, however, safety means the state of being safe. It is behaviour and its understanding depends on one's perception. Safety culture, according to the Advisory Group Committee for Safety in Nuclear Installations (ACSNI, 1993), is defined as the product of individual and group values, attitudes, perceptions, competences and pattern of behaviour that determine the commitment to safety and the life style and proficiency of an organization's health and safety management. In practical term, Moh'd Saidin *et al.* (2008) see safety culture as a set of beliefs, norms, attitudes and social technical practices that are concerned with minimizing the exposure of individuals, within and beyond an organization to conditions considered dangerous or injurious.

While Dingsdag, Sheahan and Biggs (2006) advocate for self regulation which is performance based regulation and behaviour dependant (safety culture), Che Hassan et al. (2007) stress that developing a proactive safety culture may take a long time and requires spending a large sum of money for planning, investigating and implementing into each level within the organization. They however, maintain that once it succeeds, the relative rewards will be achieved in terms of competitive advantage, quality reliability and profitability within organization. In the same vein, Occupational Safety and Health Council (OSHC, 2001) observes that one of better indicators of a positive safety culture is a good safety climate. Safety climate they say is often mistaken

for safety culture as they are both inextricably linked, but they are distinctly separate entities. Whereas safety climate refers to people's perceptions of, and attitudes towards safety (OSHC, 2001); a manifestation of safety culture in the behaviour and expressed attitudes of employees (Cox and Flin, 1998), Cooper (2000) argues that it seems plausible that safety culture and safety climate are not reflective of a unitary concept, rather, they are complementary independent concepts. Based on this, Yang, Wang, Chang, Guo and Huang (2009) observe that the concepts of safety culture and safety climate have been confused within the existing literature, where many authors have different concepts of safety culture and safety climate, sometimes the definitions are similar. They opine that safety culture can best be understood to exist in three layers. At the center are the factors normally associated with culture, which are basic assumptions held by the organization. These assumptions, they maintain, relate to the understanding of human behaviour, relationship, and the nature of work. The middle layer relates to what is commonly referred to as safety climate which highlights the explicit values and attitudes expressed regarding safety. These attitudes and values can be seen in policies, training approaches, procedures and formal communications. The final outer layer consist of what is referred to as artifacts, and include such things as accidents and incidents, the use of personal protective equipment, and other safety related behaviours or objects.

2.2 DIMENSIONS OF SAFETY CULTURE

Available literatures identified a number of safety culture dimensions (Zohar, 1980; Brown and Holmes, 1986; Dedobbeleer and Beland, 1991; Flin, Conner, & Bryden, 2000; Glendon and Litherland, 2001; Mohaned, 2002; Fu, Zhang, Xie, & Zhang, 2006; Yule, Flin, & Murdy, 2007; Mohd Saidin et al., 2008; Faridah, *et al.,* 2009; Yang *et al.*, 2009; Okoye, 2010). Faridah *et al.* (2009) identify psychological, behavioural and situational factors as factors' characteristic of safety culture. But when designing a framework for safety climate questionnaire, Fu et al. (2006) reviewed a number of safety climate surveys mainly from 2000. They found that nine (9) safety climate dimensions were most common. These include: belief and value; management commitment; risk level and hazards identify; management; efficiency; workers involvement and commitment, safety institutes and specialists, safety education and training; site management and standardization, and other related. When compared the number of times the cited literature results appear in nine (9) dimensions, management commitment and management efficiency occupy the first two (2) positions. They however, suggested that researches involving detailed safety climate questionnaire could be done upon the nine (9) outlined dimensions. In line with above findings, Yang *et al.* (2009) submit that it is due to differences in industries, theories, and perceptions of the researchers. The implication however, is that there exist some communalities in dimensions of safety culture identified by various authors. A closer look will review that safety climate of Nigerian construction workers can best be measured using the following dimensions:
Management commitment;
Workers involvement;
Safety education and training; and
Belief and perceptions. (Okoye, 2010; Okolie & Okoye, 2012).
Notwithstanding, the above claims are dependent on the concepts and direction of the research.
They also depend on the industry, variability of safety culture measures, objectivity of the safety climate questionnaire used, and different measurement methods (Dedobbeleer & Beland, 1991; Glendon & Litherland, 2001).

2.3 SUSTAINABLE CONSTRUCTION AND DEVELOPMENT

Ever since the Brundtland Report in 1987, the concept of sustainable development has continued to receive increasingly attention. The 1999 Agenda 21 for sustainable construction tends to drive home this issue in areas of construction activities and regulations associated therein as a response to the call of the intents of the Agenda. Since then, different views had been held of sustainable construction and development. According to Brundtland Report (1987), sustainable development is development which meets the needs of the present without compromising the ability of future generation to meet their own needs. Eisgruber (1993) sees sustainable development as a positive rate of change in the quality of life of people, based on a system that permits this positive rate of change to be maintained indefinitely. However, Brandon and Lombardi (2011) in their book "Evaluating sustainable development in the built environment" define sustainable development as process that aims to provide a physical, social and psychological environment in which the behaviour of human beings is harmoniously adjusted to address the integration with, and dependency on nature in order to improve, and not to impact adversely, on present or future generation.

Sustainable construction therefore is the construction that tows the principles of sustainable development. Reffat (2004) argues that it is about much more than the fabric of the built environment. Yip (2009) views sustainable development as the responsibility of the members of the society and that a genuinely sustainable society is based upon and run by citizens who initiate development in sustainable ways and in

accordance with a recognized code of conduct –"sustainable culture". Upon this, Irurah (2002) suggests that sustainable development and construction calls for a paradigm shift to a more sustainable agenda. In the face of safety challenges and unsustainable safety culture, a sustainable construction is highly questionable. This is because according to Shah (2002), sustainable construction must embrace much more than just the process of constructing buildings and structures in a sustainable manner but also means that both the process and products must be seen in its backward and forward linkages. To Opoku and Fortune (2011), sustainable construction is conceptualized as having three broad dimensions; social equity, environmental protection, and economic growth as a reflection of those issues in relation to sustainable development. Social sustainability, according to Opoku and Fortune (2011), deals with legal, moral and ethical obligations of construction organizations to their stakeholders. On this above premise, the social aspect of sustainable development is seen as a compilation of actions and efforts to promote development that does not deplete the stock of social and human resources but rather contributes to the enhancement of their potentials (Nierop 2008). It involves workers health and safety, impacts on local community, quality of life and benefits to disadvantaged group.

Achieving sustainability in overall construction process however, requires major societal changes, restructuring of institutions and management approaches. It requires the appropriate political will based on the conviction of the responsibility of government to its citizens, and the need to create humane and decent environment for dignified living. In order to realize sustainable construction the health and safety needs of the Nigerian construction workers have to be put into proper focus, and a coordinated programme to achieve this should be thoroughly worked out.

2.4 SAFETY CULTURE AND SUSTAINABLE CONSTRUCTION

Rahman, Kumaraswamy, Rowlinson and Sze (2003) observe that the construction industry appears to have mostly been borrowing and adapting innovative concepts and protocols from other industries in targeting improved efficiencies. They maintain that it has been fostered by worldwide calls, either explicitly or implicitly for a major cultural shift in construction industry. One of such calls is a shift towards safety culture (International Automatic Energy Agency (IAEA), 1999; Occupational Health and Safety Council (OHSC), 2001; ICAO, 2005).

Based on the definition of safety culture proposed by Faridah and Torrance (2004), "the product of shared values, beliefs, attitudes, and pattern of behaviours based on a top-down approach practices that are concerned with minimizing the exposure to conditions considered dangerous or injurious to the entire group members on a self-regulatory basis", one can rightly ask if there will ever be any sustainable safety culture. The fact that safety culture promotes safety behaviours and safe practices calls for a shift to safety culture suggests that sustainable safety culture could lead to a sustainable construction. In line with the objectives of Agenda 21 for sustainable construction, health and safety is very paramount in achieving sustainable construction as it forms one of the issues contained in the agenda. This can only be achieved through attitudinal change, perceptional change, beliefs, management commitment, workers involvement and education and training (Okoye, 2010). Supporting this view, Opoku and Fortune (2011) add that the change towards sustainability is a process that presents a leadership challenge and suggest that construction organizations need leadership that provide the collective vision, strategy and direction towards the common goal of a sustainable future. Although the United Nations Environmental Protection (UNEP, 2003) identifies upgrading skills and worksite health and safety as some of the solutions for sustainable building and construction, Talukhaba, Ngowi and Lettape (2005) suggest that sustainable construction should include socio-economic sustainability which embraces sustainable design, community development in addition to health, safety and welfare of workers in the project. In addition, Shofoluwe (2011) questions whether sustainable construction practices can be successfully adopted in developing countries without adequate consideration of their economic, environmental, social, and political imperatives. From the above position, it seems that a socially sustainable construction could be unattainable without a corresponding sustainable safety culture. It is in response to the above question, that this paper seeks to ascertain the relationship between sustainable safety culture among construction stakeholders and workers on site and achievement of sustainable construction practices.

III.   RESEARCH METHODOLOGY

A questionnaire survey research design approach was adopted in the study. The approach involves the use of structured questionnaires which was considered to be the most appropriate tool to reach the population of the study especially when data required for the study can be obtained by the instrument. Respondents were randomly selected from management personnel of contracting (contractors) and consulting construction organizations (consultants), and tertiary institutions, research institutes (training instructors) in areas of built environment professions across the South East of Nigeria. A total of 220 questionnaires were distributed to the potential respondents but only 172 questionnaires were completed, returned and found suitable for use in the analysis. This represents a response rate of 78.18%. Of these, 71, 43 and 78 were from the contractor, consultant

and instructor groups respectively. Data were collected on issues relating to health and safety culture and its relationship with sustainable construction practices in the zone. These were measured on a five point Likert Scale where 1 = strongly disagreed, 2 = disagreed, 3 = not sure, 4 = agreed, and 5 = strongly agreed.

Literature review indicates that the present research should include scales dealing with aspects of belief and perception, management commitment, education and training, and regulatory framework factor of safety culture. About twenty two (22) statements were designed to capture the above four dimensions of safety culture. The data collected were analyzes using Chi-square (X^2) statistical test, to test the hypothesis postulated at 5% significant level ($\alpha = 0.05$) while the coefficient of contingency (C) (Eze, Obiegbu & Jude-Eze, 2005), was computed to ascertain the strength of the association between safety culture dimensions and socially sustainable construction practices. The results of the analyses are presented and discussed below.

DECISION: reject H_o if Chi-square (X^2) calculated is greater than Chi-square (X^2) critical value at $\alpha = 0.05$ and degree of freedom (v) of 8. Otherwise, accept H_o.

IV. RESULTS AND DISCUSSION

Table 1: Results of Chi-square (X^2) computations

	Safety Culture Dimension	X^2 Calculated	X^2 Critical value ($X^2_{0.05,8}$)	Coefficient of Contingency (C)	Decision
1	Management Commitment	34.04	15.51	15.7%	Reject H_o
2	Belief and Perception	46.50	15..51	19.7%	Reject H_o
3	Regulatory framework	19.16	15..51	14.0%	Reject H_o
4	Education and Training	20.63	15..51	10.9%	Reject H_o

From table 1 above, it shows that all the computed chi-square (X^2) results for the four safety culture dimensions (management commitment = 34.04; belief and perception = 46.50; regulatory framework = 19.16; education and training = 20.63) are greater than their critical values (15.51) at 5% significance confidence and 8 degree of freedom. This however leads to the rejection of the null (H_O) hypothesis in all the cases and conclusion that there is significant relationship between safety culture dimensions and socially sustainable construction practices.

When tested for the level of the strength of the association, it shows that management commitment, belief and perception, regulatory framework and education and training have the following strength of association (15.7%, 19.7%, 14.0% and 10.9%) with sustainable construction practices, respectively. Although the results show weak relationships, the association is significant.

This implies that sustainable safety culture through management commitment, belief and perception, regulatory framework and education and training promotes sustainable construction practices.

V. CONCLUSION

Sustainable development is inimical without sustainable construction. This is because construction industry is seen as a driver to all facets developmental processes. However, sustainable construction cannot be completely achieved without considering those aspects of social sustainability which include health and safety. In view of this, this study has established that socially sustainable construction practices can be promoted through attaining sustainable safety culture. The study revealed that imbibing safety culture through management commitment to safety concerns of construction workers, workers perception and belief that safety is very paramount in every construction operation, instituting regulatory framework that will ensure strict compliance to safety regulations by the relevant authorities and providing safety training and education to the construction workers will contribute significantly to the attainment of socially sustainable construction practices in Nigeria. In respect of this, the study recommends among other adequate safety training for all construction workers both at management level and operative level; and institution of regulatory framework that will put in place mechanism for strict compliance of safety regulations in Nigerian construction industry.

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