

BARRIERS TO SUSTAINABLE CONSTRUCTION PRACTICE IN NIGERIA

Emmanuel Itodo Daniel¹, Oluwakemi Oshineye² and Olalekan Oshodi³

¹ *Department of Construction Management and the Built environment, Solent University, East Park Terrace, Southampton SO14 OYN, UK*

² *Department of Building, University of Jos, 930001, Jos, Nigeria*

³ *Department of Construction and Management and Quantity Surveying, University of Johannesburg, 37 Nind Street, Doornfontein, Johannesburg, 2094, South Africa*

There is a growing body of literature that recognises that adoption of sustainable construction practices (SCP) would result in significant reduction in the greenhouse emissions from the construction industry. Despite its importance, the practice of sustainable construction has not received much attention in developing countries, such as Nigeria. The current research aims to assess the barriers to the adoption of sustainable construction practices (SCP) in Nigeria. A combination of questionnaire survey and interviews were used for data collection. A total of 150 questionnaires were disseminated to major construction industry stakeholders based in Abuja, Nigeria and eight interviews were conducted. The findings of the study revealed that lack of expertise, lack of strategy to promote sustainable construction and lack of demand are considered to be the most critical barrier to the SCP in Nigeria. Also, the dominant culture of short-term benefit over lifecycle costing and the argument for the inclusion of sustainable practice in the contract seems to be peculiar in the Nigeria context and also less reported in previous studies. Taken together, there is a need to improve the knowledge of professional on sustainable construction through training programmes in Nigeria. The study recommends that sustainability module should be formally included in the built environment programmes in higher education in Nigeria to deepen its knowledge among the construction professionals.

Keywords: barriers, construction practices, developing countries, sustainability

INTRODUCTION

Sustainable construction is a rising concept that aims to incorporate the general principles of sustainability current practice of the construction industry. Sustainability means that lifecycle (social, economic and the environment) is the primary criterion guiding the process of creation and management of the built environment (UNEP Report, 2002). This includes but is not limited to new environmentally orientated construction designs, new environmentally friendly operation and maintenance procedures. It is axiomatic that the construction industry has significant impact on the environment. For instance, buildings produce waste that significantly pollute the natural environment during their construction and use (Albino and Beradi 2012).

¹ emmanuel.daniel@solent.ac.uk

While the call for sustainable practice in the built environment sector has received much attention from clients, contractors, small and medium scale companies, researchers, social enterprises, Government and its regulatory bodies in countries such as the UK, USA, New Zealand, Australia among others (Upstill-Goddard *et al.*, 2016; Bond and Parrett, 2012; Shiers *et al.*, 2006). However, very little is known about sustainable construction practice in developing countries, such as Nigeria (Dania *et al.*, 2014). Dania *et al.*, (2014) and Dahiru *et al.*, (2010) observed that sustainable practice is still an emerging concept in the Nigeria construction industry.

In Nigeria, Mbamali and Okotie (2012) and Dahiru, *et al.*, (2010) assert that not until 2006 when discussions for the National Building Code started, the Nigerian construction industry was without uniform regulations, guidelines and standards for the design, construction and operation/maintenance of buildings. Dahiru *et al.*, (2010) noted that while it is true that the situation in the Nigerian Building industry has greatly improved in some aspect there is no adequate consideration for sustainability in the National Building Code (2006) and within the current practice in the construction sector. However, the reasons for the current unsustainable practice are not yet explored in Nigeria. According to Wilson and Rezgui (2013), the construction industry is characterised by a complex socio-cultural, contextual, structural issues as reflected by its endemic resistance to change. While there is considerable need to migrate from the conventional construction system to sustainable construction practice in Nigeria, there is lack of authoritative research to understand the current barriers to sustainable construction practice in the Nigeria through the lens of stakeholders.

In order to endorse and drive the agenda for sustainable construction in Nigeria, the barriers that hinder these practices must first be identified from the stakeholders' perspective. Previous studies on SC in Nigeria focused on understanding capabilities of construction firms on sustainable construction practice (Dania *et al.*, 2014); sustainable health and safety practice in construction (Okoye and Okelie, 2013); prospect of green practice (Dahiru *et al.*, 2014) and prioritisation of sustainable construction attributes (Nwokoro and Onukwube, 2011). None of this study focuses on prioritising the barriers to sustainable construction practice in Nigeria. However, this study maps out the barriers to SC practice and identified the most significant barriers to SC practice in Nigeria through the lens of the key stakeholders. An understanding of the barriers to sustainable construction practice would aid the development of strategies to ease its implementation not only in Nigeria but also in other developing countries as well.

The outcome of this study provides insights on measures to improve SC practice in developing countries in general

LITERATURE REVIEW

The construction industry and its products are major contributors of greenhouse gas (GHG) emissions to the environment. Several authors (Hwang and Tan, 2012; Shi *et al.*, 2013) have shown that the adoption of sustainable practice would reduce the adverse impact of the construction sector on the environment. In addition, research has shown that the use of components, such as precast concrete components (Mao *et al.*, 2013) and green roof systems (Kumar and Kaushik, 2005), results in significant reduction of GHG emissions from construction projects. Similarly, evidence suggests that the demand for eco-friendly products have been on an increase (Sharpley, 2006; Kumar *et al.*, 2011). Based on the foregoing, it is evident that the adoption of sustainable construction practices would be beneficial for construction business in

terms of business performance and client satisfaction, amongst others. However, the adoption of sustainable construction practices still remains as a challenge, especially in developing countries like Nigeria.

To date, the barriers to the adoption of construction practices have led to academic investigations in several countries. These studies found in literature have been carried out in China (Shi *et al.*, 2013); Finland (Häkkinen and Belloni, 2011); Hong Kong (Zhang *et al.*, 2012); Malaysia (Abidin *et al.*, 2013); Singapore (Hwang and Tan, 2012) and United Kingdom (Williams and Dair, 2007), among others. Shi *et al.*, (2013) found that high cost, longer time required, shortage of green suppliers and information and additional consideration for maintenance are the significant barriers to sustainable building in China. A study on barriers to green building project management in Singapore showed that high cost, lack of communication and interest among project team members, low demand/lack of interests by clients, limited research highlighting the benefits of sustainable construction practices and the high cost of implementing green building practices are the five most important barriers (Hwang and Tan, 2012). Both studies agreed that high cost is a major barrier to the adoption of sustainable construction practices. However, there are variances in the significance of the barriers associated with sustainable construction practice in China and Singapore. These differences could be due to the level of government's commitment to sustainable development in these countries. Table 1 provides a summary of significant barriers to sustainable construction practices identified from previous studies found in the literature. This information served as the take-off point for the development of the questionnaire used in the present study.

RESEARCH METHOD

A mixed research design that uses quantitative cross-sectional survey and qualitative opened interviews (Bryman, 2016) was used in identifying and understanding the barriers to sustainable construction practice in the Nigeria construction industry. The use of mixed approach in construction management research has been widely reported in literature (Dainty, 2008). In this study the quantitative survey was used to rate the significant barriers to sustainable construction practice that are peculiar to the Nigerian construction industry. While the open ended interviews, aim to identify other barriers to sustainable practice in Nigeria context and to also triangulate the result of the survey. Creswell, (2007) observes that interviews gives research participants the opportunity present their own view on the phenomenon or problem being investigated rather than that reported in literature alone. The use of interview provides deeper insights into a problem being investigated when compared to questionnaire survey (Creswell, 2007).

A review of the extant literature was carried out to grasp and engage with the current knowledge of barriers to sustainable construction practice (SCP). The barriers to SCP were identified from previous research found in the existing literature (see Table 1). This activity was done to ensure that the current investigation in Nigeria is guided by existing empirical evidence using the deductive approach (Bryman, 2016). This information was used to develop the survey instrument used in examining the barriers to SCP in Nigeria from the stakeholders' perspective. The questionnaire comprises two sections. Section A identified demographic data of respondents while section B considers the stakeholders' view on the barriers to SCP. In section B, respondents were asked to rate the barriers to SCP in Nigeria on a scale of 1 to 10 (with 1 being the weakest and 10 being the strongest).

Table 1: Summary of the significant barriers to sustainable construction practices

Author(s)	Country	Significant barriers
Wilson and Tagaza (2006)	Australia	High initial cost
Williams and Dair (2007)	United Kingdom	High cost, slow return on investment, resistance to changes in the current practices and subcontractors lack the skills and knowledge.
Hakkinen and Belloni (2011)	Finland	Lack of client awareness, lack of reliable information on the cost savings associated with the use of sustainable construction and lack of methods that support the adoption of sustainable construction.
Hwang and Tan (2012)	Singapore	High cost of sustainable construction projects, ineffective communication and interest among project team members, and cost of implementing sustainable construction practices.
Zhang <i>et al.</i> , (2012)	Hong Kong	Lack of client demand, shortage of government's incentive and high cost.
Abidin <i>et al.</i> , (2013)	Malaysia	Lack of government commitment, high cost and client demand.
Shi <i>et al.</i> , (2013)	China	Extra cost associated with sustainable construction, schedule overrun linked to sustainable construction and shortage of green suppliers.
Szydluk (2014)	US	Poor perception due to bad experience, lack of experience and resistance of changes in the current culture.
AlSanad (2015)	Kuwait	Lack of awareness
Ametepey <i>et al.</i> , (2015)	Ghana	Resistance to change, lack of government's commitment and perceived high cost.

Face validity as suggested by Bryman (2016) was used to ensure that the survey instrument sufficiently measure the barriers to SCP in Nigeria. Accordingly, two construction management experts in the academia and two senior construction manager based in Nigeria validated the research instrument. The initial survey instrument was modified based on the recommendations and suggestions from these experts. Additionally, the survey instrument was piloted with two clients, two contractors and two consultants, this was done to identify and minimise any form of ambiguity with the survey instrument.

The data employed in the study were gathered from construction stakeholders based in Abuja, the Federal Capital of Nigeria. Preliminary investigation at the start of the study revealed that major construction projects that involve the major stakeholders in the Nigerian construction industry are initiated and on-going in the Abuja metropolis, for example the Centenary City project (Oxford Business Group, 2018). It also housed the head offices of the construction companies in Nigeria. This suggests that current information on SCP could be gleaned from construction professionals based in Abuja Metropolis; this informed the choice of Abuja as the study area.

The sample for the study was purposive drawn from client organisation (Federal Housing Authority of Nigeria); contracting organisation (registered contractors with the Nigeria Institute of Building); consulting organisation (Nigeria Institute of Architects). This was done to ensure only those who are qualified professionals participate in the study. This approach ensures the view of the designers, the contractors, the professional bodies and statutory agencies on the barriers to

sustainable construction practice is sought. These organisations were selected to participate in this study because the professionals in their employ play active roles in phases of construction projects. The invited participant in the study has over 8 years' experience within the Nigeria construction industry and they are fully chartered with their professional bodies. This means their response could be relied on.

A total of 150 questionnaires were disseminated to major stakeholders in the construction industry based in Abuja, Nigeria. The questionnaire was sent via email and physically given to the respondents in their offices. Out of the 150 questionnaires administered, 80 questionnaires were received. Relative importance index (RII) was used to rank the dominant factors under the objectives of the study. Johnson and LeBreton, (2005) observed that RII enable a study to identify how a given variable contribute to the prediction of a criteria in relation to other predictor variables for the purpose of ranking. In this study RII was used to rank the most significant barriers to the SCP in Nigeria in relation to other variables as perceived by the research participants. Additionally, eight research participants were interviewed. This includes one client (CL 01); four main contractors (MC, 01, 02, 03, and 04); three consultants (CO, 01, 02 and 03). More contractors were interviewed because they are more involved in the construction phase of a project. All the interviewees have over 8 years' experience in construction and they are chartered member of their professional bodies. The interview was analysed using content analysis and themes (Bryman, 2016).

RESULTS

The RII and the rank of the barriers to SCP in Nigeria are presented in Table 2. The five most important barriers to SCP are: lack of expertise and professional knowledge; lack of strategy to promote sustainable construction; Lack of demand; Lack of legislation, enforcement and monitoring; and Lack of government incentives and support with corresponding values of 0.94, 0.92, 0.92, 0.90 and 0.87, respectively. However, extensive pre-contract planning is considered to be the least important barrier to SCP in Nigeria.

Emerging Themes from Interviews on the Barriers to SCP in Nigeria

The core themes that emerged from the content analysis of the eight semi-structured interviewed on the barriers to SCP in Nigeria include: (1) Lack of consideration for sustainability in the design phase (2) Low level of knowledge and ignorance of sustainability among construction practitioners (3) Dominance of short term benefit culture over life cycle benefit (4) Absence of clear government policy and standard on sustainable construction practice (5) Lack of demand for sustainable product and process.

DISCUSSION OF RESULTS

The evidence on the significant barriers to SCP gleaned from the survey result presented in Table 2 is now discussed and triangulated with the themes that emerged from the interviews.

Lack of expertise and low level of sustainability among practitioner

The survey result indicates that the lack of expertise and professional knowledge was ranked as the most significant barrier to SCP in Nigeria. This view was further echoed by the research participants that participated in the semi-structured interviews. Some of the respondent interviewed stated that: The current knowledge on sustainable

construction among practitioners in Nigeria is low and there is less emphasis on it in trainings in schools especially in the past [CO1, Consultant Project Manager]. "The level of awareness and education on sustainability among practitioners here is still very low" [CL 01, Construction Director].

Table 2: Barriers to the adoption of Sustainable Construction Practice in Nigeria

Barriers to SCP	Relative importance index	Rank
Lack of expertise and professional knowledge	0.94	1
Lack of strategy to promote sustainable construction	0.92	2
Lack of demand	0.92	2
Lack of legislation, enforcement and monitoring	0.90	4
Lack of government incentives and support	0.87	5
Lack of public awareness of the benefits of sustainability	0.85	6
Resistance to change from the current practices	0.85	6
Lack of training opportunities	0.82	8
Lack of design and construction teams for sustainable construction	0.80	9
Perceived increase in cost and time	0.79	10
Lack of measurement tool to showcase benefits of SCP	0.78	11
Lack of cooperation	0.77	12
Risk associated with investment	0.76	13
Increased documentation	0.76	13
Higher investment cost	0.75	15
Lack of financing	0.74	16
Extensive pre-contract planning	0.72	17

It is not surprising that most of respondent see lack of expertise and knowledge as a major barrier to sustainable construction practice in Nigeria. This perception could be due the non-existence of clear framework for sustainable construction practice for practitioners and even in the training of built environment professionals (such as construction managers, architects and engineers, among others) in the institution of higher learning in Nigeria.

This finding align with Dania *et al.*, 2014 and Dahiru, *et al.*, 2010 where they found that the concept of sustainable construction practice is still in its infancy among practitioners in Nigeria. While sustainability is seen a core module or incorporated into most module in developed countries such as the UK in construction related programmes, this is yet to be a common practice in construction related courses in higher education in Nigeria.

Lack of policy, standard and strategy to promote sustainability

Table 2 reveals the lack of strategy to promote sustainable construction ranked second, closely related to this is lack of standard, legislation and enforcement which ranked 4th. This finding is supported by the interview result where some of the respondents stated that: "Although some knowledge of sustainable construction is now being disseminated in part to those who has been to school in recent time but because of lack of policy to drive it this is not implemented in practice people do want they like" [CO2, Project Coordinator]. "There is lack of government policy to support sustainable construction, for instance there is no regulation on the nature or quantity of waste that should be sent to landfill or reused as done in other parts of the world"[MC

02, Project Director]. There is no law or framework to guide and enforce sustainable construction practice [CO3, Consulting Architect]. According to Dahiru *et al.*, 2010 there is dearth of regulation, standard and policy to drive the implementation of sustainable construction practice in Nigeria. Similarly, Mbamali and Okotie (2012) observed that there is still no clear policy to drive sustainable construction practice in Nigeria. However, in developed countries such as the UK and USA where there are standards such as BREEAM and LEED among others to drive sustainability practice (Sherratt and Farrell, 2015). The interview result further suggests that in addition to developing appropriate legislations and standards, mechanisms for monitoring compliance must be put in place.

Lack of demand for sustainable product and lack of inclusion in contract clauses

Table 2 shows that there is lack of demand for sustainable construction practice also ranked second. The lack of demand is both from public client and private client Professionals have primarily focused on the cost, time and quality as the metrics for evaluating the of construction projects (Chan and Chan, 2004). However, in recent times, there has been a shift towards the inclusion of sustainability as a performance indicator for construction projects (Shen *et al.*, 2007). This view was further echoed in the interview; one of the main contractors stated that: "Most time SCP practice is not clearly stated in the contract and this makes it difficult for us to deliver"[MC 04, Project Manager]. It could be argued that the lack of reference to sustainable construction practice in the contract shows a lack of demand for it by the client. The lack of demand for sustainable construction by clients in Nigeria could be explained from two perspectives. First, it could be due to clients ignorance of the benefits associated with the practice of sustainable construction. Studies such as Hwang and Tan, 2012 found that the lack of awareness and limited evidence on the benefit of sustainable construction practice are among the barriers to it adoption. Second, the client may not be demanding for it because for it because of its cost implication. One of the Designers stated that: "Do you know that some of these clients would not like to pay for it, for example my client seek for advice on the choice between wood or asbestos for ceiling. After giving him the cost for both, the client went for asbestos instead of wood that is more sustainable" [CO 3, Consulting Architect].

Lack of consideration for sustainability in design and short term benefit culture

The interview result shows that sustainability issues seem not be adequately considered during the design phase of the project in Nigeria and clients focuses more on short-term benefit than the lifecycle benefit in choosing materials and method for constructing a facility. Some of the respondents stated that: "Sustainability is not considered during design most time it seen as an afterthought or as ad on during construction"[MC 03, Project Manager]. "There is this culture that is with us, seeking for immediate short term benefit without looking at the lifecycle costing in choosing material and process"[MC04, Project engineer]. This shows the need to develop appropriate regulation for the inclusion of sustainable consideration into design for constructed facilities. However, with the current culture of going for lowest cost over value and sustainability client may still continue in their old way in the absence of enforceable regulation. It is worth mentioning that the conflict between cost and value as captured is not peculiar to the Nigeria construction industry alone; rather it is an industry wide problem. The recent Hackitt report following recent Grenfell fire incidence and other construction industry report such as Latham reiterate this assertion (Hackitt Report, 2018)

CONCLUSIONS

The purpose of this study is to identify the barriers to SCP within the Nigerian construction industry with a view to suggest strategies to mitigate them. The study found that lack of expertise and professional knowledge, lack of legislation, stand and strategy to promote sustainable construction, lack of client demand, lack of consideration for sustainability in design and the culture of short term benefit over life cycle costing are the core barriers to SCP in the Nigerian construction industry. While some of these barriers have been reported elsewhere the form in which it manifest in the context of Nigeria construction industry as seen from the interviews response is unique. However, some of the barriers identified from the semi-structured interview such as the non-consideration of sustainability in designs, the dominance culture of short term benefit over lifecycle costing and the argument for inclusion of sustainable practice in contract seems to be peculiar in the Nigeria context and have been less reported in previous studies. The study conclude that the need to include sustainability consideration right from the design and its inclusion in the contract cannot be underestimated especially in Nigeria and in other part of the world where contract dictates the tune on how construction projects are delivered.

This study has shown that the level knowledge of SCP among core construction stakeholders in Nigeria is still very low compared to other part of the world. Again, this suggests there is a need for training and retraining of built environment professional on issues related to sustainable construction practices. This could entail introducing sustainability modules into the built environment and construction management programmes in the Nigeria Universities and holding of CPD events on sustainable construction practice by professionals bodies in the built environment in Nigeria. Client demand can be generated through publicity of the benefits of sustainability on the environment and business performance. Additionally, incentives (financial and non-financial) are vital for improving the practice of sustainable construction. For example, government could reduce the import tax on sustainable technologies. The findings of the current study contribute to the existing knowledge on the barriers to SCP from the context of the Nigerian construction industry.

Although the current study is limited to the view of construction stakeholders and practitioners in Abuja metropolis, the study provides valuable insights on the barriers to SCP in a developing country such as Nigeria and contributes to future implementation of sustainable construction practice in Nigeria and possibly in other developing countries.

REFERENCES

- Albino, V and Berardi, U (2012) Green buildings and organizational changes in Italian case studies. *Business strategy and the Environment*, 21, 387-400.
- AlSanad, S (2015) Awareness, drivers, actions and barriers of sustainable construction in Kuwait. *Procedia engineering*, 118, 969-983.
- Ametepey, O, Aigbavboa, C and Ansah, K (2015) Barriers to successful implementation of sustainable construction in the Ghanaian construction industry. *Procedia Manufacturing*, 3, 1682-1689.
- Bond, S and Perrett, G (2012) The key drivers and barriers to the sustainable development of commercial property in New Zealand. *Journal of Sustainable Real Estate*, 4(1), 48-77.
- Bryman, A (2015) *Social Research Methods*. London: Oxford University Press.

- Chau, K W (2007) Incorporation of sustainability concepts into a civil engineering curriculum. *Journal of Professional Issues in Engineering Education and Practice*, 133(3), 188-191.
- Chan, A P C and Chan, A P L (2004) Key performance indicators for measuring construction success. *Benchmarking: An International Journal*, 11(2), 203-221.
- Creswell, J (2007) *Qualitative Inquiry and Research Design: Choosing among Five Traditions 2nd Edition*. London: SAGE.
- Dahiru, D, Abdulazeez A D and Abubakar M (2010) An evaluation of the adequacy of the national building code for achieving a sustainable built environment in Nigeria. *Research Journal of Environmental and Earth Sciences*, 4(10), 857-865.
- Dainty, A R J (2008) Methodological pluralism in construction management research. In: A Knight and L Ruddock (Eds.) *Advanced Research Methods for the Built Environment*. Wiley-Blackwell, Oxford, 1-13.
- Dania, A A, Larsen, G D and Ewart, I J (2014) Sustainable construction: Exploring the capabilities of Nigerian construction firms. In: Raiden, A and Aboagye-Nimo, E (Eds.), *Proceedings 30th Annual ARCOM Conference*, 1-3 September 2014, Portsmouth, UK, Association of Researchers in Construction Management, 3-12.
- Hackitt, D J (2018) *Building a Safer Future, Independent Review of Building Regulations and Fire Safety: Final Report*. London: HMSO.
- Häkkinen, T and Belloni, K (2011) Barriers and drivers for sustainable building. *Building Research and Information*, 39(3), 239-255.
- Johnson, J W and LeBreton, J M (2004) History and use of relative importance indices in organizational research. *Organizational Research Methods*, 7(3), 238-257.
- Kumar, R and Kaushik, S C (2005) Performance evaluation of green roof and shading for thermal protection of buildings. *Building and Environment*, 40(11), 1505-11.
- Kumar, S, Kwon, H-T, Choi, K-H, Lim, W, Cho, J H, Tak, K and Moon, I (2011) LNG: An eco-friendly cryogenic fuel for sustainable development. *Applied Energy*, 88(12), 4264-4273.
- Mao, C, Shen, Q, Shen, L and Tang, L (2013) Comparative study of greenhouse gas emissions between off-site prefabrication and conventional construction methods: Two case studies of residential projects. *Energy and Buildings*, 66, 165-176.
- Mbamali, I and Okotie, A J (2012) An assessment of the threats and opportunities of globalization on building practice in Nigeria. *American International Journal of Contemporary Research*, 2(4), 143-150.
- Nwokoro, I and Onukwube, H N (2011) Sustainable or green construction in Lagos, Nigeria: Principles, attributes and framework. *Journal of Sustainable Development*, 4(4), 166-174.
- Okoye, P U and Okolie, K C (2013) Social approach to sustainable construction practices through safety culture. *International Journal of Engineering Research and Development*, 6(11), 76-83.
- Oxford Business Group (2018) *Domestic Supply Sustains Growth in Nigeria's Construction Sector*. Available from <https://oxfordbusinessgroup.com/overview/rebound-local-contractors-see-return-growth-and-increased-use-domestic-inputs> [Accessed 18th June 2018].
- Sharpley, R (2006) Ecotourism: A consumption perspective. *Journal of Ecotourism*, 5(1-2), 7-22.

- Sherratt, F and Farrell, P (2015) *Introduction to Construction Management*. London: Routledge.
- Shiers, D, Rapson, D, Roberts, C, and Keeping, M (2006) Sustainable construction: the development and evaluation of an environmental profiling system for construction products. *Construction Management and Economics*, 24(11), 1177-1184.
- Shen, L Y, Li Hao, J, Tam, V W Y and Yao, H (2007) A checklist for assessing sustainability performance of construction projects. *Journal of Civil Engineering and Management*, 13(4), 273-281.
- Shi, Q, Zuo, J, Huang, R, Huang, J and Pullen, S (2013) Identifying the critical factors for green construction-an empirical study in China. *Habitat International*, 40, 1-8.
- Szydlak, C (2014) *Identifying and Overcoming the Barriers to Sustainable Construction*. PhD Thesis, Missouri, USA: Missouri University of Science and Technology.
- UNEP Report (2002) *Agenda 21 for Sustainable Construction in Developing Countries*. Available from <http://www.unep.or.jp/ietc/Focus/Agenda%2021%20BOOK.pdf> [Accessed 6th April 2018].
- Upstill-Goddard, J, Glass, J, Dainty, A and Nicholson, I (2016) Implementing sustainability in small and medium-sized construction firms: The role of absorptive capacity. *Engineering, Construction and Architectural Management*, 23(4), 407-427.
- Williams, K and Dair, C (2007) A framework for assessing the sustainability of brownfield developments. *Journal of Environmental Planning and Management*, 50(1), 23-40.
- Wilson, I E and Rezgui, Y (2013) Barriers to construction industry stakeholders' engagement with sustainability: Toward a shared knowledge experience. *Technological and Economic Development of Economy*, 199(2), 289-309.
- Wilson, J L and Tagaza, E (2006) Green buildings in Australia: Drivers and barriers. *Australian Journal of Structural Engineering*, 7 (1), 57-63.
- Zhang, X, Shen, L, Tam V W Y and Lee, W W Y (2012) Barriers to implement extensive green roof systems: A Hong Kong study. *Renewable and Sustainable Energy Reviews*, 16, 314-319.