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Exploring the Drivers and Barriers for Sustainable Infrastructure Projects Delivery in Sub-Saharan Africa

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Sustainability of the built environment has become an international imperative within the Architecture, Construction, and Engineering (ACE) sector. While much has been written about the drivers and the mitigating barriers to sustainability and sustainable construction in Africa, the implementation of the concept is still a challenge. This exploratory research employs an interpretative paradigm to add to what is known about the issues in sub-Saharan Africa. The collection, categorization and analysis of interview transcripts and a review of extant literature and document analysis led to salient insights. Findings show that education and experience inform a designer's understanding of sustainable design and construction and that designers' understanding of sustainable design values or lack of, affect their behaviour, attitude and likelihood to promote sustainable practice. The study found that Change strategy that equips a project actor with knowledge and skill needed to do things differently as a major factor for embedding sustainability in the construction industry. Drivers as solutions to barriers that were identified include improved knowledge of sustainable design, leadership and demands, and construction and the material usage. Most importantly, there is a need for a change in clients' perception of the cost of going green.

Keywords: Built Environment, Infrastructure Projects delivery, Sustainable construction, Sub-Saharan Africa.

Introduction

Sustainability of the built environment has become a global imperative within the Architecture, Construction, and Engineering (ACE) sector. Whereas, studies (such as Wackernagel & Rees, 1996) shows that the ecological footprint of the human race has exceeded the Earth's carrying capacity, development in time past neglected the reality of natural resource exploration and environmental issues. There is no doubt that there is continuous need for physical infrastructure and large-scale development in the built environment in developing countries (Du Plessis, 2007; Bangdome-Dery & Kootin-Sanwu, 2013). The increasing human needs must, therefore, be addressed in a way that is socially and ecologically responsible.

Lessons from the developed world suggest that greater urgency is required in making sustainable interventions, while these built environments are being created, rather than trying to make changes in the way things are after technically exceeding the ecosystem's carrying capacity. This "overshoot", resulting from upstream activities, comes with diverse symptoms that affect various facets of daily living; resource depletion and environmental degradation, environmental pollution, ozone layer depletion, global warming, and economic downtown (Bangdome-Dery & Kootin-Sanwu, 2013). These revelations changed worldviews and spurred global stakeholders to embrace paradigm shift towards environmental responsiveness especially in construction practices. Environmental responsibility in the form of new values, change in belief, attitude or way of doing things became fundamental in the new worldview. This paradigm shift in the upstream activities as a whole towards best practices could lead to

cleaner industries and creation of industry and resource sectors with low environmental impact compared to its socio-economic impact.

Sustainability is a growing economic development model based on the knowledge that aims to address the interdependence of economic growth and natural ecosystems and the adverse impact economic activities can have on the environment (Bangdome-Dery & Kootin-Sanwu, 2013). Various concepts and terminologies have been developed and promoted over the years to situate the sustainability idea in the built environment. The concepts and terminologies include; 'green building', 'sustainable design', 'sustainable architecture', 'sustainable construction', 'ecological building', and 'sustainable materials'. Adequate application of these concept provides significant balance in the state of the ecosystem and enhance the built environment (Jones, 2008). With the emergence of the sustainability concept: design and construction however, adaptation of the design thinking and production method has been slow in its uptake. The slow environmental pollution, adaptation results from the fragmented, complex and project-based nature of the construction industry that hinders the implementation of sustainable construction practices (Bygballe & Sward, 2014). While most of the challenges to sustainable construction globally and Africa in particular has been captured in several studies, the implementation of the concept is still challenged. These challenges have limited adaptability and denying the industry of the benefits of sustainable construction practices.

Previous studies have identified drivers of sustainable construction that make it worth pursuing to include competitive advantage, meeting legislative framework, company reputation, client value creation, meeting client demand, overall financial incentive, and good community relation (Othman, 2011; Suresh, Bashir & Olomolaiye, 2012; Madu and Kuei, 2012). Nevertheless, the means for bringing about such development is considerable limited, as implementation barriers continue to deter the industry stakeholders from achieving successfully implementation performance. The development of certain enablers is therefore required to assist stakeholders to achieve sustainability objectives.

Studies have acknowledged the current drive towards sustainable design and construction, its frequency of application and the scope of sustainability tools is still poor and not all encompassing (Aye, 2003; Kang & Guerin, 2009). In these studies, multiple variables for the incorporation or attempts to mainstream sustainable design and construction into practice were identified. Identified variables include cost, materials availability, education and training, understanding and in-house experts. Other variables for sustainable construction include client demands, client knowledge and call backs from clients, accurate and accessible information and tools that can serve as drivers / barriers (Davis, 2001). In view of the stated observations, the main questions therefore are, what is the nature of the sustainable construction as applied in sub-Saharan African construction context? The various forms of such limiting factors, and possible means of enhancing/ameliorating identified factors for an acceptable uptake within the industry.

Preliminary investigation by the researchers shows that in Bloemfontein, South-Africa, sustainability still follows the policy path rather than conscious efforts by stakeholders to maximize it benefits, or an attempt to climate resilience. Unfortunately, stakeholders are not equipped with adequate information, skills, and motivation for holistic pursuit of sustainable design and construction, so as to harness the benefits and preserve the ecosystem. The rest of this paper is structured into six sections: a literature review; research methodology and the research findings tailored along the common barriers theme of cost, education and experience, stakeholder's awareness, political and policy, and materials as

derived from the data sources; followed by a discussion, based on sustainability drivers.

Literature review

The energy crisis, environmental pollution and the climate change in the 1970s alerted the world of the need for a balanced ecosystem (Ghosh *et al*., 2014). Such concern led to world congress 'Our Common Future' report of the World Commission on Environment and Development (WCED, 1987). This report defined sustainable development as "a development which meets the needs of the present without compromising the ability of future generation to meet their own needs". This appears to have become the definition for sustainable development. The Organization for Economic Co-operation and Development (OECD) in their report of sustainable building and construction in 2003 observed that the building sector is largely responsible for the pollution and energy deficit. The International Energy Agency (IEA) also ascribes responsibility for the consumption of more than 40% of the world's total primary energy and for 24% of global carbon dioxide emissions to existing buildings (Howe, 2010).

To ameliorate the impact of the building sector on the environment, sustainable management and operational practices ranging from planning, design, development, construction, ownership, financing, management and utilization of built properties were developed (OECD, 2003), resulting in a number of green tools for design and construction that promote global sustainable building practice. Examples of such strategies include the Leadership in Energy and Environmental Design (LEED), Building Environmental Quality Evaluation for Sustainability through Time (BEQUEST), Building for Environmental and Economic Sustainability (BEES), Building Research Environmental Assessment Method (BREEAM). These tools according to Hui (2002), are built on six (6) key principles namely; understanding place, connecting with nature, understanding natural processes, understanding environmental impact, embracing co-operative design processes and understanding people. Accordingly, the seven principles for sustainable construction consist of the following, namely; reduce resource consumption (reduce), reuse resources (reuse), use recyclable resources (recycle), protect nature (nature), eliminate toxics (toxics), apply life-cycle costing (economics) and focus on quality (quality) (Kibert, 2008). The integrated application of these principles produces a sustainable architecture that will save money, increase comfort and create healthier environments for people to live and work by using improved indoor air quality, natural daylight and thermal comfort (OECD, 2003).

In Africa, the philosophy of sustainable building has been championed by pressure groups and a number of private and public organizations. This is evident in the plethora of works seeking to address sustainable building, namely; Promoting Renewable Energy in Africa (PREA), South Africa Chapter of the Green Building Council (GBCSA), Holcim Foundation as well as Emerging Africa Infrastructure Fund (EAIF) (Bangdome-Dery and Kootin-Sanwu, 2013). In 2008, Green Star rating tool was developed by GBCSA to provide objective measurement for green buildings in the commercial property industry and to recognize and reward environmental leadership in the built industry (Jacobs, 2011). Besides, favourable sustainable development-oriented standards have been established by the South African government to promote environmental sustainability and energy savings, regulate energy usage in new buildings and ensure environmental sustainability.

Although Africa is considered as a low risk area due to the availability of green building potentials with materials such as sun dried bricks, compressed earth blocks, lime stabilized earth blocks, laterite stones and pozzolana in abundance there is however limited (Manu *et al*., 2009). Studies including (Koranteng, 2010; Ashiboe-Mensah *et al*., 2011) suggest the need for

built environment professionals adopt sustainable building practices such as energy efficiency concepts and sustainable materials (Koranteng, 2010; Ashiboe-Mensah *et al.,* 2011). The research further suggests the need for a policy direction, incentives and disincentives that encourage sustainable urban and rural development, environmental education and the use of renewable energy and green building materials to reduce emissions. In line with these, a proper understanding of the drivers and the barriers of sustainable construction within the industry will be required to foster the needed knowledge and policy direction.

Drivers for Sustainable construction

Sustainable construction involves the deployment of sustainable procurement practices that encompasses some basic principles such as; whole life costing, integrated design, waste management, energy modelling, corporate social responsibility (CSR) and community engagement, and use of sustainable material resources (Rafindadia *et al*., 2014). These principles accrue some benefits to sustainable organizations in enhancing the process and limits the barriers associated with such practices. Madu and Kuei (2012) and Finch and Zhang (2013) identified drivers for sustainable practice in construction industry to include; competitive edge, meeting legislation and legal requirement, improve reputation / image, meeting client demand, win more contract / financial incentive, attract and retain good employees, and good community relation. Studies also identified clients' demand, knowledge of materials, limited material selection and authenticity of suppliers of sustainable materials, along with clear understanding of the impact of non-conventional materials, accurate and accessible information and appropriate tools for sustainable design and construction (Mate, 2006: Kang & Guerin, 2009).

In its bid to attain the global goals of improved health and well-being, industry productivity, and the target of reducing the global worming by 2^{o}C and building related emissions by 80 gigatonnes by 2050, COP21 placed the construction industry as central to meeting the global demands for sustainability practice (Green Building Council South Africa (GBCSA, 2016). The COP21 agenda renewed the stakeholders' deliberate pressure on construction organizations to provide public reports on social and environmental issues and set targets relating to their business operations. Jacobs (2011) argues that the right policy formulation regulating the green building practice will drive construction professionals to utilize sustainable design principles on projects. Nilsson *et al.* (2011) assert the need for improvements in the knowledge base of both architect and client alike, for positive impact on sustainable design and construction in the industry.

Barriers to Sustainable construction

Despite the numerous benefits that have been the highlight of sustainable construction, its uptake has been confronted by several challenges. Achieving sustainability in the industry remains a challenge partly due to a range of barriers associated with the practice. These barriers stem from cultural and structural values such as the lack of cooperation and integration within a known fragmented sector; project stages and various professional (Thompson & El-haram, 2011). The promotion of sustainable construction is also limited by the cost concepts, due to lack of knowledge that understanding sustainable cost economic can be a strong driver rather than been viewed as main barrier to its practice (Zhou & Lowe, 2003).

Jacobs (2011) and Wilreker (2011) examine barriers for sustainable design and construction in South Africa. The authors identify cost; lack of knowledge about sustainable practices; lack of knowledge about effects of non-sustainable practices in the environment; lack of training and education; availability / lack of availability of green resources; and attitude of professionals as barriers for sustainable construction. The absence of a legislative instrument on sustainable development and political consideration – especially in public

projects - in most developing countries remain a major barrier. Based on the above, it can be inferred that variables such as knowledge, leadership, demands, policy and regulation, and materials serve as drivers and barriers respectively and we form part of the pre-set themes for the study.

Research Methodology

This research contributes to the discourse about sustainability in the built environment by identifying the barriers and drivers for the development of sustainable infrastructural projects in the sub-Saharan Africa. In conducting this exploratory study, the interpretative paradigm was employed. A review of the literature was conducted on the development of sustainable infrastructure projects to draw insight about the issues and the challenges facing it in the study area. This was followed by an in-depth interview of 11 relevant stakeholders involved in infrastructural development projects in Bloemfontein - South Africa and Abuja - Nigeria. The stakeholders cut across five different entities including the Department of works, project managers, consultants, policy administrator and academia. (Table 1 shows the interviewees' profile). The interviewees were identified through a purposive sampling technique, based on a defining characteristic that makes them role players (Nieuwenhuis, 2007), and their ability to provide information and/or opinions about sustainable infrastructure development projects programmes in the study area. Prior to the interview, questionnaire guide and confidentiality agreement were sent to each participant.

The semi-structured interviews were conducted in 2016 via telephone call that lasted for two weeks and an average of 25minutes per participant. The interviews were recorded using a tape recorder. Document analysis of the available information on completed projects from the department of works was used to complement the data emanating from the interviews. Stakeholder's interviews were conducted to fill gaps in the data obtained from secondary sources, to minimise bias, triangulate the data collection sources, and to ensure the validity and reliability of the study findings. Information obtained from the interviews was transcribed, and categorised under pre-identified. The results obtained from analysis of interview transcript were synthesised with those from document analysis and insights drawn from the review of the literature resulting in the identification of the enablers and barriers for sustainable infrastructure projects procurement in sub-Saharan Africa.

Table 1: Profile of Interview respondents

Int. Code	Qualification	Years of Experience	Designation	Entities
1.	Bachelor's Degree	>5	Project supervisor	Works department
2.	Bachelor's Degree	>9	Project manager	Consultant
3.	National Diploma	>10	Site agent	Project manager
4.	Bachelor's Degree	>25	Architect	Consultant
5.	Honours Degree	>25	Managing director	Project manager
6.	Master's Degree	>20	Senior Lecturer	Academia
7.	Honours Diploma	>11	Junior manager	Works department
8.	Honours Degree	>31	Director	Project developer
9.	National Diploma	>8	Director	Policy administrator
10.	Bachelor's Degree	>14	Quantity surveyor	Consultant
11.	Bachelor's Degree	>9	Civil engineer	Consultant

Challenges facing sustainable infrastructural projects procurement in sub-Saharan Africa

From the analysis and synthesis of data obtained, five main themes which are subsequently discussed emerged from the study, namely: stakeholder's awareness and demand, cost implication, education and experience, political and policy issues, and materials.

Stakeholder's awareness and demand

The fragmentation of the construction industry has makes delivery of infrastructure projects very dynamic in nature. This delivery exercise involve various stakeholders and specialists that are very mobile, such as; government as a client and regulator, developers, investors, green building council, contractors, consultants, building materials manufacturers and tenants, a such, having different success criteria for a specific project, so also are their demands and needs from a project. These needs are robbing the industry of the needed repetitiveness and sustainability experience over time. For example, clients are more concerned with a report prioritizing long term economic savings, contractors maximizing the profit margin and company's reputation, users are more concerned with comfort level and energy use. Most interviewees agreed with interviewee No. 2 that says "*you would have to almost do that study, come up with empirical evidence and show the benefits in terms of their core values, for stakeholders to dispense their resources or demand for such*". Also, interviewees opined that the lack of time and resources to do research that will reveal the empirical outcomes, of what materials and systems are environmentally dependable, strong enough to convince the stakeholders has a negative impact on the implementation of sustainability. Most participants also agreed with the view of interviewee 6, that indicate that: "*I don't think that we are ready for total uptake of green materials in this country as yet*" and "*Everybody wants imported and sophisticated material, especially if clients can afford it, not minding the carbon footprint increases*". These can also be traced to the level of awareness, as most stakeholders are not even aware of the carbon footprint of products or their effects on the built environment.

Cost implication

The most significant barrier to sustainability in the built environment, as reiterated by all the interviewees, has been the sustainable practices come with a premium and clients are unwilling to bear such premium. The general question was '*who is going to pay for the extra cost'*, despite the stakeholders' commitment to sustainable design and construction, and often the client's intention to procure a sustainable infrastructure, the costs involved in opting for and implementing such a solution were usually an overriding barrier. Most interviewees state that less than 10% sustainable design projects in their books were eventually backed for completion due to perceived extra initial costs of procurement. The interviewees argued that environmentally responsible materials and systems carry initial cost implications, which made it more expensive in relation to the traditional design in a short time, so a client demand is needed for a chance of its actualization.

Education and experience

Sustainability, sustainable design and sustainable construction are new concepts currently undergoing a developmental phase within the industry and the academia alike. The new philosophy became prominent in the late 90's, in response to the effects of prolonged environmental degradation. Interviewee 10 said, *"Sustainability was not taught during our time at the university*" while others agreed, stating that "*it was mentioned briefly".* Since the commencement of the sustainability discourse, the main promoters have been civil societies, professional bodies and relevant government agencies through; workshops, seminars, continued professional development (CPD) events and conferences. While the actual driver for its enlightenment, uptake and policy direction have been somewhat limited to government interventions and the current drive in the

academia for its proper integration into the school curriculum. Based on the affirmations, most participants agreed to their lack of adequate experience and knowledge of the practice thereof.

Political and policy issues

An interviewee argued that political and policy issues were vital to decision making when it comes to sustainability issues, as its application can easily swing from being a driver to a major barrier. Furthermore, the interviewee proffer that political decisions are mostly based on some inherent interests beyond the analysis of the socio-economic and environmental benefits. Interviewees' agreed that projects are often awarded to contractors, lacking in the right skill and competency for sustainable technology, due to political considerations. The state of policy development, sustainability tools and the capacity of the regulation body for effective monitoring is also a barrier. According to Interviewee 6 "*most stakeholders are unwilling partakers in the sustainability concept, unless driven by government regulations*". People tend to comply with legal issues especially for projects approval.

Materials

Material characterization, certification, selection, and sourcing have been identified as constituting significant barriers to sustainability in the construction industry. Participants revealed that *"most sustainable materials are relatively new and often manufactured by new small business"* and information about new materials to warranty reliability comes from extensive research for proper characterization, which leads to product classification by manufacturers and suppliers. Classification is a criterion for material certification. Certification ensures that a product is indeed environmentally responsible and infrastructure designers find it hard to distinguish between what is authentic from that which is not. This opinion was unanimous among the interviewees seeking to specify environmentally sustainable products and materials. The interviewees further mentioned that due to the non-transparent nature of product suppliers and manufacturers, designers found it difficult to source and/or establish which products are authentic. Pertaining to selection of environmentally responsible materials interviewee 1 stated that: "*the range of green materials in the industry is limited, so it is quite a barrier, deterring freedom of selection*". Another major obstacle expressed in the literature is the inability to source locally produced environmentally responsible products. Considering that imported products carry a carbon footprint, consultants, where possible, should try to recommend locally available materials.

Discussion

The findings are herein discussed in line with sustainability drivers of economic and ecological/societal concerns of stakeholder's demand, financial issues, environment sustainability, and social responsibility dimensions (Windapo, 2014). These drivers normally manifest as a result of the need to reduce building operating costs and acquire competitive advantage, financial benefits of green building as a result of various incentives. Other manifestations occur in the following forms, namely; reduced operating costs, reduced environmental impact/need for environmental sustainability, and the need for corporate social responsibility.

Stakeholders Demand

The effectiveness of infrastructure development depends on meeting the varying needs of stakeholders, which is often, hinged on the level of their awareness of the activities and knowledge of the built environment. This knowledge serves as a driver for their demands and the ability to benchmark own determinant for sustainable infrastructure. Most interviewees agree with Bond (2010) that tenant demands are driving client's involvement with green practices, despite the tenants' unwillingness to pay extra to lease a Green rated building. Investors are also leaning towards building green for long term financial benefits, reduced maintenance costs and future sales of green rated properties. These developments in South Africa are not

unconnected with the drive by the government. The drive by the government is seen through policies and rating systems, apart from the works of relevant civil societies serving as pressure groups, the academia in bringing the curriculum gap and academics seminars and conferences; and professional bodies through the CPD and membership. These activities bring benefits of sustainability to stakeholders, and also promote the needs for sustainable practices. The seemingly lack of demand is a human response to the level of awareness, and therefore management should take the necessary steps to counter it through education and communication; participation and involvement; facilitation and support, and negotiation and rewards (Smit *et al*., 2011).

Financial issues

Whole life study is essential whenever the issue of sustainable design and construction is deliberated upon in relation to cost, as cost is always the bottom line. Researchers in one study argued that reduced operating costs are a primary motive for sustainable construction (Tzschentke *et al*., 2004). Buys and Hurbissoon (2011) further indicate that companies that integrate green initiatives as part of its policy, such as natural and renewable energy and sustainable design, are able to reduce energy related operating costs. As energy cost is becoming more important in built environment discourse, it can be inferred from the interviewees' transcript that the knowledge of financial benefits, even though in long term aid the stakeholders demand for sustainable designs and practices. Consultants must hence, certainly be up-to-date with the industry developments in order to present the needed facts and create options, for an easy decision for any investor and users alike.

Environmental sustainability

Sustainability is now a focal point of world debate due to the upstream activities and built environment re-creation. Ozone layer depletion, environmental degradation, carbon content and carbon footprint gradually became economic and political issues. Goals such as reducing a building's environmental impact, decreasing the building's contribution to greenhouse gas emissions, and providing a healthier work environment for occupants often factor into the decision for design and construction of today's building (International Corporate Responsibility Report (ICRP), 2008). The interviewees affirmed the adoption by the designers of the 3R; reduce, reuse, and recycle, as a guide for resources management. Resources such as land, energy, water and other materials are managed for efficiency in green building as opposed to the case of conventional buildings, and with the prevalent use of natural lighting and improved indoor air quality, which contributes to the overall health, comfort, and productivity of its occupants (Kats, 2003). The Green Building Council of South Africa (GBCSA) has developed a policy for promoting sustainable development and energy saving, in line with other developed world rating systems such as LEED and BREEAM, to assist the built environment in becoming sustainable. The Green Star rating system was developed and has been managed by the GBCSA, as a voluntary tool that provides the property industry with "an objective measurement for green buildings".

Social Responsibility

Sustainable design and construction practices are often adopted for ethical reasons and to promote moral beliefs, although such practices raise construction costs in most cases, investors and construction firms considered it an obligation to the community (Tzschentke et al., 2004). Interviewees assert that the industry stakeholders prefer to be seen as being environmentally / socially responsible rather than the actual practice. Organisations within the industry have developed policies which focus on a deliberate sourcing certain percentage of human and materials resources within the local community, to promote community relations and company's image. It can also be inferred from the interviewee's transcript that some industry players also have degradation and climate change resilience

approaches, for ameliorating the effects of their upstream activities such as afforestation, water purification and land reclamation within the operating areas. These practices are of mutual benefit, as most communities look to work with socially and environmentally responsible firms, and in addition, they tend to attract and keep the best human resources available in the industry (Yates, 2001 & Opoku and Ahmed, 2015).

Conclusion

Sustainability in the built environment is assuming wider dimensions, moving from technical physical considerations that are evident in environmental impact to various forms of adaptation. Whereas much has been written about the drivers and the barriers to sustainable construction in Nigeria and South Africa, the implementation of the concept is still a challenge. The findings of this study resonate with previous work. As it highlights the variables linked with the uptake of sustainability ethos under the following themes, namely; awareness and demand, cost implications, education and experience, policy issues, and material. Therefore, overcoming these challenges through promotion and understanding are central to the full uptake of sustainable design and construction in sub-Saharan Africa. For instance, insights from this study show that education and experience inform a designer's understanding of sustainable design and construction. In addition, project actors' understanding of sustainable design values affect demand, behaviour, attitude and likelihood to practice in accordance with green building ethos. More so, the understanding of these values should placate the apathy brought about by the initial cost barriers. Change strategy that equips a project actor with knowledge and skill needed to do things differently seems to be a major factor for the promotion of sustainability in the built environment. The key driver will be the establishment of a solid knowledge foundation in African construction industry that will equip the stakeholders with accurate and relevant knowledge generated within the context of the country social needs, its cultures and its biophysical environment to guide their decisions and actions towards establishing a sustainable infrastructure in the built environment. Solutions to barriers that were established include improved knowledge of sustainable design and construction, a change in cost perception, improved knowledge and scope of materials and proper client enlightenment. Whereas this study mirrors the opinions of professionals within Bloemfontein – South Africa and Abuja - Nigeria, subsequent studies will seek to embark on generalizing these findings to a wider sample within sub-Saharan Africa.

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