SUSTAINABILITY IN THE BUILT ENVIRONMENT: EXPLORING BARRIERS IN SOUTH AFRICA

Fidelis EMUZE[1]
Basia Kevin NTOI[2]
Rasheed Babatunde ISA[3]

[1] Department of Built Environment / Faculty of Engineering and Information Technology/Associate Professor and Head of Department / Central University of Technology, femuze@cut.ac.za
[2] Department of Built Environment / Faculty of Engineering and Information Technology/Graduate / Central University of Technology
[3] Department of Civil Engineering / Faculty of Engineering and Information Technology/ Doctoral Student / Central University of Technology, batunde@futminna.edu.ng

Keywords: Built Environment, Project Actors, Sustainability, South Africa

Abstract

Sustainability in the built environment has become an international imperative within the Architecture, Construction, and Engineering (AEC) sector. While much has been written about the barriers to sustainable construction in South Africa, the implementation of the concept is still a challenge. This study thus employs an interpretative paradigm to add to what is known about the issues in South Africa. The collection, categorization and analysis of interview transcripts and a review of the findings in relation to the literature led to salient insights. Such insights show that education and experience inform a designer's understanding of sustainable design and construction. Designers' understanding of sustainable design values affect their behaviour, attitude and likelihood to promote sustainable practice. Change strategy that equips a project actor with knowledge and skill needed to do things differently seems to be a major factor for embedding sustainability in the built environment. Solutions to barriers that were identified include improved knowledge of sustainable design, construction and the material usage. Most importantly, there is a need for a change in clients' perception of the cost of going green.

1. Background

Sustainability in the built environment has become an international imperative within the Architecture, Construction, and Engineering (AEC) sector. Patterns of development in the past have largely neglected the reality of natural resources and environmental issues. The ecological footprint of the human race has exceeded the global carrying capacity of the Earth (Wackernagel & Rees, 1996). This "overshoot", as a result of upstream activities, comes with diverse symptoms that affect various facets of daily living; environmental pollution, global warming, resource depletion and environmental degradation, ozone layer depletion and economic downtown. These revelations have changed the worldviews and spurred people across the globe to embrace paradigm shift towards environmental responsiveness. 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 a 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 this new idea; 'green business', 'green building', 'sustainable design', 'sustainable architecture', 'sustainable construction', 'ecological building', 'renewable energy', and 'sustainable materials'. These concepts, if implied correctly will significantly balance the state of the ecosystem and improve the built environment (Jones, 2008). It is never in doubt, the need for physical infrastructure and large-scale development in the built environment in developing countries (Du Plessis, 2007; Bangdome-Dery & Kootin-Sanwu, 2013). However, these needs need to be addressed in a way that is socially and ecologically responsible. Lessons from the developed world suggest that greater urgency is needed now in making sustainable interventions, while these built environments are being created, rather than try and change things after technically exceeding the ecosystem's carrying capacity.

Since the emergence of the sustainability concept: design and construction, adaptation of this production method and thinking has been slow in its uptake. The fragmented, complex and project-based nature of the construction industry poses as a hindrance to the implementation of sustainable

construction practices (Bygballe & Sward, 2014). While much has been written about the barriers to sustainable construction globally and in particularly in South Africa, the implementation of the concept is still a challenge. These barriers have limited adaptability within the industry and hence robbing the industries of the expected benefits associated with sustainable construction practices. Some of the associated benefits of sustainable construction, which make it worth pursuing are 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, implementation challenges continue to elude industry stakeholders. The development of certain enablers were indeed required to assist stakeholders to achieve sustainability objectives.

Previous studies further suggested that although there is current drive towards sustainable design and construction, its frequency of application and the scope of sustainability tools is still poor and not all encompassing respectively (Aye, 2003; Kang & Guerin, 2009). These authors identified multiple barriers to the incorporation or attempts to mainstream sustainable design and construction into practice. These include perceived cost, time to source the right materials, education and training, understanding and in house experts. Studies also identified clients' lack of demand and resistance, 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). Other barriers that were identified are client demands, client knowledge and call backs from clients, accurate and accessible information and appropriate tools (Davis, 2001).Based on this observation, the study set out to investigate the common barriers in South African Construction; the various forms of such limiting factors, and possible means of ameliorating them for an acceptable uptake within the industry. Preliminary investigation by the researchers shows that in Bloemfontein, 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. This gap is what is needed to be bridged. The general structure of this study is as follows: literature review; research methodology; research findings, tailored along the common barriers theme of cost, education and experience, stakeholders awareness, political and policy, and materials as derived from the data sources; followed by a discussion, based on sustainability drivers. These drivers are economic and ecological/societal concerns - of stakeholder's demand, financial issues, environment sustainability, and social responsibility as postulated by Windapo (2014).

2. 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). This environmental concern later led to the world congress, which cumulated in the report of the World Commission on Environment and Development (WCED, 1987) that defines 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 is the most widely accepted definition for sustainable development. The Organization for Economic Co-operation and Development (OECD) in their report of sustainable building and construction in 2003 stated that the building sector is largely responsible for the pollution and energy deficit of the built environment. The International Energy Agency (IEA) released a publication which estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and for 24% of global carbon dioxide emissions (Howe, 2010). Therefore, in order to lessen the destructive impact of construction on the natural environment, OECD brought together experts to develop sustainable management and operational practices ranging from planning, design, development, construction, ownership, financing, management and utilization of built properties (OECD,2003).

As a direct result of the aforesaid, a number of green tools for design and construction in the built environment have been developed to promote green/sustainable building practice throughout the world. The first being the Leadership in Energy and Environmental Design (LEED), followed by others such as, Building Environmental Quality Evaluation for Sustainability through Time (BEQUEST), Building for Environmental and Economic Sustainability (BEES), Building Research Environmental Assessment Method (BREEAM), etc. These tools are built on six (6) main principles namely; understanding place, connecting with nature, understanding natural processes, understanding environmental impact, embracing co-operative design processes and understanding people (Hui, 2002). According to Kibert (2008), the seven principles for sustainable construction include 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). The successful application of these principles, in an integrated manner, will produce 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, sustainable building philosophy has been championed by pressure groups, and a number of private and public institutions and organizations. This is evident in the plethora of several reports, 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). GBCSA in 2008, developed a Green Star SA rating tool, to provide the commercial property industry with an objective measurement for green buildings and to recognize and reward environmental leadership in the built industry (Jacobs, 2011). South African government has made progress in establishing policy in favour of sustainable development through regulations guiding the built environment. At present, there are two South African National Standards which promote environmental sustainability and energy savings. These include SANS 204:2011 (SABS SANS 204 2011) which regulate energy usage in new buildings and SANS 10400-XA (SABS SANS 10400-XA 2011) which has two parts: i. Part X which concerns environmental sustainability, and ii. Part XA considers energy usage in buildings. Some researchers point to the need for the built environment professionals to begin utilizing sustainable building practices such as energy efficiency concepts and sustainable materials (Koranteng, 2010; Ashiboe-Mensah et al., 2011). Africa is considered a low risk area, as a result of availability of green building potentials in the zone, materials such as sun dried bricks, compressed earth blocks, lime stabilized earth blocks, laterite stones and pozzolana are in abundance but their use is so limited to have significantly increase global warming (Manu et al., 2009). Further suggestions from the research include 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.

Jacobs (2011) and Wilreker (2011) examine barriers for sustainable design and construction particularly in South Africa. These studies flag 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. The absence of a legislative instrument on sustainable development and political consideration – especially in public projects - in most developing countries remain a major barrier. 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.

3. Research Methodology

The purpose of this study is to contribute to the discourse on the topical issues of sustainability in the built environment by further examining the barriers hindering its full uptake by the stakeholders in infrastructural development in the South Africa. Within the construction context, the understanding of the barrier to sustainable design and construction, and the assessment of its possible enablers is of significance to sustainable development. This study employs an interpretative paradigm to add to what is known about the issues. The collection, categorization and analysis of interview transcripts and a review of the findings in relation to the literature, in Bloemfontein - South Africa in 2014, led to salient insights. The participants were selected based on ‘purposive sampling’, as this was vital to the success of the interviews. Purposive sampling means that participants are selected according to a defining characteristic that makes them role players of the data needed for the study (Nieuwenhuis, 2007).

In particular, eleven stakeholders in infrastructure development were interviewed in five different entities (department of works, project managers, consultants, policy administrator and academia) with semi-structured questions that were initially sent to them by e-mail. A follow up telephone call was used to confirm the actual date of the interview. This was done to make the interview exercise consistent. The interviews were conducted over a period of two weeks. Interviews, generally, were between 20 to 25 minutes in duration. At the commencement of the interviews, each participant was reminded of the research problem and of the interview processes. Each interviewee was then provided with a covering letter to read, a confidentiality agreement to sign; on demand. This process was then followed by the actual interview during which the interview protocol was utilized as a guide. Each participant was asked about his/ her experience and perception of the numerous themes related to the phenomenon. All interviews were recorded and transcribed.

As mentioned earlier, eleven interviewees participated in the study. The interview findings were further supported with secondary data from available information on completed projects from the department of works. The interviewees consisted of 4 women and 7 men between the ages of 30 and 54. The educational levels of the participants ranged from a national diploma to a master degree, and construction industry experience ranged from 5 to 31 years (see Table 1). The management levels of interviewees varied from junior management to senior management, with job titles ranging from site agent to managing director. In compliance with the confidentiality agreement, the identities of the interviewees were not revealed and only referred to as numbers 1-11 in the course of the study.

Table 1: The demographics of interviewees

S/N	Highest Level of Education	Entities	Designations	Years in Industry
1.	Bachelor's Degree	Works department	Project supervisor	5
2.	Bachelor's Degree	Consultant	Project manager	9
3.	National Diploma	Project managers	Site agent	10
4.	Bachelor's Degree	Consultant	Architect	25
5.	Honours Degree	Project managers	Managing director	25
6.	Master's Degree	academia	Senior Lecturer	20
7.	Honours Diploma	Works department	Junior manager	11
8.	Honours Degree	Project developer	Director	31
9.	National Diploma	Policy administrator	Director	8
10.	Bachelor's Degree	Consultant	Quantity surveyor	14
11.	Bachelor's Degree	Consultant	Civil engineer	9

4.0 Research Findings

From a critical review of the data available, five main themes were identified through the study, namely: stakeholder's awareness and demand, cost implication, education and experience, political and policy issues, and materials.

Theme 1: Stakeholder's awareness and demand

With several stakeholders such as government as a client and regulator, developers, investors, green building council, contractors, consultants, building materials manufacturers and tenants having different success determinants for a specific project, so also are their demands for the project. This need, along with the fragmented nature of project development, which is often one-off with different set of stakeholders is robbing the industry of the needed repetitiveness and sustainability experience over time. Most of the interviewees agree 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". Clients 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. Respondents also see 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 as a definite negative impact on the implementation of sustainability within the industry. Most participants also agree with the view of interviewee 6, who indicates 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.

Theme 2: Cost implication

The most significant barrier to sustainability in the built environment, reiterated by all the interviewees, has been the cost in monetary terms. 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 argue 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.

Theme 3: 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, as a 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. For this reason, most participants agreed to their lack adequate experience and knowledge of the practice thereof.

Theme 4: political and policy issues

An interviewee argues that political and policy issues are vital to decision making when it comes to sustainability issues, as its application can easily swing from being a driver to a major barrier. He further proffer that most a time's political decisions are based on some inherent interests beyond the analysis of the socio-economic and environmental benefits. Interviewees' agree 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 sustainability concept, unless driven by government regulations". People tend to comply with legal issues especially for projects approval.

Theme 5: Materials

Material characterization, certification, selection, and sourcing have been identified as a major barrier 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 almost 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, designer's found it difficult to source and/or establish which products are authentic. Pertaining to selection of environmentally responsible materials interviewee 1 states that: "the range of green materials in the industry is limited, so it is quite a barrier, to 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.

5. Discussion

The findings are herein discussed in line with drivers of economic and ecological/societal concerns of stakeholder's demand, financial issues, environment sustainability, and social responsibility dimensions. This provides a platform to integrate the primary data and the literature for meaningful interpretation within the context, for the right insight into the phenomenon. These drivers normally manifest in the forms of the need to reduce building operating costs and acquire a 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.

5.1 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).

5.2 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). Buy 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.

5.3 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 such as land, energy, water and other materials, for more 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 more sustainable. The Green Star rating system was developed and has been managed by the GBCSA, though, a voluntary tool that provides the property industry with "an objective measurement for green buildings".

5.4 Social Responsibility

Sustainable design and construction practices are often adopted for ethical reasons and to promote moral believes, although such practices raise construction costs in most cases, investors and construction firms considered it an obligations to the community (Tzschentke et al., 2004). Respondents assert that the industry stakeholders prefer to be seen as being environmentally / socially responsible rather than the actual practice. Industry today now have a deliberate company policy of 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 forestation, water purification and land reclamation within the operating areas. These practices are of mutual benefits, as most communities look to work with social and environmental 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).

6. 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 adaptations. While much has been written about the barriers to sustainable construction in South Africa, the implementation of the concept is still a challenge. The findings of this study resonate with previous work. It highlights the continuing challenges linked 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 is central to the full uptake of sustainable design and construction in South 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. 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. However, it can be said that this paper is limited to Bloemfontein role player's perspectives that generally affects its generalization, the dearth of data and knowledge of

stakeholders regarding the scope and the context of this study also calls for a wider study within South Africa.

References

Ashiboe-Mensah, N. A., Akuffo, F. and Fugar, F. 2011. Investigating the perceptions of architects in the Ghanaian building Industry with regard to photovoltaic energy technology. *In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 675682.

Aye, E. 2003. *Taking the Pulse: Sustainability and the Interior Design Practice*. Retrieved 11/08/2011, from Green Building Services: http://www.greenbuildingservices.com/news/releases/2003_13__55_pulse.pdf

Bangdome-Dery, A. and Kootin-Sanwu, V. 2013. Analysis of barriers (factors) affecting architects in the use of sustainable strategies in building design in Ghana. *Research Journal in Engineering and Applied Sciences* (RJEAS), 2(6), pp. 418-426.

Baygballe, L. E. and Sward, A. 2014. Implementing lean construction: a practice perspective. In: *Proceedings of the 22nd Conference of the International Group of Lean Construction* (IGLC), Oslo, Norway, pp. 3-14.

Bond, S. 2010. Best of the Best in Green Design: Drivers and Barriers to Sustainable Development in Australia; *Lincoln University Digital Dissertation: Cantebury*, UK.

Buys, F. and Hurbissoon, R. 2011. Green buildings: A Mauritian built environment stakeholders' perspective. *Acta Struct*. 18, pp. 81–101.

Davis, A. 2001. *Barriers to Building Green*. Retrieved on 11/06/2013, from http://www.architectureweek.com/2001/0822/ environment_1-1.html

Du Plessis, C. 2007. A strategic framework for sustainable construction in developing countries. *Construction Management and Economics*, retrieved from http://www.tandf.co.uk/journals on 03/11/2014.

GBCSA (Green Building Council of South Africa). 'Vision and Mission [Sa]'. Retrieved on 04/10/2013, from Green Building Council of South Africa: http://www.gbcsa.org.za/about/ vision.php

Ghosh, S., Bhattacharjee, S., Pishdad-Bozorgi, P. and Ganapathy, R. 2014. A case study to examine environmental benefits of lean construction. In: *Proceedings of the 22nd Conference of the International Group of Lean Construction* (IGLC), Oslo, Norway, pp. 133-144.

Hakinson, M and Breylenbanch, A. 2012. Barriers that impact on the implementation of sustainable design. *Northern World Mandate Conference, Culmulus Hensinki, 2012*, May 24-26, Hensinki, Finland.

Howe, J.C. 2010. *Overview of green buildings*. National Wetlands Newsletter, 33(1)

Hui, S.C.M. 2002. Sustainable Architecture and Building Design. Retrieved from http://www.arch.hku.hk/research /sustain.htm on 11/03/ 2013.

ICRR, 2008. *Intel Corporate Responsibility Report*. Retrieved on 11/05/2013 from http://www.intel.com/.

Jacobs, E. 2011. Sustainable Building awareness in the Free State Province, South Africa. *Proceedings of 6th Built Environment Conference.* July – August 2011, JHB, South Africa.

Jones, L. 2008. *Environmentally responsible design: green and sustainable design for interior designers*. New Jersey: John Wiley & Sons, Inc.

Kang, M., Kang, J.H and Barnes, B. 2008. Interior Design Characteristics Influencing Sustainable Energy Awareness and Application. *International Journal of Spatial Design & Research*, 8(10), pp. 17-28.

Kats, G.H. 2003. *Green Building Costs and Financial Benefits*. Massachusetts Technology Collaborative: Massachusetts, MA, USA.

Kibert, C. J. 2008. *Sustainable construction: green building design and delivery*. New Jersey. John Wiley & Sons, Inc.

Koranteng, C. 2010. Evaluation of occupants' behaviour and preferences in office buildings in Ghana. *Journal of Science & Technology*, KNUST, 3 (30), pp 299 – 307.

Madu, C.N. and Kuei, C. (2012). Introduction to Sustainable Management. In: Madu, C. N. and Kuei, C. (eds), *Handbook of Sustainability Management*. Singapore, World Scientific Publishing Co.

Manu, F. W., Baiden-Amissah P.D, Adobor, D. C. I. and Danquah, J.A. 2009. Mitigating Global Climatic Change through The Use Of Green Building Materials. *National Housing Conference Proceedings*: 7th-8th October, 2009 at STEPRI. C.S.I.R (Building and Road Research Institute). ISSN 0855-1715 Pp208 -217.

Mate, K.J. 2006. Champions, Conformists and Challengers: Attitudes of Interior Designers as Expressions of Sustainability through Material Selection. *Paper presented at Design Research Society International Conference*. Wonderground, 1-4 November, Paper 0066, Lisbon, portugal.

Nielson, C., Wolfe, C. B. and Conine, D. 2009. Green *Building Guide: Design techniques, Construction Practices & Materials for Affordable Housing*. Published by Rural Community Assistance Corporation (RCAC). www.rcac.org

Nieuwenhuis, J. 2007. Qualitative research designs and data gathering techniques. *First steps in research*, 69-97.

OECD, 2003. *Environmentally Sustainable Buildings: Challenges and Policies*. Organization of Economic Cooperation and Development (OECD), Paris.

Opoku, A. and Ahmed, V. 2015. Drivers and challenges to the adoption of sustainable construction practices. In: Opoku, A. and Ahmed, V. (ed.) *Leadership and sustainability in the built environment*. Abingdon, Oxon, Taylor and Francis.

Othman, A.A.E. 2011. Lean principles as a strategic option for delivering innovative sustainable construction projects: a client value driven approach. In: *proceedings of 6th Built Environment Conference*, Johannesburg South Africa 31 July – 2 August, pp. 174-187.

Smit, P.J., Cronje, G.J., Brevis, T. and Vrba, M.J. 2011. *Management Principles: A Contemporary Edition for Africa*, 5th Edition. Epping, Cape Town: Juta

South Africa. (2008). Department of Environmental Affairs and Tourism. *People-Planet-Prosperity: A National Framework for Sustainable Development in South Africa*. Retrieved on 10/01/2014, from South African Government Department of Environmental Affairs: http://www.environment.gov.za/HotIssues/2008/nfsd/nfsd.html#

Suresh, S., Bashir, A.M. and Olomolaiye, P.O. 2012. A protocol for lean construction in developing countries. In: Ofori, G. (ed.) *Contemporary Issues in Construction in Developing countries*. London, Spon Press.

Tzschentke, N.; Kirk, D. and Lynch, P. 2004. Reasons for going green in serviced accommodation establishments. *Int. J. Contemp. Hosp. Manag*. 16, pp.116–124.

Wackernagel, M. and Rees, W. 1996. *Our ecological footprint: reducing human impact on earth*. Gabriola Island: New Society Publishers

WCED, 1987. *Our Common Future*: Brundtland report of the world commission on environment and development (WCED), United Nations General Assembly, New York.

Wilreker, H. 2011. Green – an architect's perspective. *Urban Green File*, 15(6), pp. 6-7.

Windapo, A.O. 2014. Examination of green building drivers in the South African construction industry: Economics versus ecology. *Sustainability*, 6, retrieved from http://www.mdpi.com/journal/sustainability.

Yates, A. 2001. *Quantifying the business benefits of sustainable buildings: Summary of existing research findings*. Centre for Sustainable Construction, Watford: Building Research Establishment (BRE).