STANDARDIZATION AND COST EFFECTIVENESS IN CONSTRUCTION FOR SUSTAINABLE DEVELOPMENT

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Abstract

The ongoing challenges faced in building industry, such as poor quality construction, low profitability and high construction costs, results in demands for higher value, cost saving, better quality and longer guarantees in construction finds its solution in standardization and cost effectiveness in construction for sustainable development. Sustainable development is meeting the needs of the present without compromising the ability of the future generations to meet their own needs, it cuts across environmental, social and economic factors. Sustainable construction therefore, should ensure the design, construction and effective management of the built environment on prudent use of available resources. The goal of cost effectiveness in construction is to save money while also maintaining building quality. This paper therefore, focuses on principles of sustainability in construction industry – challenges and benefits, implementation of standardization and cost effectiveness in the construction sector – barriers and the way forward. Council of Registered Builders of Nigeria is making frantic efforts in achieving its mandate on standardization and sustainability of the construction industry. This will need the contributions and support of other stakeholders in the construction sector. When this is effectively implemented, many benefits are gained by the company, staff, clients, contractors and built environment professionals. Nevertheless, the implementation of standardization for a sustainable construction sector is associated with certain challenges which can be handled by constantly strategizing ways of educating and enforcing of the standards, projecting the benefits and rewarding companies for sustainable standardization best practices.

Introduction

Essential requirement to human existence is building next only to food and clothing. The world's rapid population growth and rapid urbanization have brought an increasing need for a high quality, cost effective, safe and sustainable built environment. A breakthrough for application of sustainable construction and cost effective technologies for better housing in Nigeria is an urgent need considering spiraling construction costs. Sustainable development is one of the main challenges faced by the construction industry, which has attracted global attention. Building construction practitioners worldwide are beginning to appreciate sustainability and acknowledge the advantages of implementing sustainable principles in building projects. The concept of sustainable building costs lower than conventional method and saves energy. This was supported by [33], who added that sustainable buildings will contribute positively to better quality of life, work efficiency and improve standards. He further explored the business benefits, noting cost effectiveness and other potentially very significant benefits.

The construction industry in Nigeria is characterized with problems which impair the standard of construction while according to [30] are often hinged on quality of materials and workmanship which can be controlled by proper use of appropriate regulations. The issue of quality has become a serious concern within the construction industry. [12], mentioned that considering the significance of construction industry to Malaysian economy and with its rapid development, the issues debated are inferior quality of construction materials, building defects, construction delays, high accident rates and environmental impact issues. [16], further emphasized that some multistorey building collapse in Abuja and parts of Nigeria was majorly on the use of inferior building materials - concrete, sandcrete blocks and reinforcement bars were not meeting the specified standards. Because of these incidents, public's confidence towards the image of the construction industry has greatly reduced. There is need for the adoption of strong, durable, environmental friendly, ecologically appropriate, energy efficient and yet cost effective materials and appropriate technologies in construction. Therefore, implementing sustainable principles in building project, standardization and cost effectiveness in construction are essential to overcome these problems and achieve sustainable development. This presentation therefore, focuses on principles of sustainability in construction industry – challenges and benefits, implementation of standardization and cost effectiveness in the construction sector – barriers and the way forward.

Sustainable Development in the Construction Industry

In the World Summit on Sustainable Development (WSSD) in Johannesburg, leaders and representatives of 183 countries reaffirmed sustainability, or sustainable development as a central element of the international agenda [38, 15]. The governments agreed to a wide range of concrete commitments and targets for actions to achieve sustainable development objectives. The sustainability agenda moved further and consolidated and broadened the understanding of

sustainable development, particularly the important linkages between poverty, the environment and the natural resources [39], [32] and [10] reported that awareness and significance of sustainable development has been growing around the world for the last few decades. Many international and national initiatives showed the increasing concern to protect the environment for future generations by adopting sustainable development principles [20], [32], and [10].

[34], noted that there appears to be no common understanding either on the definition of sustainable development or on the possible measures needed to be taken in order to achieve it. [39], proposed the most widely used definition of sustainable development as it meets the needs of the present without compromising the ability of the future generations to meet their own needs. [18], emphasized that for the development to be sustainable, it must take account of social and ecological factors, as well as economic factors. [32], [17] and [21] presented three essential areas involved in sustainability which are environmental responsibility; social awareness; and economic profitability. [23], reported that sustainable development goals include:

1. Environment: reduces water use, reduce net land disturbance, and reduce net emissions;
2. Social: improve equal employment opportunities, improve contribution to community capacity building and reduce impact on heritage;
3. Economic: optimize long-term economic value.

Sustainable development goals can be actualized in effective implementation of sustainable construction which can be described as green construction concerned with the economic, social, and environmental impact of creating a usable structure. Sustainable construction requires designers and contractors to use building practices that will not have long-term adverse effect on the environment. [12], reported sustainable construction as the creation and responsible management of a healthy built environment pivoted on the prudent use of resources and ecological principles. [29], stressed the need for ensuring sustainability system through construction management to address the aspect of performance, workmanship and quality. Any client would want to construct a facility of the highest quality and it is the goal of the project team to maximize quality while minimizing cost and time.

Sustainable construction is conducted through all stages of a building's life from design to construction to maintenance and beyond. It has been found that some nations actively promote sustainable construction with rebates and other incentives to companies that practice it. It is also promoted through trade organizations that provide certifications to sustainable buildings that fall within the acceptable standards [12]. These organizations inspect buildings to determine whether or not they were built sustainably, and sometimes their certifications qualify buildings and companies which use green construction for awards, tax breaks, and other incentives.

The principal issues associated with the key sustainable building themes has been mapped out and collated in the Table 1.

Title	Key Theme	Principal Issues
Economic Sustainability	**1.0 Maintenance of high and stable levels of local economic growth and employment** 1.1 Improved project delivery 1.2 Increased profitability & productivity	Improved productivity; Consistent profit growth; Employee satisfaction; Supplier satisfaction; Client satisfaction Minimizing defects; Shorter and more predictable completion time; Lower cost projects with increased cost predictability; Delivering services that provide best value to clients and focus on developing client business
Environmental Sustainability	**2.0 Effective protection of the environment** 2.1 Avoiding pollution 2.2 Protecting and enhancing biodiversity 2.3 Transport planning	Minimizing polluting emissions; Preventing nuisance from noise and dust by good site and depot management; Waste minimization and elimination; Preventing pollution incidents and breaches of environmental requirements; Habitat creation and environmental improvement; Protection of sensitive ecosystems through good construction practices and supervision; Green transport plan for sites and business activities
	3.0 Prudent use of natural resources 3.1 Improved energy efficiency 3.2 Efficient use of resources	Energy efficient at depots and sites; Reduced energy consumption in business activities; Design for whole-life costs; Use of local supplies and materials with low embodied energy; Lean design and construction avoiding waste; Use of recycled/sustainability sourced products Water and Waste minimization and management
Social sustainability	**4.0 Social progress which recognizes the needs of everyone** 4.1 Respect for staff 4.2 Working with local communities and road users 4.3 Partnership working	Provision of effective training and appraisals; Equitable terms and conditions; Provision of equal opportunities; Health, safety and conducive working environment; Maintaining morale and employee satisfaction; Participation in decision-making; Minimizing local nuisance and disruption; Minimizing traffic disruptions and delays; Building effective channels of communication; Contributing to the local economy through local employment and procurement; Delivering services that enhance the local environment; Building long-term relationships with clients; Building long-term relationships with local suppliers; Corporate citizenship; Delivering services that provide best value to clients and focus on developing client business

Sustainable building approach is considered as a way for the building industry to move towards achieving sustainable development taking into account environmental, socio and economic issues, as shown in Table 1. It is also a way to portray the industry's responsibility towards protecting the environment [3], [19], [24] and [25]. The practice of sustainable building refers to various methods in the process of implementing building projects that involve less harm to the environment-that is, prevention of waste production [26], increased reuse of waste in the production of building material-that is, waste management [27] ,[28], beneficial to the society, and profitable to the company [29], [33] and [34], state that sustainable building starts at the planning stage of a building and continues throughout its life to its eventual deconstruction and recycling of resources to reduce the waste stream associated with demolition. The authors then describe sustainable building as consisting of four principles: social, economic, biophysical and technical. In general, there is a consensus that the breadth of the principle of sustainable building mirrors those of sustainable development, which is about synergistic relationships between economic, social and environmental aspects of sustainability. Each of these three pillars and their related principles is over-arched by a set of process-orientatedprinciples, including:

1. The undertaking of assessments prior to the commencement of proposed activities assists in the integration of information relating to social, economic, biophysical and technical aspects of the decision making process;
2. The timeous involvement of key stakeholders in the decision making process [35];
3. The promotion of interdisciplinary and multi-stakeholder relations (between the public an private sectors, contractors, consultants, non governmental) should take place in participatory, interactive and consensual manner;
4. The recognition of the complexity of the sustainability concept in order to make sure that alternative courses of action are compared. This is so that the project objectives and the stakeholders are satisfied with the final action implemented;
5. The use of a life cycle framework recognizes the need to consider all the principles of sustainable construction at each stage of a project's development (i.e., from the planning to the decommissioning of projects);
6. The use of a system's approach acknowledges the interconnections between the economics and environment. A system's approach is also referred to as an integrated design process;
   That care should be taken when faced with uncertainty;
   Compliance with relevant legislation and regulations;
   The establishment of a voluntary commitment to continual improvement of sustainable performance;
10. The management of activities through the setting of targets, monitoring, evaluation, feedback and self-regulation of progress. This iterative process can be used to improve implementation in order to support a continuous learning process; and
11. The identification of synergies between the environment and development.

These principles will form a framework for achieving sustainable building that includes an environmental assessment during the planning and design stages of building projects, and the implementation of sustainable practices. It will be used to guide the process of construction at all levels and within all disciplines. From them, it is possible to extrapolate an endless series of project- or discipline-specific principles and guidelines, which can assure that decisions taken follow the road of sustainable development.

Implementation, Barriers and Solutions of Sustainable Construction

To create a competitive advantage using environment-friendly construction practices, the whole life-cycle of buildings should, therefore, be the context under which these practices are carried out. A review of literature has identified three general objectives which should shape the framework for implementing sustainable building design and construction, while keeping in mind the principles of sustainability issues (social, environmental and economic) identified previously. These objectives are:

1. Resource conservation
2. Cost efficiency and
3. Design for Human adaptation

The construction industry is client driven and level of awareness as well as adoption of sustainable construction by clients play an important role in the implementation. The main challenge for the industry is to reduce the impacts of its activities on the environment and local communities. In order to have a sound and more sustainable construction industry, contract parties must take the leadership role in such transformation [18], and [21]. During construction, operation, and deconstruction, homes consume large amounts of energy, raw materials, and water [23].Construction professionals are the main stakeholders in actualizing sustainable construction [19]. The greater percentage of clients was not aware of sustainable construction and the ones that are aware, are interested in initial cost rather than the long term benefits of sustainable construction. Zhou and Lowe [21] reported that sustainable construction is faced with some challenges such lack of unawareness of its economic benefits,in appropriate building regulations and planning policies that will make obligatory sustainable construction.

However, the challenges acknowledged in the literature can be classified into four main categories as regards to Nigeria's perspective, these include; cultural, financial, capacity or professional, and steering barriers. Furthermore, in addition to the on-going challenges are cultural belief barriers, initial cost perspective barriers, technical know- how of the professionals barrier, technical barriers, steering barriers and inappropriate construction practices. Notwithstanding the numerous challenges hindering sustainable construction, the following solutions are proffered;

1. Proper awareness of sustainable construction
2. Support of government policies
3. Client education
4. Introduction of sustainable construction in the educational institutions
5. Accessibility of information and intricacy of analysis

The Concept of Cost Effectiveness in Construction

The name of the game of project management therefore is "cost effectiveness". Cost effectiveness may be defined as best value for money. Cost effectiveness is measured both in terms of the initial construction cost and in terms of the cost benefit over time of the building. Therefore, when defined in terms of a building or choosing construction materials, it is important to compare the initial costs with the savings that can be realized over time.When deciding to start a new building project, it's important to measure its' cost effectiveness. Striving to always execute project in the built environment being able to run with the most cost effectiveness strategies it can, saves money. The goal of cost effectiveness in construction is to save money while also maintaining building quality. This can be achieved through green building, improved skills and technology, use of locally available materials without sacrificing the strength, performance and life of the structure.

Some of the factors affecting construction cost, includes but not limited to; building material costs, labour rates, size and type of building, special construction, project accessibility, time of year and general economic pressures. These factors affects the budget of constructing any structure. Cost effective houses are not just for the poor, they are for everyone. Time and cost optimization is, therefore necessary as it may minimize the total project cost. As such, this optimization in time and cost assists in achieving the highest benefit which is cost effective and affordable building design and construction.

Cost analysis is a critical process in construction projects. It is comprehensive breakdown of all cost to be incurred in performing any activities per project requirement and specification. It maintains its importance not only from cost control and estimation point of views but also as a planning, administration, management and for those involved in business development marketing and sales. For a contracting organization which competes in a tender or bid process to get new projects, cost analysis is far more important as effectiveness of cost analysis of activity and line items in the contract will determine not only the budget of the project but also the profitability for the organization.

The process of cost analysis can vary from organization to organization and use of tools. The generic approach for cost analysis are as follows;

1. Breakdown the activities for which the cost analysis is to be performed further if possible in work unit where it is possible to directly assign project resources.
2. Estimate the resource for the work based on the specific deliverable specification.
3. Many published standard industry information can provide guideline for resource estimate. However in organization with effective project documentation process, it is usually the internal statistic that is more helpful and accurate as it is based on the understood productivity of the organization on similar projects in the same organizational context. It is always wiser to involve the

execution team members or experts for activity resource requirements.

4. Resource will include all hard and soft resource, i.e. man, plant and machinery, consumables and services.

Once the resource requirement for the unit of work or the whole volume of work has been finalized, it is time to load it with the unit cost of these resources. If the cost analysis is being done as a part of bid process for submission to client, the profit, predetermined or based on the market condition is added to arrive at the overall and unit cost of the activity.As the execution begin, it is wise for an organization to maintain cost analysis as a regular process and to keep the cost data updated. It not only guarantees quick turnaround of the project estimation process but also increases the probability of financial success. There exists different estimating techniques for cost and resource in a construction project, the selection of method is governed by the accuracy, consistency and user comfort of the method. Some of these includes; cost benefit analysis, quantitative analysis, sensitivity analysis, cost of quality analysis and reserve analysis.

The concept of sustainability as applied to the construction of buildings is intended to promote the utmost efficiency and to reduce financial costs. There is considerable evidence to suggest that many organizations, in both the private and public sectors, make decisions about building related investment based on estimates of the initial construction cost, with little or no consideration for costs relating to operation and maintenance throughout the life of the building.

Standardization in the Construction Industry

Construction regulations are widely regarded as the drivers of good standard of construction in most of the construction companies in Nigeria. The importance of quality structures has necessitated the need for improvements and strict compliance to standards in construction. This can be achieved by coordinated and committed participation of all stakeholders in the industry using the appropriate regulations and standards as key guide and document for quality management[37]. Implementation of standards in the construction industry will not only enhance cost effectiveness and greater profit margin but will also reduce the cases of building collapse and structural failures in Nigeria to the barest minimum.

Standards and regulations provides a series of guidelines on how to establish a quality system to manage the process that affect its product or services. [6], noted that in Nigeria, there are few existing national standards relating to general construction and many of them are not even known. As a result, the designers use mainly British and American standard and code despite the fact that local requirements are often different. Furthermore many designers in Nigeria lack adequate knowledge with respect to the function and performance of the materials and components they specify [6].

Since the establishment of ISO 9000 quality system by the International Organization for Standardization (ISO), it has been gradually adopted by all industries worldwide. It can be said that ISO 9000 in the most successful standard in ISO history because there is over 500,000 registrations with registrants in over 100 countries from all continents [22]. Standardization is the extensive use of processes or procedures, products or components in which there is regularity, repetition and a record of successful practice. However, very few things are generically standard. Most countries have

standards that are controlled by legislation or common practice and some of these standards are becoming internationally recognized. [16], [30], [31] and [17] agreed on the importance of National Building Code (NBC) and need to get legal backing for implementation in the construction sector. While, noting that Nigeria Industrial Standards (NIS) packaged by Standard Organization of Nigeria (SON) and other building regulations are used in place of British Standard. Furthermore, having the standard is not enough but setting up a compliance enforcement committee which will constitute of professionals in the built environment will enhance quality and standardization in construction industry thereby taming the tide of building collapse. Some try to deny standardization - but it exists in all organizations and all projects. The issue is how best to manage its implementation.

Implementation of Standardization in Construction – Benefits and Challenges

The implementation of standardization in construction should not be considered as an easy task. Even after the construction company manages to obtain certification, maintaining it also requires a great participation from all parties. [4], concluded on their study that non-standardization of design and resistance of clients to buildabilityprogrammes which will enhance the quality of the building are ranked most as the standardization and quality problems. It is important to note that the quality of construction projects will not necessarily improve even if the contractor is forced to set up a quality management system. This is because the attitude of the contractor is a major factor which governs the successful implementation of the system. Therefore, continuous enlightment on the principles and benefits of standardization will encourage effective implementation.

Generally in every country, construction regulation authorities are established to harmonize construction laws found in statutes which may contradict each other, curb uncontrolled and unchecked physical planning of buildings and construction, control and enforce the mechanisms on the application of building code in the construction industry, and prevent easy entry and perpetration of unqualified contractors, and improve on the bureaucratic requirements and procedures in approval of building plans. Furthermore, construction regulation authorities eliminate corruption cases in the building industry, emphasize on both material quality and contractor performance, and revise the building codes to ensure relevance [28].

Regulation of building construction in Nigeria is done through a statutory authority known as the Council of Registered Builders of Nigeria (CORBON), whose function is to establish and oversee the construction industry and coordinate its development. CORBON is mandated to encourage the standardization and improvement of construction techniques and materials, provide, promote, review and coordinate training programmes for skilled construction workers and construction site supervisors, accredit and register contractors and regulate their professional undertakings, accredit and certify skilled construction workers and construction site supervisors, develop and publish a code of conduct for the construction industry [17].Despite the numerous challenges associated with the implementation of standardization in construction industry many benefits are gained when efficiently practiced. [24], conducted their study on construction companies of Malaysia that benefits can be categorized into two; internal benefits and external benefits;

1. Internal benefits are enjoyed by the staff and internal operation of the organization. Examples are enhanced company communication, improved documentation, improved method of working, improved quality of work done, improved employee morale, increased efficiency and productivity and reduced wastage of materials.
2. The external benefits refer to customer viewpoint which is useful for the business itself. Examples are enhanced company's corporate image, increased profitability, increased sales with existing customers, improved supplier relations, more new local customers, reduced problems in detects liability period, on-time completion of project, more agreements or contracts and access to domestic market.

[25], through the survey of construction companies in Singapore found that among the benefits gained by the contractors are:

1. Increase competition for better quality products and services.
2. Facilitates and promotes third party auditing and certification.
3. Increase client satisfaction on quality.
4. Common language for communicating quality assurance.
5. Increase client confidence.
6. A general guideline for an organization in any industry to develop a quality management system.
7. Reduce quality and corrective costs.

[13], has divided his findings on the benefits experienced by companies in Hong Kong into three categories which are benefits to staff, to operation and to business.

1. Benefits to Staff: Improve team spirit, clearer working procedure, less staff conflicts, lower staff turnover rate, more suggestion from staff.
2. Benefits to Operation: Reduced wastage of materials, increased efficiency, improved quality of product or service, better control of sub-contractors, reduced operational costs and increased quantity of production.
3. Benefits to Business: Increased sales with existing customers, more new local customers, less complaints, increase profits, more new overseas customers.

The path to implementation of standardization and quality management system is seldom pleasant and smooth. Among the implementation challenges that have been identified by the previous researchers are:

1. Resistance to change; According to [19] and [24] resistance from employee is the most critical factor that become a barrier to actualizing standardization. Complying with the regulations and codes would require additional work, trainings and time.
2. Difficult to interpret the standard and requirement of quality system; [1] confirmed that the standard is hard to understand and if not fully comprehended, it becomes impossible to translate into action to achieve standardization in construction.
3. High implementation and maintenance cost; [35] noted that many organizations misunderstand the cost of quality since they often perceive that the implementation is an extra cost.Actually, it is not quality. This can be associated with the cost of correcting error, rework and reacting to customer complaints.

4. Lack of technical expertise and skills; [37] emphasized that low competency among staff has contributed to implementation problems of standardization, while [28] advocates for the appointment of quality consultant to avoid unnecessary delays, errors and rework which will result in high cost.
5. Lack of resources can also pose challenges to implementation of standardization as supported by [36] that human and capital resources lacking in building construction projects can affect standard implementation.
6. Poor communication; [19] stated that poor internal communication can be an obstacle to the successful implementation of standard. Rohayah (2004) found that weak communication in the organization was due to limited information and resources, lack of experience and training.

Conclusion

The ongoing challenges faced in building industry such as poor quality construction, low profitability and high construction costs, results in demands for higher value, cost saving better quality and longer guarantees in construction finds its solution in standardization and cost effectiveness in construction for sustainable development. Sustainable development is meeting the needs of the present without compromising the ability of the future generations to meet their own needs, it cuts across environmental, social and economic factors. Sustainable construction therefore, should ensure the design, construction and effective management of the built environment on prudent use of available resources. The goal of cost effectiveness in construction is to save money while also maintaining building quality.

In Nigeria today and infact, globally building collapse and structural failures which bothers so much on not implementing the standards and principles of sustainability in construction is a serious concern and fast eroding the confidence of clients on the construction professionals. Implementation of standards in the construction industry will not only enhance cost effectiveness and greater profiting but will reduce structural failures globally. Construction regulations are drivers of good standards which provide guidelines on how to establish quality system to manage the process that affect its products and services.

Council of Registered Builders of Nigeria (CORBON) is making frantic efforts in achieving its mandate on standardization and sustainability of the construction industry. This will need the contribution and support of other stakeholders in the construction sector. When this is effectively implemented, many benefits are gained by the company, staff, clients, contractors and built environment professionals. Nevertheless, the implementation of standardization for a sustainable construction sector is associated with certain challenges which can be handled by constantly strategizing ways of educating and enforcing of the standards, projecting the benefits and rewarding companies for sustainable standardization best practices.

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