Establishing the limitations of sustainable construction in developing countries: a systematic literature review using PRISMA.

OGUNMAKINDE, O.E., EGBELAKIN, T., SHER, W., OMOTAYO, T. and OGUNNUSI, M.

2024

Establishing the limitations of sustainable construction in developing countries: a systematic literature review using PRISMA

Olabode Emmanuel Ogunmakinde
Faculty of Society and Design, Bond University, Robina, Australia
Temitope Egbelakin
Faculty of Engineering and Built Environment, The University of Newcastle, Callaghan, Australia
Willy Sher
The University of Newcastle, Callaghan, Australia
Temitope Omotayo
School of Built Environment, Engineering and Computing, Leeds Beckett University, Leeds, UK, and
Mercy Ogunnusi
Robert Gordon University, Aberdeen, UK

Abstract

Purpose – Establishing a more sustainable built environment is an increasing global concern for the construction industry. Despite the intrinsic and extrinsic obstacles the stakeholders face, huge efforts are required to transition to a smooth, sustainable construction (SC) practice. This study identifies and discusses cogent obstacles to SC in developing nations.

Design/methodology/approach – The Preferred Reporting Item for systematic reviews and Meta-Analysis (PRISMA) approach was employed to establish research work in SC for developing countries. The databases used were Scopus and Web of Science. Meta-analysis of keywords was analysed thematically. The initial broad search returned 8,420 publications which were filtered and reviewed in-depth to fit the aim of the study, produced only 21 relevant publications from the years 2000–2021.

Findings – The four identified themes of obstacles to SC in developing countries are as follows: construction professional training and education, clients' attitudes and awareness, construction industries' culture and capacity and governments' regulation, policies and economy. The key barriers identified from the meta-analysis include inadequate training and education amongst construction professionals, poor execution of sustainability ethics, poor populace attitude towards sustainability, poor awareness and understanding, dearth of precise data and integrated study and inappropriate priorities about sustainability.

Originality/value – The originality in this study are themes drawn from millennium development goals (MDGs) and sustainable development goals (SDGs) publications related to SC. Consequently, the final framework presented a holistic approach to surmounting the established limitations and aided recommendations for future studies. Thus, setting a background for developing strategies to overcome the limitations and further attain sustainable development (SD).

Keywords Construction industry, Developing countries, Sustainable construction, Sustainability

Paper type Literature review

1. Introduction

Cambridge dictionary (2022) describes limitations as blocking movement, progression or achievement that is prevented or made more complicated. It inhibits movement from one phase to another. Limitations are part of advancement and can prevent the accomplishment of the project. In the building industry, barriers to the successful completion of construction

projects include permits or approval process, limited budget, workers and force majeure and inclement weather. The rising cost of construction, completion delays and sustainability issues are some of the results of these obstacles. They could be referred to as setbacks that may be overcome differently.

Sustainable development (SD) has been discussed extensively and embraced in many aspects of life. United Nations, in the document chaired by Brundtland in 1987, defined SD as the capability to make development sustainable to ascertain that the present needs are met without compromising the future generation's capability to meet their own needs (Toriola-Coker *et al.*, 2020). SD is designed to incorporate economic, social, social and environmental factors to attain what is naturally possible (Emmanuel *et al.*, 2014). The phrase has been acknowledged and applied in some sectors. For instance, sustainable production, sustainably built environment, sustainable agriculture and sustainable health practices. These sectors have recommended diverse processes to attain SD. Sustainable construction is a method that tackles the demands of the building industry. It intends to realise SD (Abidin, 2010). Wu *et al.*(2017) considered sustainable construction (SC) as construction that gratifies the needs of SDs and, therefore, defined it as a quest to guarantee social health and economic development whilst lowering the negative effect of construction activities on the environment.

Pearce (2005) noted that the industry had been criticised for its involvement in environmental dereliction which contradicts the philosophical stance of SD. For example, Hill and Bowen (1997), Ofori (2000), Du Plessis (2002), Pearce (2005), Dania *et al.* (2007) and Oko John and Emmanuel Itodo (2013) unearthed the noticeable impacts enforced on the environment by the building activities. These have emphasised the necessity for SC. Establishing a more sustainable built environment is an increasing concern for the building industry in developing and developed nations. Intensive attempts have been made and are still ongoing in the developed nations for its accomplishment. These attempts have led to laws, policies and construction of various SC.

Although SC has demonstrated its achievement in some developed nations, the responsibility lies on the developing nations to go along. Leiserowitz *et al.* (2006) affirmed that SC is all-inclusive and could be challenging. Huge efforts are required from all stakeholders, but this faces intrinsic or extrinsic barriers. Intrinsic barriers are internal factors such as constrained budget, whilst extrinsic barriers are external factors such as extreme weather (Newton, 2012). These factors inhibit an effortless transition to SC practices such as installing substantial openings to provide sufficient natural light and fresh air, utilising energy-saving bulbs and recycling or reusing building materials (Assylbekov *et al.*, 2021; Nwokoro and Onukwube, 2015). Besides, building professionals are accountable for ascertaining that they incorporate SD procedures into their practices to attain a SC (Cotgrave and Riley, 2012; Newman *et al.*, 2009; Newton, 2012). This notion is supported by Ifije and Aigbavboa's (2020) primary and secondary data collection affirming the imperativeness of the construction professionals in the Nigerian building industry to overcome the obstacles hindering the execution of SC.

The current trends in SC in developing countries have gravitated towards green construction practices and digitalisation. However, the typological limitation regarding the organisational construction process and the concise application of SC in the construction section has been limited. This study will, therefore, expose these limitations for future study purposes.

2. Methodology

This research applied the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA), first designed in 2009 with updated guidance of 2020 (Sarkis-Onofre *et al.*, 2021). PRISMA aims to support a comprehensive, transparent and complete reporting of systematic reviews for effective

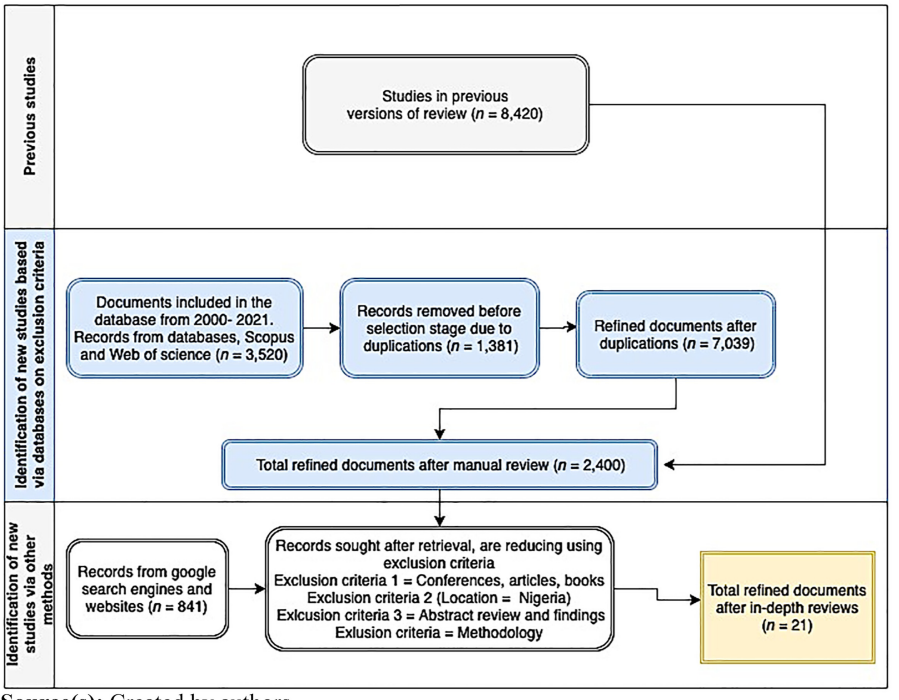
systematic reviews for effective decision-making (Panic *et al.*, 2013; Fleming *et al.*, 2014). The PRISMA 2020 includes elaborations and reporting on the abstract, introduction, method, results and conclusion. As part of the methods section under PRISMA 2020, the eligibility criteria and information sources such as Scopus and Web of Science, search strategy, selection process, data collection, data items, study risks, effect measures, reporting bias statements and certainty assessment (BJM, 2021). Scopus, Web of Science databases and Google Scholar search engines are the largest compendiums of published articles (Sarkis-Onofre *et al.*, 2021; Fleming *et al.*, 2014; BJM, 2021). The following is the 2020 PRISMA guideline by BJM (2021):

(1) Previous studies, inclusive of previous versions of reviews, were identified and reported.

(2) This was followed by the identification of new studies using databases. This was achieved through Scopus and Web of Science database searches.

(3) Identify new studies through other methods such as websites and search engines like Google Scholar.

Following a structured approach, the sources were determined to be peer-reviewed publications. Searches for relevant articles were conducted using Scopus and Web of science databases. As highlighted in Figure 1, the keywords used include *"sustainability", AND "sustainable construction", AND ""limitations to sustainable construction", OR "obstacles to sustainable construction", OR "sustainable development", AND "construction industry", AND "developing countries"*. The exclusion criteria covered the nature of articles



Source(s): Created by authors

Figure 1. PRISMA 2020 protocol adapted for this study

considered conferences, articles and books. The search location was narrowed down to developing countries such as Nigeria, actions such as building information modelling and lean construction practices. This investigation examined the obstacles to implementing SC in developing countries through publications using the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA).

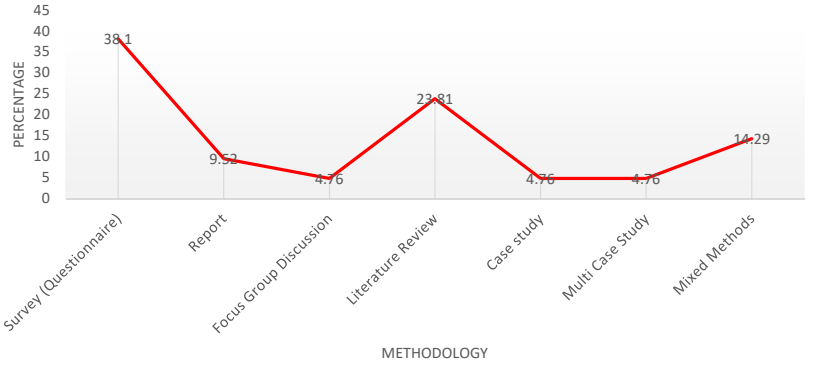
The advanced scholar search engine for other studies feature in Google Scholar was used to set specific search criteria. The search was limited to peer-reviewed publications written in English. The exclusion criteria of years between 2000 and 2021 were applied in the study because the millennium development goals (MDGs) were aimed at years 20,000 to 2015 and theSD Goals (SDGs) cover 2015 to the present (Fehling *et al.*, 2013; Bali Swain and Yang-Wallentin, 2020). Developing countries have been lagging in the attainment of SDGs, and this is like those of the MDGs. In terms of developing countries, it is highly imperative to consider the timeframe from 2000 to 2021 because of the themes of MDGs and SDGs for SC.

The abstracts of extracted relevant 21 articles were then examined to determine if the original research included data collected about any obstacles to SC. Afterwards, the full-text version of relevant articles was selected. The bibliographies of the articles consulted were combed for articles with different terminologies to obtain additional studies. Similar articles relating to sustainability in different fields were also included. In total, 21 articles were obtained, reviewed and analysed. The 21 publications were analysed by synthesising the themes and meta-data of SC in developing countries. The thematic analysis considered the research method in terms of percentages and meta-data indicators for SC in developing countries.

The first stage of the systematic review applied the general search keywords related to "sustainable construction" without any exclusion criteria identified in Figure 1 and Stage 2 of Figure 2. A combined 8,420 documents were returned across all databases. This was conducted to ensure that all duplicates across all databases noted above were removed. The duplicates found were 1 381. Further, stage 2 in Figure 2 enforced the selection criteria with the dates 2000 to 2021 and associated keywords. The refined documents after exclusion criteria were 48. An in-depth review of all documents pruned the final files relevant to the aim of the study to 21 files.

3. Results

This section analyses the 21 articles identified above. The methodologies adopted in these studies are shown in Table 1 and discussed below.



Source(s): Created by authors

Figure 2. Percentage of methodologies adopted in sustainable construction research

Methods	Approach
Eligibility criteria	Keyword search = *"sustainability", "sustainable construction", "limitations to sustainable construction", "obstacles to sustainable construction", "sustainable development", "construction industry" and "developing countries"*
Information sources	Scopus, web of science and Google scholar
Search strategy	Exclusion criteria = include Articles, books, conferences, reports, citations, developing countries such as Nigeria, Brazil, South Africa, Malaysia, etc. and a search time frame of 2000–2021
Selection process	Three (3) reviewers screened the outcomes of the publications retrieved. The abstracts of the retrieved articles were reviewed manually. The worked independently and combined their findings
Data collection process	Data from the publications were collected by manually reviewing the publications spreadsheet for the research strategy, methods, keywords, and themes on limitations of sustainable construction
Data items	A list of all outcomes for which data were sought was recorded in a table in terms of sustainable development research about developing countries. The specified list was compatible with the outcomes of the knowledge domain
Study risk of bias assessment	Three (3) reviewers reviewed the outcomes of the study and worked independently before combining and contrasting the outcomes of the findings. This process was used to eliminate bias
Effect measures	The effect measures were produced using percentage values
Synthesis methods	The tabulation of the study featured the sources for each theme of sustainable development in developing countries Summary statistics were presented in line graphs of percentages of research methods applied in the study Meta-analysis considered the citations as a level of impact for the study
Certainty assessment	The assessment certainty was measured through comparatives with previous studies in the field and contribution to knowledge

Source(s): Created by the authors

Table 1. PRISMA 2020 Item checklist for research method

Table 2 and Figure 2 illustrate that most (38.10%) of the researchers conducted questionnaire surveys. The questionnaires were administered to stakeholders in the construction industry. Similarly, literature reviews (23.81%) and mixed methods (14.29%) were employed. Case studies, surveys, focus group discussions and interviews were identified as the applicable research methods in the publications.

The researchers suggest that the building industry negatively impacts the environment (Abidin, 2010; Dania *et al.*, 2007; Emmanuel *et al.*, 2014) and that most building projects in developing nations are not sustainable. The sustainability of infrastructure is between moderate and high, according to the study conducted by Emmanuel *et al.* (2014). Some features fell below moderate, adversely affecting sustainability. These features include the release of water, standardised or grid planning and ozone layer protection (Emmanuel *et al.*, 2014). The consequence is that the less sustainable infrastructure becomes, the more the ecosystem turns out to be dilapidated.

Table 3 lists the barriers to SC in Figure 2. The classification is centred on stakeholders' perspectives. Each classification is subdivided by serial number. The implications of the findings are discussed in the next section. The thematic synthesis of obstacles in Table 3 was based on specific meta-data texts pertaining to negativity, limitations, SC indicators, attitudes and perceptions.

4. Discussion

The phrase *"sustainable construction"* (SC) usually expresses pre- and post-construction processes. Sustainable construction is defined as the efforts of the industry to attain SD (Pitt et al., 2009). Abidin

Methodology	Frequency	Percentage (%)
Survey (Questionnaire)	8	38.10
Report	2	9.52
Focus Group Discussion	1	4.76
Literature Review	5	23.81
Case study	1	4.76
Multi Case Study	1	4.76
Mixed Methods	3	14.29
Total	*21*	*100*

Source(s): Created by the authors

Table 2. Methodology adopted in the studies

Nr	Obstacle	Author(s) and year
1	Resistance to change	Wong and Yip (2004) and Babawale and Oyalowo (2011)
2	Financial incentives	Wong and Yip (2004)
3	Culture of the industry	Wong and Yip (2004) and Ebohon and Rwelamila (2001)
4	Lack of training and education	Abidin (2010), Ebohon and Rwelamila (2001), Gan *et al.* (2015), Nwokoro and Onukwube (2015), Shafii *et al.* (2006) and Wong and Yip (2004)
5	Deficiencies in construction industry capacity	Plessis (2001) and Moghayedi *et al.* (2021)
6	Uncertain economic environment	Plessis (2001) and Ebohon and Rwelamila (2001)
7	Poverty and low urban investment	Plessis (2001)
8	Inaccurate data	Moghayedi *et al.* (2021)
9	Lack of interest in SC issues	Plessis (2001) and Osobajo *et al.* (2022)
10	Unavailable proven alternative technology	Plessis (2001), Pitt *et al.* (2009) and Ebohon and Rwelamila (2001)
11	Integrated research deficiency	Plessis (2001) and Babawale and Oyalowo (2011)
12	Lack of knowledge, understanding and awareness of SC	Shafii *et al.* (2006), Abidin (2010), Dania *et al.* (2013), Jailani *et al.* (2015), Pitt *et al.* (2009) and Dania *et al.* (2007)
13	Higher cost of SC	Shafii *et al.* (2006) and Pitt *et al.* (2009)
14	Procurement issues	Shafii *et al.* (2006) and Ebohon and Rwelamila (2001)
15	Building regulatory barriers	Shafii *et al.* (2006) and Pitt *et al.* (2009)
16	Limited exposure of professionals	Shafii *et al.* (2006) and Babawale and Oyalowo (2011)
17	Unavailable domestic materials production	Shafii *et al.* (2006) and Ebohon and Rwelamila (2001)
18	Training needs and demonstration examples	Shafii *et al.* (2006)
19	Measurement standard	Emmanuel *et al.* (2014), Pitt *et al.* (2009) and Shen *et al.* (2010)
20	Business case understanding	Pitt *et al.* (2009)
21	Low client demand	Pitt *et al.* (2009), Gan *et al.* (2015) and Abidin (2010)
22	Vagueness of SC definition	Dania *et al.* (2013), Lai and Yik (2006) and Plessis (2001)
23	Lack of planning policy	Pitt *et al.* (2009)
24	Clients' requirement	Gan *et al.* (2015)
25	Enforcement and monitoring of law and legislation difficulties	Abidin (2010), Nwokoro and Onukwube (2015) and Ebohon and Rwelamila (2001)
26	Inappropriate priority	Babawale and Oyalowo (2011), Shen *et al.* (2010), Gan *et al.* (2015) and Shafii *et al.* (2006)
27	Perception and public attitude	Nwokoro and Onukwube (2015) and Mansaray *et al.* (1998)
28	No common basis for information	Emmanuel *et al.* (2014) and Gan *et al.* (2015)
29	Coordination challenges	Ebohon and Rwelamila (2001) and Dania *et al.* (2007)
30	Political instability	Ebohon and Rwelamila (2001) and Shen *et al.* (2010)

Source(s): Created by the authors

Table 3. Limitations of sustainable construction in developing countries

(Pitt *et al.*, 2009). Abidin (2010) and Uchehara *et al.* (2022) also support this definition by describing it as an avenue through which the industry can achieve SD. Hill and Bowen (1997) described the SC as the maintenance and management of buildings over their lifespan purposely to reduce deconstruction waste.

Even though SC has been the focus of broad research, especially in the developed nations, only a little has been done in most developing nations, especially in Africa. Sustainable construction can also be viewed as a holistic procedure to maintain and restore coordination between natural and built environments whilst creating communities that support economic equity and human dignity (Du Plessis, 2002). This definition proposes an interaction between the SD ethics of environmental, economic and social that are challenging and complex to achieve for most developing nations (Serpell *et al.*, 2013; Omotayo *et al.*, 2022).

The preceding definition suggests that SC takes more work for stakeholders to execute. Stakeholders include construction material manufacturers, clients, government (legislatures), professionals, planning regulatory agencies and builders. The stakeholder expects to apply their experience and knowledge to reduce waste and project costs and implement efficient maintenance strategies through decision-making and careful material selection (Shafii *et al.*, 2006; Omotayo *et al.*, 2023). These activities align the industry with the SC agenda when deployed (Murray and Cotgrave, 2007). For instance, Building Research Establishment Environmental Assessment Methodology (BREEAM), the Green Building Rating System, Home Energy Rating System, Green Star and Leadership in Energy and Environmental Design (LEED) are assessment rating systems (ARS) designed to differentiate buildings in different nations. These tools can be used as SC measures to ensure SD. Implementing SC demands an appropriate understanding of SD philosophies in building projects, lifecycles and sustainable procedures by the stakeholder's (Hill and Bowen, 1997; Matar *et al.*, 2008).

There has been a noticeable and recent increase in infrastructure advancement and urbanisation in most developing nations. This is apparent in Africa and Asia. Nations such as Nigeria, China, Hongkong, Malaysia, Tanzania and South Africa are experiencing remarkable advancement in their building industries. Besides these advancements are the adverse environmental effects of construction. Most developing nations strive with the swift frequency of urbanisation, low skill levels, poverty, institution capacity, environmental development, weak governance and social inequality. All these factors make development very difficult (Du Plessis, 2007; Ofori, 1998).

Research from developed nations has recognised barriers to executing SC. According to Williams and Dair (2007), stakeholders' detachment from sustainability is their research's main commonly documented obstacle. They also recognised a lack of client need, stakeholders' incapacity to implement sustainable procedures, the exchange of one sustainability procedure for another, absence of sustainable procedures, the inadequacy of verified sustainable products/materials/systems, negligence of statutory undertakers and regulators, omission of stakeholders in the execution process, ignorant stakeholders and inadequate proficiency to achieve sustainable procedures. Assylbekov *et al.* (2021) classified barriers to SC into five categories which include political, economic, sociocultural, technological and legal barriers.

Häkkinen and Belloni (2011) also recognised guiding mechanisms, clients' knowledge, economics, process (cooperation and networking, tendering and procurement and timing) and supporting knowledge (common language and knowledge, availability of tools and methods, innovation) as obstacles to SC. Wilson and Rezgui (2013) studied obstacles to building industry stakeholders' engagement and grouped the obstacles into three classifications. The first relays individually recognised obstacles which include mistrust in information sources, knowledge inadequacy about SC, dependence on technology, scepticism and uncertainty and resistance to change in lifestyle. The second relays to an organisation's recognised obstacles, including lack of training, time inadequacy for reflective activities and taking benefit of lessons learnt, lack of empowering initiatives, work priority and overload to accelerate current activities and

and tasks and lack of knowledge and information sharing. The third relays to obstacles recognised by the industry in general, including a lack of government focus on regulation and a lack of government action. The barriers identified from the emerging themes from the interviews conducted by Daniel *et al.* (2018) are the domination of short-term benefit culture over life cycle benefit, ignorance of sustainability and low level of knowledge among building professionals, inadequate consideration for sustainability in the design stage, inadequate demand for sustainable process and product and absence of clear government regulation and standard on SC procedure.

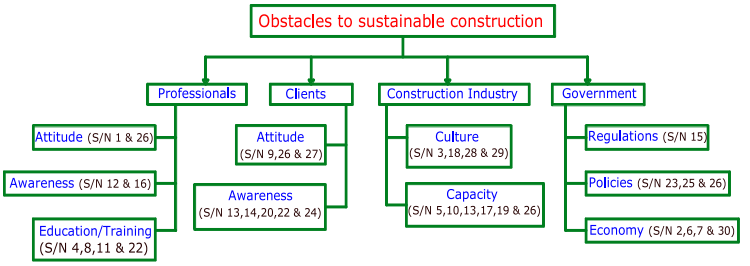
Several drivers of SC have also been recognised. Pitt *et al.* (2009) recognised the drivers to include building regulations, labelling/measurement, client awareness, planning policy and levies/taxes, client demand, investment, and financial incentives. Häkkinen and Belloni (2011) identified the advancement and implementation of processes for SC requirement management, advancement of services and concepts as drivers of SC, advancement of designers' capability and team working, advancement of client understanding of the advantages of SC and deployment of SC tools.

The abovementioned literature has recognised that SC is challenging and necessitates combined efforts of stakeholders for successful execution, especially in developing nations. It has indicated that building activities negatively impact the environment. It has identified several drivers and barriers to the execution of SC. Some of these barriers have been improved in developed nations but may remain in developing nations. It is imperative to identify the barriers challenging developing countries and how they can be alleviated to enhance an effortless transition to a SC process. This is the overall gap that this research contributes.

Mavi *et al.* (2021) also identify recommendations for future research in inspiration across various external and internal stakeholders, sustainability incorporation at the strategic levels of the organisations, and behavioural obstacles to sustainability incorporation instead of just technical and economic. Mjakuskina *et al.* (2019) identified technological features of SC, including research and development of new technologies and materials which use raw materials, improve energy efficiency, inspire green construction, implementation innovative technologies in building regulations.

4.1 Implications of findings for sustainable construction in developing countries

The agenda of this study was to expose the typologies limiting the advancement of SC in developing countries. In achieving this aim, Figure 3 articulates the stakeholders' limitations towards sustainability resulting from their education, attitudes, training, and awareness. Their viewpoint towards SC stems from their opposition to change and unsuitable priorities. This occurs when professionals hesitate to accept innovative technologies and construction techniques for fear of incurring additional costs and time. Professional viewpoints on SC are imperative if SC is to be accomplished. Inadequate knowledge, restricted exposure, awareness



Source(s): Created by authors

Figure 3. Limitations of sustainable construction

and understanding of SC were also recognised and classified under awareness. Some are not just conversant with SC and its concept. For instance, Dania *et al.* (2013) affirmed that practising professionals in the Nigerian construction industry possessed inefficient knowledge of SC. This could be ascribed to their inadequate exposure to the concept (Nwokoro and Onukwube, 2015). The knowledge of SC performs an imperative role in decision-making and could appear as a catalyst for the successful execution of SC. Inadequate client awareness of SC practices and benefits has been a major limitation in developing countries.

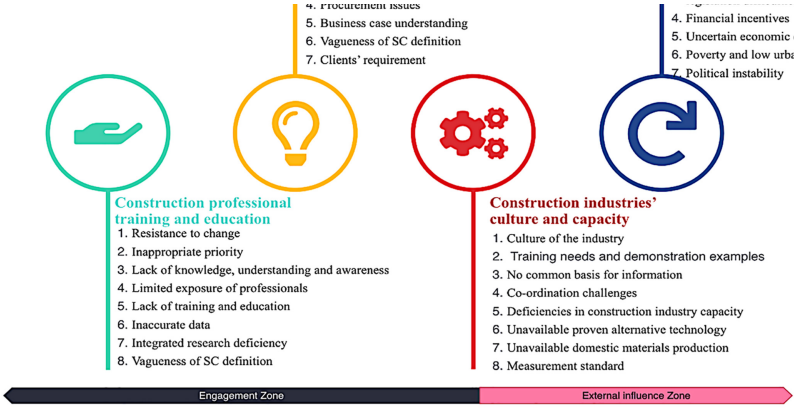
Table 4Thematised implications of the results in Table 3 and Figure 4 lead to four (4) themes: construction professional training and education, client's attitude and awareness, construction industries' culture and capacity and governments' regulation, policies and economy. These themes are explained below with supporting scholarly sources.

The four themes constituting the constraints of SC in developing countries can be divided into engagement and external influence zone. The engagement zone comprises construction professional training and clients' attitudes and awareness. The external influence zone of SD comprises construction industries, culture and capacity, and governments' regulation, policies, and economy.

Nr	Theme	Meta-data analysed
1	Construction professional training and education	Attitude (SN 1and 26), Awareness (SN 12 and 16), and Education and Training (S/N 4, 8, 11 and 22)
2	Clients' attitude and awareness	Attitude (S/N 9 and 27) and Awareness (S/N 13, 14, 20, 22 and 24)
3	Construction industries' culture and capacity	Culture (S/N 3, 18, 28 and 29) and Capacity (5,10, 17 and19)
4	Governments' regulation, policies, and economy	Regulations (S/N 15), Policies (S/N 23, 25 and 26) and Economy (2, 6, 7 and 30)

Source(s): Created by the authors

Table 4. Themes as drawn from the results in Figure 3



Source(s): Created by authors

Figure 4. Highlighting the framework of sustainable construction barriers in developing countries

4.2 Engagement: construction professional training and education

Deficient integrated research, the ambiguity of definition, inadequate accurate data, inadequate education, and training in SC were grouped under training and education. Construction professionals in developing nations need more roles in accomplishing SD. Even though younger generations are informed about SC techniques through formal education, their academic skills are yet to be tested (Abidin, 2010). Inadequate training and education were reported in almost all the literature reviewed. Wong and Yip (2004) opined that training and education in SC are uncommon due to inadequate sponsorship from employers and heavy work responsibilities. The required knowledge to enable sustainable performance has yet to be fully propagated throughout the building industry, heightened by the lack of crucial knowledge of construction design and operation (Jailani *et al.*, 2015).

Training and education ranked second out of the ten (10) factors required for SC in the survey conducted by Nwokoro and Onukwube (2015). Dania *et al.* (2007) also discovered that building professionals' waste management knowledge needed improvement. Dania *et al.*(2007) recommended that professional bodies utilise workshops and conferences to educate active professionals while educational institutions also include SC in the professional construction curriculum. Lai and Yik (2006) also investigated the *"knowledge and perception of serving and prospective operation and maintenance practitioners in Hong Kong about sustainable buildings"*. They unfolded an inadequate understanding of SC. This signifies a clear difference between education, experience and training. Shafii *et al.* (2006) opined that inadequate awareness of SC, inadequate education and training in sustainable design and construction, insufficient designers/professional capacity, and various other issues as obstacles to SC in Southeast Asia.

4.3 Engagement: clients' attitude and awareness

Clients, motivators of a good number of building projects, also perform imperative roles in the successful execution of SC. The barriers they identified emanate from inadequate awareness and attitudes to SC. Clients' requirements, inadequate business case understanding, lack of demand, procurement issues and higher cost of SC were established in the literature reviewed and classified under clients' awareness. Findings from the literature disclosed that most clients in developing nations do not request SC for projects as they are unaware of its benefits. They seem to view SC as a costly endeavour. This is apparent from the prerequisites they conveyed to their consulting building professionals, contributing to the abovementioned procurement issues. Lack of familiarity with SC, uninformed attitude and misplaced priorities from the public towards SC result in clients' lack of interest in SC are classified under the client's attitude. Nasereddin and Price (2021) developed an innovative framework to encourage project decisions that permit clients to identify the whole-life value of investing in SC.

4.4 External influence: construction industries' culture and capacity

The construction industry in developing countries also encumbers the successful execution of SC. The impacts of the industry may be classified into the industry's capacity and culture. Issues such as inadequate demonstration examples, industry culture, lack of coordination and unreliable information were noted in the literature reviewed and classified under culture. These issues encumbered professionals who depend on feasible illustrations for exemplars and information. Likewise, inadequate capacity, inappropriate priorities, inadequate measurement standards, lack of proven alternative technologies, inadequate domestic materials and higher costs of SC have been identified and classified in this category. The impacts of these issues on SC cannot be overemphasised.

For instance, inadequate measurement standard indicates an inaccurate measurement of actions considered sustainable or not (Hill and Bowen, 1997). The measurement of sustainability noted by Pitt *et al.* (2009) remains to be discovered. The industry depends deeply on imported materials as local, sustainable materials may be scarce unavailable and limited. This makes SC very costly in developing nations.

4.5 External influence: governments' regulation, policies and economy

The position of government institutions in developing countries towards SC is imperative. The government performs an imperative role through its regulations and policies. Additionally, a favourable economic climate also enhances the execution of SC. Shafii *et al.*(2006) and Pitt *et al.* (2009) purported that construction regulatory obstacles are one of the issues that encumber SC. Furthermore, lack of implementation and monitoring of law and legislation; a lack of misplaced priorities and planning were established and classified under policies. Shafii *et al.* (2006) and Gan *et al.* (2015), infrastructure development and poverty reduction in developing nations as government concerns in achieving SD. Attention is being paid to economic viability in mainland China with fewer priorities on economic feasibility and fewer on social and environmental performance (Shen *et al.*, 2010). Lack of implementation and monitoring of law and legislation have also been recognised as obstructing SC in developing nations. Abidin (2010) suggest that in circumstances where awareness is moderate or high, execution problems exist. Nwokoro and Onukwube (2015) also identified inadequate institutional infrastructure encouraging green buildings and professional capabilities to integrate green building opportunities and issues.

Abidin (2010) stated issues that hamper wider implementation of SC: lack of knowledge, education versus experience, financial constraints and passive culture. Karji *et al.* (2020) further classified the constraint into four categories, preconstruction, legislative, managerial and planning constraints, as the industry's most significant challenges in promoting SC. Additionally, poverty and low urban investment, financial incentives, political instability and uncertain economic environment were identified in the literature reviewed and classified under economy. These issues impact the economy and alter an effortless transition to SC.

Having acknowledged the barriers, the most important challenge industry encountered is "finding a holistic approach to making sure that its contribution to the physical, economic and human development of these countries meets the requirements of sustainable development" (Du Plessis, 2007). This ensues from different challenges encountered by different nations (Dania *et al.*, 2013). As related to developed countries, the building construction industry in developing nations encountered SC challenges (Plessis, 2001; Du Plessis, 2002; Kumaraswamy and Shrestha, 2002; Ofori, 2003). Recognises health and safety of construction workers, international construction, climate change, population issues, environmental issues, communication and information technology, globalisation, poverty alleviation, technology innovation and development, productivity and quality and reconstruction and disaster prevention to be some of the variances between construction industries of developing and developed nations. Therefore, there is a serious and significant gap between what is presently achieved and what needs to be accomplished.

6. Conclusion, limitations and recommendations for further studies

This research reviewed the literature on SC, disclosing the dominance in the developed nations with little in developing nations. SC is also known to be challenging, requiring stakeholders' joint attempts for successful execution. The study identified 30 obstacles to SC in developing nations. Clients, government, the building industry and professionals are the barriers recognised. Clients' barriers were classified based on their awareness and attitude.

Government barriers were classified based on regulations, economy and policies. Building industry barriers were unique to the capacity and culture of the industry, whilst professionals' barriers were further classified relating to their attitude, education, awareness and training. These barriers are contingent on each other, which signifies that surmounting them entails robust and complete processes. The robust, complete processes for accomplishing SC are proposed as follows:

(1) The government should implement and examine existing rules and regulations to discourage defaulters.

(2) The construction policies and regulations that will enhance the development of SC should be implemented. Therefore, the government must incentivise SC project owners to encourage others.

(3) The building industry needs to be well managed and provide a shared basis for developing domestic or local SC materials and information exchange. In other words, the industry must invest more in studies to develop home-grown technologies for SC. This should reduce the high cost of SC materials.

(4) Professionals require education, training and awareness of the possibilities of SC. This will motivate and position them to educate the clients who may need to be more conversant with the advantages of SC. Increasing clients' knowledge of SC will lead to high demand for SC projects.

These recommendations, if executed, offer possible solutions to the barriers encountered in executing SC in developing nations. The view of building professionals about sustainability and how sustainability can be determined could be a catalyst for further investigation. The limitations of this study are its theoretic nature without empirical quantitative or qualitative data. Further recommendations for future studies should include a longitudinal empirical study of the impact of SDGs since 2015 on developing countries and transference into SC. Furthermore, the typologies limiting the application of SC in developing countries may be compared with developed countries for further amelioration of the challenge.

References

Abidin, N.Z. (2010), "Investigating the awareness and application of sustainable construction concept by Malaysian developers", *Habitat International*, Vol. 34 No. 4, pp. 421-426, doi: 10.1016/j.habitatint.2009.11.011.

Assylbekov, D., Nadeem, A., Hossain, M.A., Akhanova, G. and Khalfan, M. (2021), "Factors influencing green building development in Kazakhstan", *Buildings*, Vol. 11 No. 12, 634, doi: 10.3390/buildings11120634.

Babawale, G. and Oyalowo, B.A. (2011), "Incorporating sustainability into real estate valuation: the perception of Nigerian valuers", *Journal of Sustainable Development*, Vol. 4 No. 4, 236, doi: 10.5539/jsd.v4n4p236.

Bali Swain, R. and Yang-Wallentin, F. (2020), "Achieving sustainable development goals: predicaments and strategies", *International Journal of Sustainable Development and World Ecology*, Vol. 27 No. 2, pp. 96-106, doi: 10.1080/13504509.2019.1692316.

BJM (2021), "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews", *BMJ Publishing Group*, Vol. 2021 No. 71, p. 372, doi: 10.1136/bmj.n71, (accessed 4 July 2022).

Cotgrave, A. and Riley, M. (2012), *Total Sustainability in the Built Environment*, Palgrave Macmillan, New York, ISBN- 9780230390584.

Dania, Kehinde, J. and Bala, K. (2007), "A study of construction material waste management practices by construction firms in Nigeria", *Proceedings of the 3rd Scottish conference for postgraduate*

researchers of the built and natural environment, Glasgow, Glasgow Caledonian University, pp. 121-129, available at: http://www.irbnet.de/daten/iconda/CIB10782.pdf (accessed 03 July 2022).

Dania, A.A., Larsen, G.D. and Yao, R. (2013), "Sustainable construction in Nigeria: understanding firm level perspectives", *Paper presented at the Sustainable Building Conference*, Coventry University, pp. 37-46, available at: https://www.academia.edu/download/36699760/SB13-05-Sustainable-construction-in-Nigeria-understanding-firm-level-perspectives.pdf (accessed 11 July 2022).

Daniel, E.I., Oshineye, O. and Oshodi, O. (2018), "Barriers to sustainable construction practice in Nigeria", *Proceedings of the 34th Annual ARCOM Conference*, Belfast, 3–5 September 2018, Association of Researchers in Construction Management, pp. 149-158, available at: https://www.arcom.ac.uk/-docs/proceedings/03b99b49b476d24431f1f5b1b30c8da3.pdf (accessed 11 July 2022).

Du Plessis, C. (2002), *Agenda 21 for Sustainable Construction in Developing Countries*, Vol. 204, CSIR Report BOU E, pp. 2-5, available at: https://www.academia.edu/download/44239864/Agenda_21. pdf (accessed 11 August 2022).

Du Plessis, C. (2007), "A strategic framework for sustainable construction in developing countries", *Construction Management and Economics*, Vol. 25 No. 1, pp. 67-76, doi: 10.1080/01446190600601313 4.

Ebohon, O.J. and Rwelamila, P. (2001), "Sustainable construction in Sub-Saharan Africa: relevance, rhetoric, and the reality", *Agenda*, Vol. 21, 16, available at: http://www.sustainablesttelement.co. za/docs/a21ebohon.pdf (accessed 2 July 2022).

Emmanuel, A.J., Ibrahim, A.D. and Adogbo, K.J. (2014), "An assessment of professionals' perception of the sustainability performance of infrastructure projects in Nigeria", *Journal of Construction Project Management and Innovation: Supplement*, Vol. 1 No. 4, pp. 912-932, available at: https://hdl.handle.net/10520/EJC162730

Fehling, M., Nelson, B.D. and Venkatapuram, S. (2013), "Limitations of the Millennium development goals: a literature review", *Global Public Health*, Vol. 8 No. 10, pp. 1109-1122, doi: 10.1080/17441692.2013.845676.

Fleming, P.S., Koletsi, D. and Pandis, N. (2014), "Blinded by PRISMA: are systematic reviewers focusing on PRISMA and ignoring other guidelines?", *PLoS One*, Vol. 9 No. 5, e96407, available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0096407

Gan, X., Zuo, J., Ye, K., Skitmore, M. and Xiong, B. (2015), "Why sustainable construction? Why not? An owner's perspective", *Habitat International*, Vol. 47, pp. 61-68, doi: 10.1016/j.habitatint.2015. 01.005.

Häkkinen, T. and Belloni, K. (2011), "Barriers and drivers for sustainable building", *Building Research and Information*, Vol. 39 No. 3, pp. 239-255, doi: 10.1080/09613218.2011.561948.

Hill, R.C. and Bowen, P.A. (1997), "Sustainable construction: principles and a framework for attainment", *Construction Management and Economics*, Vol. 15 No. 3, pp. 223-239, doi: 10.1080/014461997372971.

Ifije, O. and Aigbavboa, C. (2020), "Identifying barriers of sustainable construction: a Nigerian case study", *MATEC Web of Conferences - 312*, EPPM, doi: 10.1051/matecconf/202031204004.

Jailani, J., Reed, R. and James, K. (2015), "Examining the perception of tenants in sustainable office buildings", *Property Management*, Vol. 33 No. 4, pp. 386-404, doi: 10.1108/PM-05-2014-0022.

Karji, A., Namian, M. and Tafazzoli, M. (2020), "Identifying the key barriers to promote sustainable construction in the United States: a principal component analysis", *Sustainability*, Vol. 12 No. 5088, pp. 1-20, doi: 10.1080/15623599.2021.1967577.

Kumaraswamy, M.M. and Shrestha, G.B. (2002), "Targeting technology exchange for faster organizational and industry development", *Building Research and Information*, Vol. 30 No. 3, pp. 183-195, doi: 10.1080/096132101101521 66.

Lai, J.H. and Yik, F.W. (2006), "Knowledge and perception of operation and maintenance practitioners in Hong Kong about sustainable buildings", *Facilities*, Vol. 24 Nos 3/4, pp. 90-105, doi: 10.1108/02632770610649368.

Leiserowitz, A.A., Kates, R.W. and Parris, T.M. (2006), "Sustainability values, attitudes, and behaviors: a review of multinational and global trends", *Annual Review of Environment and Resources*, Vol. 31 No. 1, pp. 413-444, doi: 10.1146/annurev.energy.31.102505.1335522.

Mansaray, A., Ajiboye, J. and Audu, U. (1998), "Environmental knowledge and attitudes of some Nigerian secondary school teachers", *Environmental Education Research*, Vol. 4 No. 3, pp. 329-339, doi: 10.1080/1350462980040307.

Matar, M.M., Georgy, M.E. and Ibrahim, M.E. (2008), "Sustainable construction management: introduction of the operational context space (OCS)", *Project Management and Control for Sustainability*, Vol. 13 No. 4, pp. 1-24, doi: 10.1080/01446190701842972.

Mavi, R.K., Gengatharen, D., Mavi, N.D., Hughes, R., Campbell, A. and Yates, R. (2021), "Sustainability in construction projects: a systematic literature review", *Construction Management and Economics*, Vol. 26 No. 3, pp. 1-24, doi: 10.3390/su13041932.

Mjakuskina, S., Kavosa, M. and Lapina, I. (2019), "Achieving sustainability in the construction supervision process", *Journal of Open Innovation: Technology, Market and Complexity*, Vol. 5 No. 47, pp. 1-11, doi: 10.3390/joitmc5030047.

Moghayedi, A., Awuzie, B., Omotayo, T., le Jeune, K. and Massyn, M. (2021), "A critical success factor framework for implementing sustainable innovative and affordable housing: a systematic review and bibliometric analysis", *Buildings*, Vol. 11 No. 8, 317, doi: 10.3390/buildings11080317.

Murray, P.E. and Cotgrave, A.J. (2007), "Sustainability literacy: the future paradigm for construction education?", *Structural Survey*, Vol. 25 No. 1, pp. 7-23, doi: 10.1108/02630800710740949.

Nasereddin, M. and Price, A. (2021), "Addressing the capital cost barrier to sustainable construction", *Developments in the Built Environment*, Vol. 7 No. 2021, pp. 1-14, doi: 10.1016/j.dibe.2021.100049.

Newman, P., Beatley, T. and Boyer, H. (2009), "Resilient cities: responding to peak oil and climate change", *Australian Planner*, Vol. 46 No. 2009, 59, doi: 10.1080/07293682.2009.9995295.

Newton, P.W. (2012), "Liveable and sustainable? Socio-technical challenges for twenty-first-century cities", *Journal of Urban Technology*, Vol. 19 No. 1, pp. 81-102, doi: 10.1080/07293682.2009. 9995295.

Nwokoro, I. and Onukwube, H. (2015), "Understanding green and sustainable construction in Lagos, Nigeria: principles, attributes and framework", *Ethiopian Journal of Environmental Studies and Management*, Vol. 8 No. 1, pp. 57-68, doi: 10.4314/ejesm.v8i1.6.

Ofori, G. (1998), "Sustainable construction: principles and a framework for attainment-comment", *Construction Management and Economics*, Vol. 16 No. 2, pp. 141-145, doi: 10.1080/0144619983724485.

Ofori, G. (2000), "Greening the construction supply chain in Singapore", *European Journal of Purchasing and Supply Management*, Vol. 6 No. 3, pp. 195-206, doi: 10.1016/S0969-7012(00) 00015-0.

Ofori, G. (2003), "Preparing Singapore's construction industry for the knowledge-based economy: practices, procedures and performance", *Construction Management and Economics*, Vol. 21 No. 2, pp. 113-125, doi: 10.1080/0144619032000079680 7.

Oko John, A. and Emmanuel Itodo, D. (2013), "Professionals' views of material wastage on construction sites and cost overruns", *Organization, Technology and Management in Construction: An International Journal*, Vol. 5 No. 1, pp. 747-775, available at: https://hrcak. srce.hr/file/154727 (accessed 03 June 2022).

Omotayo, D.T., Tan, S.W. and Ekundayo, D. (2023), "Sustainable construction and the versatility of the quantity surveying profession in Singapore", *Smart and Sustainable Built Environment*, Vol. 12 No. 2, pp. 435-457, doi: 10.1108/SASBE-07-2021-0125.

Osobajo, O.A., Oke, A., Omotayo, T. and Obi, L.I. (2022), "A systematic review of circular economy research in the construction industry", *Smart and Sustainable Built Environment*, Vol. 11 No. 1, pp. 39-64, doi: 10.1108/SASBE-04-2020-0034.

Panic, N., Leoncini, E., De Belvis, G., Ricciardi, W. and Boccia, S. (2013), "Evaluation of the endorsement of the preferred reporting items for systematic reviews and meta-analysis (PRISMA) statement on the quality of published systematic review and meta-analyses", *PloS One*, Vol. 8 No. 12, e83138, available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0083138 (accessed 02 February 2023).

Pearce, D. (2005), "Do we understand sustainable development?", *Building Research and Information*, Vol. 33 No. 5, pp. 481-483, doi: 10.1080/09613210500219154.

Pitt, M., Tucker, M., Riley, M. and Longden, J. (2009), "Towards sustainable construction: promotion and best practices", *Construction Innovation*, Vol. 9 No. 2, pp. 201-224, doi: 10.1108/14714170910950830.

Plessis, C.d. (2001), "Sustainability and sustainable construction: the African context", *Building Research and Information*, Vol. 29 No. 5, pp. 374-380, doi: 10.1080/09613210110063809.

Sarkis-Onofre, R., *et al.* (2021), "How to properly use the PRISMA Statement", *Systematic Reviews*, Vol. 10 No. 1, pp. 1-3, doi: 10.1186/s13643-021-01671-z.

Serpell, A., Kort, J. and Vera, S. (2013), "Awareness, actions, drivers and barriers of sustainable construction in Chile", *Technological and Economic Development of Economy*, Vol. 19 No. 2, pp. 272-288, doi: 10.3846/20294913.2013.798597.

Shafii, F., Arman Ali, Z. and Othman, M.Z. (2006), "Achieving sustainable construction in the developing countries of Southeast Asia", *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC 2006)*, Kuala Lumpur, 5-6 September 2006, available at: https://www.academia.edu/download/37552678/Faridah_Shafii2006_AchievingSustainableConstructionInTheDeveloping.pdf (accessed 03 July 2022).

Shen, L.-Y., Tam, V.W., Tam, L. and Ji, Y.-b. (2010), "Project feasibility study: the key to successful implementation of sustainable and socially responsible construction management practice", *Journal of Cleaner Production*, Vol. 18 No. 3, pp. 254-259, doi: 10.1016/j.jclepro.2009.10.014.

Toriola - Coker, L.O., Alaka, H., Bello, W.A., Ajayi, S., Adeniyi, A. and Olopade, S.O. (2020), "Sustainability barriers in Nigeria construction practice", *IOP Conference Series: Materials Science and Engineering*, Vol. 1036 No. 2021, pp. 1-12, doi: 10.1088/1757-899X/1036/1/01202.

Uchehara, I., Moore, D., Jafarifar, N. and Omatayo, T. (2022), "Sustainability rating system for highway design:—a key focus for developing sustainable cities and societies in Nigeria", *Sustainable Cities and Society*, Vol. 78, 103620, doi: 10.1016/j.scs.2021.103620.

Williams, K. and Dair, C. (2007), "What is stopping sustainable building in England? Barriers experienced by stakeholders in delivering sustainable developments", *Sustainable Development*, Vol. 15 No. 3, pp. 135-147, doi: 10.1002/sd.308.

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*, Vol. 19 No. 2, pp. 289-309, doi: 10.3846/20294913.2013.799105.

Wong, E.O. and Yip, R.C. (2004), "Promoting sustainable construction waste management in Hong Kong", *Construction Management and Economics*, Vol. 22 No. 6, pp. 563-566, doi: 10.1080/0144619042000226270.

Wu, G., Zuo, J., Zhao, X. (2017), "Incentive model based on cooperative relationship in sustainable construction projects", *Management Strategies and Innovations for Sustainable Construction*, Vol. 9 No. 7, pp. 1-20, doi: 10.3390/su9071191.

About the author

Dr Olabode Emmanuel Ogunmakinde is Senior Teaching Fellow in the areas of construction management and sustainable construction. His research interests are construction material waste minimisation, interactions between sustainable construction principles and construction phases, as well as

construction professionals' perceptions, attitudes and behaviour. He has conducted research in the areas of building maintenance, building information modelling, intelligent buildings, professional practise and disaster risk management. Dr Ogunmakinde is currently a co-investigator on two collaborative research grants with academics from the School of Architecture and Built Environment, University of Newcastle. Dr Ogunmakinde is chartered building professional with the Australian Institute of Building.

Temitope Egbelakin is the Executive Director of Centre International de Formation des Autorités/Acteurs Locaux (CIFAL, in English International Training Centres for Local Authorities and Local Actors) Newcastle, a United Nations and United Nations Institute for Training and Research (UNITAR)-affiliated training and research centre based at the University of Newcastle. CIFAL Newcastle is the only CIFAL centre in Australia and the Pacific regions, positioning Temitope and her team as highly influential and respected global disaster resilience and sustainability experts. Her research interests are construction management, disaster resilience, stakeholder management and risk mitigation.

Willy Sher is Associate Professor in the areas of construction management. His research interests are the niches of computer-aided applications for the management of construction projects as well as construction education. He have published three books, over 120 refereed conference papers and over 30 refereed journal papers. He has secured research funding (in UK and in Australia) of over $1m in a range of areas and is Fellow of the Chartered Institute of Building.

Temitope Omotayo is Senior Lecturer in Quantity surveyor in quantity in the school of the built environment, engineering, and computing at the Leeds Beckett University. His research interests are continuous improvement, sustainable construction and construction cost management. Temitope has worked with Robert Gordon University as a lecturer in quantity surveying. He recently completed a£15,000 research grant on global surveying education which was funded by RICS/CHOBE. Currently, he is the leading investigator for an £80,000 Royal Academy of Engineering Grant. Temitope Omotayo is the corresponding author and can be contacted at: t.s.omotayo@leedsbeckett.ac.uk

Mercy Ogunnusi is a PhD candidate studying sustainable innovations in project abandonment in Nigeria. Mercy graduated with a distinction in Construction Project Management at Robert Gordon University, Scotland, UK. She has 20 years working experience cutting across various facets of built environment including Architecture, Manufacturing and Project Management. In addition to her project delivery roles while at Comprehensive Project Management Services Limited (CPMS). Her research interest are multi-criteria decision-making, infrastructure, sustainability and Building Information Modelling (BIM).