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# Understanding barriers affecting the selection of sustainable materials in building projects

Peter Oluwole Akadiri

*College of Engineering, Architectural Engineering Department, University of Buraimi, Al-Buraimi, Oman*

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ABSTRACT

The selection of sustainable building materials has been identified as an important strategy in the design of a building. Although the sustainability imperative is gaining in importance, there are still major barriers preventing this"new style' architectural practice becoming the norm. This paper examines the major barriers encountered in the selection of sustainable building materials among building construction professionals in Nigeria. A questionnaire survey was developed to capture the perception of construction professionals regarding the significance of the identified barriers as it affects the selection and use of sustainable building materials. Case studies of three completed building projects were conducted with design team to validate the result of the survey. Research results show that perception of extra cost being incurred and lack of sustainable material information are identified as the top barriers to sustainable materials selection. The paper concludes with suggestions and actions that can help overcome these existing barriers.



## 1. Introduction

It is estimated that by 2056, global economic activity will have increased fivefold; global population will have increased by over 50%; global energy consumption will have increased nearly threefold, and global manufacturing activity will have increased at least threefold [19]. Being the most populous country in Africa and Africa biggest oil producer, Nigeria has undergone rapid changes since adoption of economic reform in 2003, which affect all sectors of the economy including construction. The sector now contributes about 5% to Nigeria's annual gross domestic product and one-third of her total fixed capital investment and employs around 8% of the Nigerian labor force [12]. However, construction-contributed environmental impacts have been increasing in Nigeria in line with its economic reforms and fast urban development since the early 1990 s. The extent of its impact is still being debated because information and data about the environmental impacts of the construction industry are still not being collected and analyzed systematically. Building construction practitioners have an important role in contributing to the reduction of the built environment impact on the environment and hence advancing the sustainability agenda across the three bottom lines of sustainability, the economic, environmental and social strands. With respect to such significant influence of the building industry, the selection of sustainable materials has been identified as the easiest way for building professionals to begin incorporating sustainable principles in building projects [4]. According to [5,28], the selection of building materials is one of several factors that can impact the sustainability of a building project. This was also reaffirmed in the work of [36,39], that an appropriate choice of materials for a design process plays an important role during the life cycle of a building.

Kibert [23] view sustainable material selection as one of the most difficult tasks to undertake in a building project. In part, this is because:

- so many different products and materials need to be evaluated, both individually and as assembled building components;
- assessment parameters are not consistent across product categories or different countries of origin;
- manufacturing processes lack transparency;
- products and materials evaluation has no universally agreed approach.

Several manuals now provide guidelines for material selection. These include [4,8,14]. Baharetha et al. [8] note that in selecting sustainable materials, designers should aim to maximize durability, energy efficiency, recyclability, maintainability, and use of local materials to reduce the environmental impact of construction. Akadiri and Olomolaiye [4] describe a strategy for the selection of sustainable building materials: design building to be efficient and to utilize as few resources as possible, specify the use of renewable and recycled sources in order to close the life-cycle

*E-mail address:* peter.a@uob.edu.om

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loop of materials and select materials with the least environmental impact throughout their entire lifetime.

However, it appears that there is limited effectiveness of the consideration of sustainable practices in the existing buildings material selection practices among building professionals in Nigeria. In a recent review of sustainable building finishes in Nigeria, Adeleji and Taiwo [1] found that a very small proportion of building stock in Nigeria can claim to be sustainable in any way, whether judged on sustainable construction, design or performance in use. The question then arises of why is this so? Given such perceived benefit, what is stopping the use of sustainable building materials from being realized in practice?

This paper therefore examines the barriers affecting the selection and use of sustainable materials for building projects, with the aim of enhancing the sustainability of the Nigerian building sector. From a thorough literature review, thirteen barriers affecting the selection and use of sustainable materials for construction projects were identified. A self-administered questionnaire was used to capture the perception of construction professionals regarding the significance of the identified barriers as it affects the selection and use of sustainable building materials. The identification of the major barriers is verified by using three case studies of completed construction projects in Nigeria. The paper concludes by proposing several proactive suggestions on mitigating the existing barriers to help promote the consideration of sustainable materials for building projects.

## 2. Empirical studies on barriers to sustainable building materials specification

The overall performance of the building is the most important consideration in achieving more sustainable construction. Building materials play an essential role in increasing the sustainability of buildings and contributing to economic prosperity. The usage of building materials has a substantial impact of the environment, mainly because of the large quantity of non-renewable resources with the potential for depriving future generations of their use [15,29]. Moreover, all building materials affect the environment during their life cycles. From extraction of raw materials to disposal of demolition waste, various forms of pollution are created, with adverse effects on the atmosphere, land, and water system. The raw materials are processed before becoming suitable for use within buildings; this process often involves consumption of large amounts of energy.

Although the sustainability imperative is gaining in importance, empirical studies suggest there are still major reasons preventing this 'new style' engineering practice becoming the norm. From the literature several studies were reviewed to provide a summary of the main barriers to integrating sustainability or sustainable innovation into the building industry.

Aye [7] and Mate [27] identified multiple barriers to incorporate sustainability into material selection practices. These include perceived cost, time to source materials, education and training, understanding and in house experts. The authors also identified client resistance, knowledge of materials, limited material selection and authenticity of suppliers along with understanding of the impact of materials.

Kang and Guerin [21] found the main barriers in the use of sustainable materials to be accurate and accessible information and appropriate tools.

The European report written by Rao and Brownhill [32] introduces the idea of the circle of blame: 'designers and contractors say clients do not ask for it, clients say designers do not provide it'. Akadiri and Fadiya [2] find government regulation and building code restriction as a key reason militating against the sustainable practices among building professionals.

Ikediashi et al. [18] discovered that the main barriers to sustainable building include lack of training and tools, lack of relevant laws and regulation, and lack of awareness. The authors also observed the roles top management played in promoting sustainable construction. A survey by Marker et al. [26] found that more than 50% of barriers to sustainable building are related to the difficult transition from traditional construction method or low return on investment. Samari et al. [35] surveyed 167 professionals in the Malaysian construction industry to discover barriers to sustainable building. They found lack of public/credit resources to cover the upfront cost, risk of investment, lack of demand, and higher final price of green buildings units. Bond [9] used data from Australia and New Zealand to discover that the main barriers to the adoption of sustainable building practices are initial costs of sustainable features and lack of information about the benefits and savings of incorporating sustainable materials.

These barriers have real or perceived impacts on the risk and profit of various industry groups, and may therefore influence their decision to not use sustainable materials. Till now, research conducted in the scientific databases Scopus and ISI Web of Science, with the key words "Sustainable materials", "barriers" and "Nigeria" revealed that this theme is still little explored in the Nigerian context, with a focus on the construction industry, so a study was conducted for casting a light on the barriers affecting the use of sustainable materials, as reported below.

## 3. Survey on factors affecting the selection of sustainable materials in Nigeria

This paper investigates barriers affecting the selection and use of sustainable materials for building projects in Nigerian Construction Industry. The research paper is positioned within the interpretive research paradigm and accorded with action research principles and as the objective being to contribute to the understanding of barriers in the selection of sustainable materials amongst construction experts. In this epistemological positioning, action research seeks to fundamentally change the dynamics of the research situation whether they are personal or social dynamics. It aims to conduct research that is non-competitive and non-exploitative to enhance the lives of all participants including the researcher. To achieve these methodological objectives, a Steering Group of twelve practicing building professionals was established to oversee the research work. This was conducted under the auspice of a professional institute (the Nigerian Institute of Building (NIOB)). This approach opens the wider builder's community to the research work and galvanized their support and input through various workshops and the questionnaire survey used in this paper.

From the review on previous studies, 13 barriers affecting the selection and use of sustainable materials for construction projects were identified (Table 1). Based on the identified barriers in Table 1, an online survey, in a form of a self-administered questionnaire was developed to capture the perception of construction professionals regarding the significance of the identified barriers as it affect the selection and use of sustainable building materials.

The survey targeted architects and building designers, quantity surveyors, construction managers and contractors registered with the Nigerian Institute of Building (NIOB) and the Council of Registered Builders of Nigeria (CORBON). An important aspect of using a questionnaire survey is that it has the advantage of reaching a reasonably representative group of people in a short period of time, providing the means to generate data that can be quantified and analyzed, thereby providing a chance to assess different issues by collecting the views of people with different social, economic and geographical backgrounds [30]. The