Drivers and Barriers to Sustainability Practices in the Zambian Construction Industry

Sambo Lyson Zulu[1], Ephraim Zulu[2], Mwansa Chabala[3] Nelly Chunda[2]

[1]Leeds Beckett University School of Built Environment, Engineering and Computing, Leeds, UK

[2]Copperbelt University, School of Built Environment, Construction Economics and Management, Kitwe, Zambia

[3]Copperbelt University, School of Business, Department of Production Management, Kitwe, Zambia

Abstract

Zambia, and Sub-Sahara Africa (SSA) generally, is lagging behind in the area of sustainable construction due to several barriers to the implementation of sustainable construction. This study therefore explored drivers and barriers to the adoption of sustainable construction practices in Zambia. The study could inform stakeholders on measures which could improve the implementation of sustainable construction. The study used an online quantitative questionnaire survey of construction professionals and clients. A total of 112 responses were received representing various stakeholder groups in the construction industry. The data were subjected to factor analysis and ranked using the relative importance index. The data show that drivers to sustainable construction cluster into three constructs namely, environment and health-related factors, regulatory and industry-related factors and, economy and firm related factors. Barriers clustered into three groups namely, awareness and knowledge related factors, regulatory and industry-related factors and, economy and cost-related factors. Therefore, measures aimed at improving sustainable construction in Zambia should focus attention on these broad clusters.

Keywords: Drivers and barriers, sustainable buildings, sustainable construction, sustainability practices, Zambian construction industry

Introduction

Increasing population and urban density have led to increased demand for infrastructure projects globally (Rooshdi et al. 2018). The provision of physical infrastructure is critical to society as it enables access to shelter, water, energy, transport, communication and sanitation. However, large infrastructure projects are a significant cause of environmental degradation in generally undisturbed natural landscapes (Carter and Keeler 2008). Research has shown that during the process of urban development, both terrestrial and aquatic ecosystems are significantly, and generally irrevocably changed (Pickett et al. 2001; Paul and Meyer 2001). Studies further show that the construction industry uses up the greater share of energy and other natural resources, with resultant significant effects on the environment, economy and society. For example, in 2010, the construction industry consumed about 32% of the global energy, produced 19% of the global energy-related greenhouse gas (GHG) emissions, and nearly one-third of the world's carbon emissions (Darko et al. 2017). In response, governments have been encouraging sustainable practices in designing, constructing and operating physical infrastructure (Zhang et al. 2011; Griffiths et al. 2018).

However, in sub-Sahara Africa (SSA), there is a cycle of poor environmental management which has led most countries to fail to meet their sustainability targets under the millennium development goals (Omisore 2018). Several barriers to sustainability have been identified most of which are hinged on poor institutions and institutional building capacity and the fact that environmental issues may not be of an immediate concern compared to economic issues (Ebohon and Rwelamila 2001; Addy et al. 2020). Subsequently, it has been suggested that it is important to remind key stakeholders to pay attention to environmental issues (Omisore 2018) and to disseminate knowledge to them (Addy et al. 2020).

Like most countries in SSA, Zambia is characterised by poor delivery of sustainable development with low adoption of sustainable construction practices (Oke et al. 2019; Phiri and Matipa 2004; Üllenberg et al. 2017; UNDP 2010). In addition, Oke et al. (2019) found that the construction landscape in Zambia is characterised by an average awareness of sustainable construction practices. Further, Phiri and Matipa (2004) noted that professionals in Zambia have an indifferent attitude towards sustainable construction with little being done to apply sustainable construction principles. More recently, a government supported and aid funded project called the Green Jobs Programme attempted to promote synergy between the business environment and environmental sustainability in an attempt to achieve sustainability reforms (Ploeg n.d.). However, notwithstanding such attempts, the UNDP (2010) noted that the country was unlikely to meet millennium development goals (MDGs) aimed at environmental sustainability. Aghimien et al. (2018) found that some of the major barriers to sustainable construction in Zambia are fear of higher investment cost, no local green certification, lack of government policies or support and lack of financial incentives. Some driver to sustainable construction in Zambia have also been identified and these include legislation or legal requirements, building regulations, advocacy and awareness, developing regulatory mechanisms and client demand (Oke et al. 2019).

Very few studies have highlighted drivers and barriers to sustainability in Zambia causing a paucity of information on the subject (Mulenga 2018; Oke et al. 2019; Üllenberg et al. 2017) and consequently very little information to guide stakeholders on sustainability issues. In view of the very few studies and considering the importance of environmental sustainability, this study explored drivers and barriers to the adoption of sustainability in the construction industry in Zambia. This is important because, while the rest of world is developing sustainability solutions, SSA and Zambia in particular still grapple with implementing known sustainability principles with little empirical evidence of why this is so and what can be done about it.

Therefore, this study first identified items from literature which were reported to be drivers and barriers to sustainable construction and factor analysed them to identify the underlying structure of the items. The items in each category were then ranked to identify the most important ones in each category.

Barriers and drivers to sustainability in the construction industry can guide stakeholders on how to improve sustainability in the industry especially considering that there are very few studies on the subject in Zambia. The results are also of benefit to other countries in SSA which shares a similar contextual background with Zambia. Also, as recommended by Omisore (2018) and Addy et al. (2020), it is important to remind stakeholders to pay attention to environmental issues and to disseminate information to them in order to avoid environmental issues continuing to be viewed as unrealistic rhetoric in SSA.

Sustainable Construction

Studies on sustainable construction in SSA are very important considering the severe adverse effect of climate change on the region. For example, a 10-20% decrease in precipitation is projected for Namibia, Botswana, northern Zimbabwe and southern Zambia with an increase in the number of consecutive dry days if the global temperature rise is not kept to less than 1.5^{o}C of pre-industrialisation levels (IPCC 2018). Therefore, measures aimed at reducing climate change are very important to the region. However, most countries in the region are failing to implement or have very low levels of adoption of sustainability. Therefore, it is important to establish the factors which either drive or hinder the implementation of sustainable construction in countries in SSA region. The following review of literature therefore identifies barriers and drivers to sustainability in the built environment in developing countries.

Barriers to Sustainable Construction

A review of literature revealed a myriad of items which have been reported to create barriers to the adoption of sustainable construction. For example, a meta-analysis of 50 highly cited works identified 175 barriers to the adoption of sustainable development (Jaramillo, Sossa and Mendoza, 2018). Serpell et al. (2013) equally noted that a large variety of factors is usually considered as barriers. This may be attributed to the fact that the majority of studies concentrated on listing individual barriers to the adoption of sustainable construction. Rather than highlight individual items reported as being barriers to sustainable construction, in the current study, a thematic review of literature was adopted in which common themes among the listed barriers to sustainable construction across different studies were identified.

Common themes that emerge from studies on barriers to the implementation of sustainable construction include cost and economy related barriers (Durdyev et al. 2018; Tokbolat et al. 2019; Ohionah et al. 2019; Dalirazar and Sabzi 2020), policy issues (Serpell et al. 2013; Tokbolat et al. 2019; Ohionah et al. 2019), construction professionals related barriers (Durdyev et al. 2018; Tokbolat et al. 2019; Ohionah et al. 2019), and client related barriers (Dalirazar and Sabzi 2020; Park and Tucker 2017) among others. These themes were arrived at after an *a priori* assessment of the literature.

Cost and Economy Related Barriers

Cost and economy related barriers emanate from the general perception that sustainable construction is more expensive that traditional methods of construction (Durdyev et al. 2018; Serpell et al. 2013). For example, Durdyev et al. (2018) found that the most significant barriers to sustainable construction practices in Malaysia were included the high cost associated with sustainable options compared to other options. The high cost of sustainable construction options is mainly due to perceived lack of availability of sustainable materials (Ohionah et al. 2019), extra time required to ensure sustainability (Akadiri 2015) and long payback periods from sustainable practices (Tokbolat et al. 2019). Akadiri (2015) found that the perception of extra cost was one of the top two barriers hindering the adoption of sustainable materials in Nigeria. Ohionah et al. (2019) also found that the perception that green buildings are more expensive was a barrier to the implementation of sustainable construction management in South Africa. Tokbolat et al. (2019) equally found that two of the top five extensive barriers to the adoption of sustainable construction in Kazakhstan were cost related. These studies from developing countries appear to unanimously find that cost is the major barrier to the implementation of sustainable. However, in contrast, Serpell et al. (2013) found that even though construction companies were concerned about the cost, it was not the main barrier hindering contractors from adopting sustainable construction in Chile. In their studies, Akadira (2013) and Durdyev et al. (2018) sampled construction consultants and contractors with the consultants making up the majority of the sample in both studies while Tokbolat et al. (2019) sampled construction consultants only and all these studies found that cost was perhaps the most significant barrier to the implementation of sustainable construction. In contrast, Serpell et al. (2013) sampled only construction contractors and found that cost was not the main barrier. Because the construction bill is ultimately paid by the client, contractors will only worry about their costs and not the total cost of the building which will be paid for by the client. On the other hand, construction consultants are engaged by the client to see to the interests of the client and are therefore responsible for ensuring that the project is done within an acceptable budget especially in developing countries. It is therefore understandable that a study with a sample of contractors found that cost was not the main barrier to the implementation of sustainable construction and studies with samples biased towards construction consultants found that cost was the main hindrance to sustainable construction in developing countries.

Policy Issues

Government incentives, statutory requirements and policies have also been noted as barriers to the implantation of sustainable construction (Tokbolat et al. 2019; Ohionah et al. 2019; Durdyev et al. 2019). Government incentives and policies are often advanced as being necessary in the promotion of sustainable construction in view of the perceived increased cost of sustainable construction (Tokbolat et al. 2019). However, these are often found to be lacking and therefore create a barrier to the implantation of sustainable construction (Tokbolat et al. 2019; Ohionah et al. 2019). Tokbolat et al. (2019) found that government factors were the second most important factors impeding the adoption of sustainable in Kazakhstan. They found that lack of promotion of sustainable construction and lack of government incentives to stimulate the adoption of sustainable construction were two of five significant factors. These findings are in tandem with findings by Ohionah et al. (2019) who found that lack of government support, and limited government involvement were hindering the adoption of sustainable construction management in South Africa. The study also found that the complexity of codes and regulations on green building and sustainable construction and the lack of efficient codes and standards were also barriers even though these ranked in last quarter of a list of twenty items. Using structural equation modelling, Durdyev et al. (2018) found that the role of government measured by lack of codes and regulation, lack of promotion, lack of enforcement and lack of government incentives significantly affected sustainable construction.

Construction Professionals Related Barriers

Some barriers to the adoption of sustainable construction may be attributed to the construction professionals because they are key in the delivery of construction projects. This is because of attributes such as lack of ability (Durdyev et al. 2018; Tokbolat et al. 2019), resistance to change (Tokbolat et al. 2019; Ohionah et al. 2019), and lack of training and education (Durdyev et al. 2018; Tokbolat et al. 2019) among other factors which may be attributed to the professionals. Tokbolat et al. (2019) found that lack of knowledge on sustainable technologies and lack of professional expertise in Kazakhstan hindered the adoption of sustainable construction practices. These findings are in line with findings by Ohionah et al. (2019) who found that lack of expertise or training, lack of awareness of sustainable construction project management, lack of experience, limited knowledge and the absence of communication among the project team ranked in the top half of a list of twenty barriers to the implementation of sustainable construction project management in South Africa. Durdeyev et al. (2018) also found that a sever lack of awareness and knowledge on sustainable practices and technologies among the industry stakeholders about sustainable construction was a barrier to the adoption of sustainable construction in Malaysia.

Client Related Barriers

A few barriers to the adoption of sustainable construction may be attributed to the client. These include lack of demand for sustainable buildings from the clients (Dalirazar and Sabzi 2020; Durdyev et al. 2018) due to lack of environmental concern, and lack of awareness about the benefits of sustainable construction among other reasons. This is in contrast to some studies which found that the client can be the driver for sustainable construction (cf. Durdyev et al. 2018). Durdyev et al. (2018) found that client and market related factors were impeding the adoption of sustainable construction in Malaysia. It was argued that the negative relationship between client and market related barriers found in their study could be attributed to the fact that clients in developing countries were reluctant to opt out of traditional buildings without statutory and financial support. This reluctance is also related to the lack of awareness, and cost related perceptions among the stakeholders (Durdyev et al. 2018). Therefore, understanding client’s goals in sustainable building projects is important in fostering sustainable construction (Dalirazar and Sabzi 2020).

Drivers to Sustainable Construction

Besides barriers to the adoption of sustainable construction, some practices are drivers of it. Common themes for drivers to sustainable construction which emerged from the literature include cost reduction (Durdyev et al. 2018; Tokbolat et al. 2019; Darko et al. 2017), company image (Durdyev et al. 2018; Tokbolat et al. 2019; Darko et al. 2017), concern for the environment (Durdyev et al. 2018; Tokbolat et al. 2019; Darko et al. 2017) and government policies (Phatak and Sople 2018; Opoku, Agyekum and Ayarkwa 2019).

Cost Reduction

While cost has been advanced as a barrier to sustainability in construction, there are instances were sustainable construction has been associated with reduced construction costs compared. Cost aspects which drive sustainable construction include reduced building whole life-cycle costs (Darko et al. 2017; Serpell et al. 2013; Tokbolat et al. 2019), high return on investment, enhanced marketability of buildings and increased monetary value of the building (Durdyev et al. 2018; Tokbolat et al. 2019; Darko et al. 2017). Green buildings are argued to have a lower whole life-cycle cost because of reduced utility bills owing to the energy efficiency of green buildings (Darko et al. 2017). Tokbolat et al. (2019) equally found that sustainable construction contributed to energy, and material or resource efficiency leading to reduced whole life-cycle costs. Serpell et al. (2013) also found that infrastructure development companies also indicated cost saving as a motivation for using sustainable construction. However, considering that the high initial cost outlay of a green building is the main barrier to the implementation of sustainable construction, it seems contradictory that cost saving is also seen as a driver. It appears that there is consensus that the initial cost of green buildings is higher than that for traditional buildings and that there are cost savings on utility bills for green buildings which run throughout the building life-cycle. However, it is unclear whether the energy cost savings in a green building eventually payoff the difference in the initial cost of the buildings and if so, when.

Company Image Reduction

An improved company image emanating from being associated with environmentally sustainable infrastructure drives the adoption of sustainable construction. Besides enhancing company image and reputation (Durdyev et al. 2018; Serpell et al. 2013; Tokbolat et al. 2019; Darko et al. 2017), commitment to corporate social responsibility by participating in environmental sustainability initiatives also drives environmental sustainability due to the resultant improvement of the company image (Darko et al. 2017; Bukarica and Robić 2013). Bukarica and Robić (2013) found that one of the reasons that the business sector in Croatia implemented energy efficiency was to improve their company image. Darko et al. (2017) identified company related factors as driver for green building technologies in Ghana. Specifically, company image and reputation was one of the drivers in the cluster of company related factors. Durdyev et al. (2018) equally found that company image and reputation were drivers of sustainable construction in Cambodia. Serpell et al. (2013) found that corporate image was one of the factors which influenced large corporations to implement sustainable construction practices. Therefore, company image may be an important motivation for promoting environmental sustainability especially among large companies.

Concern for the Environment

Concern for the environment has been found to drive sustainable construction practices. Concern for the environment is fuelled by the need to reduce environmental impact (Durdyev et al. 2018; Darko et al. 2017; Organ et al. 2012), enhancing occupants health and wellbeing (Durdyev et al. 2018; Tokbolat et al. 2019; Darko et al. 2017; Dubem and Stephen 2014) and improving indoor environmental quality (Durdyev et al. 2018; Tokbolat et al. 2019; Darko et al. 2017) among other factors. Nearly all studies on drivers for sustainable construction identify concern for the environment as one of the most significant and important factors. For example, Organ et al. (2012) found that concern for the environment was one of the major drivers for pursuing energy efficiency in the refurbishment of houses. Concern for the environment is therefore an important driver for sustainable construction.

Government Policies

While government policies and regulations were found to create barriers to the implementation of sustainable construction when they do not deliberately promote it, they can also drive its implementation when they are tailored to do so (Bond and Perrett 2012; Phatak and Sople 2018; Opoku, Agyekum, and Ayarkwa 2019). Policies and regulations may also promote sustainable construction when they promote a culture of best practice sharing and set a standard for future design and construction (Darko et al. 2017). For example, Opoku, Agyekum, and Ayarkwa (2019) found that government policies and regulations were important for the environmental sustainability of construction projects in Ghana. Bond and Perrett (2012) also found that government policies were important drivers of sustainable construction in New Zealand. Therefore, government policies can either drive or impede the adoption of sustainable construction depending on whether they are tailored to promote the practice or not.

While the above review of the literature has been done thematically, there are no widely recognised or agreed categories, themes or clusters of the barriers or drivers of sustainable construction. Most research has focused firstly on listing, then secondly ranking and thirdly grouping the items based on emerging themes from the listed items. The grouping is mostly done by identifying items with a common theme based on theoretical deduction as the case with the above review of the literature. The grouping process is therefore done *a priori*. This means that the grouping is based on the theoretical deduction or assumptions of the similarities among the items rather than any statistical or empirical consideration of an *a posteriori* approach. Factor analysis of the items would produce clusters which are empirically driven because it is an *a posteriori* process.

Only one study was found (cf. Ametepey et al. 2015) which factor analysed barriers to sustainable development. The items factored into six categories namely financial barriers, political, management/leadership, technical, socio-cultural, and knowledge/awareness. Only two studies were found (cf. Darko et al. 2017; Oluwami and Chan 2020) which factor analysed drivers of sustainable development. Darko et al. (2017) grouped the drivers into five categories, namely, environment-related, company-related, economy and health-related, cost and energy-related, and industry-related factors. Oluwami and Chan (2020) grouped them into five factors, namely, knowledge and industry-related drivers, financial, legal and statutory drivers, organizational and project-related drivers, technical drivers and information, risks and attitude-related drivers. While some groupings share commonalities such as company related drivers (Darko et al. 2017) and organisation and project related drivers (Oluwami and Chan 2020), others appear fairly different. The absence of sufficient studies which are data driven (*a posterior)* makes it difficult to conclude on the appropriate grouping of the items. Repeated studies on factors which drive and hinder sustainable construction using *a posteriori* as opposed to *a priori* processes are likely to eventually arrive at more commonly agreed and accepted clusters of factors which would eventually result in studies with more advanced multivariate analyses which are currently absent from extant literature.

Some of the barriers and drivers to the sustainable development of infrastructure found in the literature are summarised in Tables 1 and 2. As may be seen, the factors are quite vast and varied and cut across several issues in the industry.

Table 1: Consolidated list of Drivers for Sustainable Construction

Table 2: Consolidated list of barriers of Sustainable Construction

Methodology

Study design and Measures

The study started with a review of literature to identify drivers and barriers to the adoption of sustainability in the construction industry. Tables 1 and 2 show the literature sources for the identified factors. The identified factors were then formed into a self-completing questionnaire of drivers and barriers to sustainability in the construction industry. The questionnaire items are shown in Tables 4 and 5. The questionnaire items were subjected to review and pilot testing to ensure rationality and appropriateness of the questions. Minor adjustments were made to some of the items after a pre-test and a preliminary factor analysis, and reliability and validity tests. Respondents were asked to rate the extent to which they agreed with each of the drivers and barriers using a five-point Likert scale (1 = disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The five-point Likert scale was adopted because of its ability to provide results that are unambiguous and easy to interpret (Ekanayake and Ofori 2004).

Procedures and participants

The questionnaire survey was administered to professionals in the Zambian construction industry which included Quantity Surveyors, Architects and Engineers (Civil, Electrical and Mechanical). The respondents were identified based on membership to their respective professional and statutory registration bodies. This approach has been widely used in research on sustainability in the construction sector (Darko et al. 2017; Wong, Chan, and Wadu 2016). The self-administering questionnaire was created in Google Forms© and circulated via email and WhatsApp© social media. The use of online resources was preferred because of low cost, ease of use and convenience associated with them as compared to the traditional paper based self-administering questionnaires. The WhatsApp© platform was preferred over other social media because of its popularity in Zambia. This choice of non-probabilistic convenient sampling method was taken because it provided a feasible remote online data collection platform that was safe and convenient in the wake of the COVID-19 health pandemic. Online data collection methods have been found to be non-intrusive, safe, engaging and convenient during this period (Dodds and Hess 2020; Torrentira 2020). A resulting sample of 112 respondents was obtained. The demographic characteristics of the respondents in the sample are given in Table 3. The majority worked in consulting organisations (48%) while 19% worked in either the local authority or government department and the rest were classified as other. The majority of the respondents (92%) had worked in the industry for over three years. Most respondents had at least an undergraduate degree (93%) while 30% had a postgraduate qualification. The highest number of respondents were from the private sector (70%) while the public sector accounted for 30% of the sample. About 50% of respondents worked in organisations that had more than 50 employees.

Table 3: Sample characteristics

Data analysis

Data analysis was conducted in two stages. First, Exploratory Factor Analysis (EFA) was conducted to establish the underlying clusters of the drivers and barriers to sustainable construction that were in the questionnaire. Factor analysis is used to establish the underlying structure or patterns among the variables and hence identify a fewer number of factors that best represent the structure of relationships. The EFA procedure involved establishing the factorability of the scales, determining the number of factors and testing for reliability of each identified factor as a measure of internal consistency (AlSanad 2015; Hair et al. 2010; Nunnally, Bernstein, and Berge 1967). Second, descriptive and frequency statistics were used to observe the conditions of the data. The Relative importance Index (RII) was then calculated based on the formula;

$$RII = \frac{\sum W}{AN} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where W is the weighting as assigned by each respondent on a scale of one to five with one implying the least and five the highest. A is the highest weight (i.e. 5 in our case) and N is the total number of the sample (Holt 2014). The relative importance indexes were calculated for each variable and the overall rankings were established for each variable as well as within each cluster derived from EFA. The RII scores were calculated based on formula (1) and sorted in descending order from the highest to the lowest. The five important levels were deduced from the RII scores and interpreted as low (L) ($0 \leq RI \leq 0.2$), medium-low (M-L) ($0.2 \leq RII \leq 0.4$), medium (M) ($0.4 \leq RII \leq 0.6$), high-medium (H–M) ($0.6 \leq RII \leq 0.8$) and high (H) ($0.8 \leq RII \leq 1$) (Ahmed, Abu Alnaaj, & Saboor, 2020).

Findings

Factor Analysis Results

Factor analysis was employed to identify a few number of factors that best represented the structure of relationships that existed among the set of variables for both drivers and barriers (Olawumi and Chan 2020). In this regard, principal components factor analysis with varimax rotation was used to conduct the EFA. According to Hair et al. (2010), the criteria to establish factorability include checking if the items in the same scales are correlated to a factor of at least 0.3 with another item; the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy being above 0.7; the Bartlett' Test of Sphericity (BTS) must be significant at $p < .05$ and all communalities should be above 0.3.

The results indicated general factorability for both the drivers and barriers of sustainability with KMO values for drivers (0.917) and barriers (0.779) well above the minimum recommended threshold. The BTS values for both were significant ($p < 0.001$) and all communalities were greater than 0.3. A minimum Eigenvalue of one (1) was employed to establish the number of underlying factors for both barriers and drivers. Three factor solutions were extracted for both drivers and barriers with explained variances of 72.7% and 63.7% respectively which are higher than the minimum value of 60% (Chan, Olawumi, and Ho 2019). The factor loadings for both drivers and barriers were above 0.5. All the Cronbach's alpha values (α) were greater than 0.7 which indicates reliability of the established underlying themes (Chan et al. 2019; Hair et al. 2010; Nunnally et al. 1967). Table 4 shows the results of the factor analysis.

After a review of the established component structure in line with extant literature, the three components for drivers were considered to represent 1) environment and health related factors, 2) regulatory and industry related factors and, 3) economy and firm related factors. For barriers, the factors were termed as 1) awareness and knowledge related factors, 2) regulatory and industry related factors and 3) economy and cost related factors. The factors identified were to a greater extent similar to those identified in extant literature (cf. Ametepey, Aigbavboa, and Ansah 2015)

Relative importance index (RII)

Drivers

Environmental and health related drivers had the highest overall ranking with all but one attaining a high importance level (RII above 0.8). Within this cluster, the highest ranked variable was need for greater energy efficiency (RII = 0.8321), followed by indoor environmental quality (RII =0.8304), improved water efficiency (RII = 0.8250), reducing environmental impact (RII = 0.8232), waste reduction (RII = 0.8179) and enhancing the wellbeing of occupants (RII = 0.8054). The importance level for the variable 'reducing whole life cycle costs' was rated high medium (0.7857). Among the regulatory factors, setting standards for future design and construction (RII=0.8107) and building regulations (RII = 0.8018) had a high importance ranking. The remaining variables of government policies and regulations (RII = 0.7911), culture of sharing best practices (RII = 0.7911), financial incentives (RII = 0.7875), availability of green construction products (RII = 0.7732) and demand for environmentally friendly products by clients (RII = 0.7143), were all ranked high-medium. Regarding the economic factors and firm related factors, all the variables were ranked high-medium with return on investment (RII = 0.8798) being the most important item followed by marketability of buildings (RII = 0.7661), enhanced monetary value (RII = 0.7536) and then improved company image and reputation (RII = 0.7339). Table 4 shows the results of the factor analysis and relative importance index for the drivers of sustainability in the Zambian construction industry.

Barriers

Economic and cost factors, and regulation related factors were ranked highly as the key barriers to sustainability in the Zambian construction industry. Specifically, the lack of government incentives (RII = 0.8411) was ranked as the key inhibitor for the adoption of sustainable practices in the construction sector. The next important perceived barriers were economic needs having a higher priority (RII = 0.8018), lack of statutory requirements that cover sustainable buildings (RII = 8018), and inadequate building regulations to promote sustainable practices (RII = 0.8018). All the awareness and knowledge related factors were ranked high-medium with resistance to changing current building practices (RII = 0.7875) being the highest ranked followed by lack of concern for the environment (RII = 0.7643), lack of awareness of sustainable building practices and materials (RII = 0.7536), lack of knowledge about the benefits of sustainable practices (RII = 0.7357), lack of knowledge about sustainable construction technologies (RII = 0.7286) and lack of training and education in sustainable building practices (RII = 0.6804). Lack of professional capabilities of sustainable construction (RII = 0.5786) was ranked the lowest among all barrier with an importance level rating of medium. Table 5 shows the results of the factor analysis and relative importance index for the barriers of sustainability in the Zambian construction industry.

Table 1: Relative importance index ranking of drivers of sustainability

Table 5: Relative importance index ranking of barriers of sustainability

Discussion and Conclusion

This study explored drivers and barriers to sustainable practices in the Zambian Construction Industry. The study started by identifying items from literature which were reported to influence sustainable construction. The identified items were then factor analysed to establish the underlying factor structure of the items. The items in each category were there ranked to identify the most important ones in each category. The factor analysis produced three underlying constructs for the drivers to the adoption of sustainability in the Zambian construction industry and these are 1) environment and health related factors, 2) regulatory and industry related factors and, 3) economy and firm related factors. For barriers, the constructs were 1) awareness and knowledge related factors, 2) regulatory and industry related factors and 3) economy and cost related factors. The factors identified were to a greater extent similar to those identified in extant literature (cf. Ametepey et al. 2015).

The factored clusters of barriers to sustainable construction share commonalities with those by Darko et al. (2017) who also factor analysed the items. In contrast to the three factors found here, Darko et al. (2017) found five factors namely, environment-related, company related, economy and health related, cost and energy related and industry related factors. Notwithstanding, nearly all elements of the three factors found in this study can be seen in Darko et al. (2017) perhaps with the exception of the component of regulatory factors. Oluwami and Chan (2020) also factor analysed the drivers of sustainable construction and found five clusters namely, knowledge and industry related, financial, legal and statutory, organization and project related, technical and information related and risks and attitude related factors. Again, the clusters share a lot of commonality with those found in the current study. However, Oluwami and Chan (2020) included no cluster relating to the environment. For barriers, the three factors found in the current study are all accounted for in the six barriers found by Ametepey et al. (2015) namely, financial, political, management/leadership, technical, social cultural and knowledge/awareness. However, the current study found no technical or social cultural factors.

While commonalities can be seen across all studies which factored the items, the naming and combinations of parts of a cluster are distinctly different. For example, Darko et al. (2017) reported environment related drivers alone while the current study reported this as environment and health. While Darko et al. (2017) alluded to health, this was strangely clustered together with the economy in the economy and health related cluster. The present study clustered environment and health related drivers together. Such differences in naming and combining factors can be seen across all studies which factor analysed the items. These differences in naming become even more apparent and pronounced when the clusters are compared with studies which grouped the items *a priori*. Further studies with *a posteriori* clustering are needed to refine the clusters of items advanced as being either drivers or barriers to sustainable construction. This would promote more meaningful comparison, analysis and discussion of results on the subject.

On the ranking level, among the drivers, environment and health related factors had the highest overall ranking. Within this cluster, the highest ranked variable was need for greater energy efficiency, followed by indoor environmental quality, improved water efficiency, reducing environmental impact, waste reduction and enhancing the wellbeing of occupants while reducing whole life cycle costs was rated high medium. The results are consistent with most findings on drivers of sustainable construction (cf. Darko et al. 2017; Serpell, Kort and Vera 2013; Bocken and Geradts 2020; Oluwami and Chan 2020). The finding that environment and health related factors ranked the highest may be explained by the fact that the environment is at the heart of sustainability issues and so should be expected to take pre-eminence. And even within the cluster, it is also expected that energy efficiency would rank the highest because sustainability is now strongly linked to the emission of GHGs most of which can be attributed to energy consumption. It is also not surprising that reducing waste ranked higher than reducing whole life cycle costs because the main aim of environmental sustainability is not necessarily cost reduction even though some costs may be reduced. However, while reducing whole life cycle costs clusters in the environment and health related factors, one would intuitively expect it to cluster with the economy and firm related factors.

Regulatory factors were the second ranked cluster of drivers of sustainable construction of which setting standards for future design and construction and building regulations had a high importance ranking. The remaining items of government policies and regulations, culture of sharing best practices, financial incentives, availability of green construction products and demand for environmentally friendly products by clients were all ranked high-medium. Again, these findings are generally in tandem with other studies (cf. Darko et al. 2017; Serpell, Kort and Vera 2013; Bocken and Geradts 2020; Oluwami and Chan 2020). However, one would expect financial incentives to be more aligned with economy and firm related factors which it is not.

All the items ranked high-medium in the economic factors and firm related cluster. Return on investment was the most important item followed by marketability of buildings, enhanced monetary value, and lastly, improved company image and reputation. Again these findings are consistent with other studies (cf. Darko et al. 2017; Serpell, Kort and Vera 2013; Bocken and Geradts 2020; Oluwami and Chan 2020). It is not surprising that return on investment is the highest ranked economic and firm factor and that company image and reputation is ranked last.

Economic and cost factors ranked first as barriers to the implementation of sustainability in the built environment. Specifically, the lack of government incentives ranked as the key inhibitor for the adoption of sustainable practices in the construction sector. The next important perceived barriers was that economic needs have a higher priority than sustainability objectives. High cost associated with sustainable construction and the lack of financial incentives were the last barriers under the cluster of economy and cost. Again these findings are generally consistent with other studies (cf. Serpell et al. 2013; Bocken and Geradts 2020; Ametepey et al. 2015; Jaramillo et al. 2018; Ogunsanya et al. 2019). Political-will appears to be an important factor for increased adoption of green construction considering that lack of government incentives was ranked as the highest barrier. It is also intuitive that respondents feel that economic needs are of a higher priority than the sustainability agenda because the primary reason for the existence of business is to make economic profits.

Regulation related factors were ranked as the second cluster of barriers to sustainability in Zambia. Lack of statutory requirements that cover sustainable buildings, and inadequate building regulations to promote sustainable practices were ranked as first and second barriers respectively while lack of professional capabilities ranked as medium in third position. Again, this is generally consistent with other studies (cf. Serpell et al. 2013; Bocken and Geradts 2020; Ametepey et al. 2015; Jaramillo et al. 2018). The findings attest to the lack of regulation and building codes pertaining to sustainable construction in most developing countries. This resonates with the argument that political-will is an important factor for the increased adoption of sustainability in the built environment in SSA. The ranking of lack of professional capabilities as the least barrier in this cluster and also against all other clusters suggests that professionals in the Zambian construction industry are perceived as being reasonably capable of delivering sustainable construction projects.

Awareness and knowledge related factors were ranked as the last cluster of barriers to the implementation of sustainability in the built environment. Resistance to changing current building practices was the highest ranked item followed by lack of concern for the environment, lack of awareness of sustainable building practices and materials, lack of knowledge about the benefits of sustainable practices and technologies, and lack of training and education in sustainable building practices. Lack of professional capabilities of sustainable construction was ranked the lowest among all barrier with an importance level rating of medium. Again this is generally consistent with other studies (cf. Serpell et al. 2013; Bocken and Geradts 2020; Ametepey et al. 2015; Jaramillo et al. 2018). It is not surprising that resistance to change finds itself top of this list because the construction industry is notorious for its resistance to any kind of change. It appears that the consensus is that industry practitioners in Zambia are fairly well educated with the knowledge of sustainable construction because this ranked as the least of the barriers under the cluster of awareness and knowledge. This is consistent with findings by Okie et al. (2019) that construction professionals in Zambia have an average awareness of sustainable construction.

While the findings are generally in tandem with several other related studies, the fact that there is a great many items reported in literature and most studies focused on listing them makes it difficult to make more detailed comparisons and discussions of the individual items. The absence of commonly accepted and agreed clusters also means that comparison of clusters is still not possible on the subject. Therefore, more studies are required which factor the items based on an *a posteriori* process so that eventually, standard clusters can be agreed and accepted. This would lead to more detailed analyses and discussions on the subject and more streamlined recommendations on improving sustainable construction especially in SSA.

In general, the study contributes to studies on the sustainability of the built environment by proposing a factor structure for the drivers and barriers to sustainable construction. The proposed constructs which influence sustainability in the built environment may be used in studies with multivariate analyses to establish, among others, the influence of the constructs on the intention of stakeholders to adopt sustainable construction practices. For example, client intention to invest in a sustainable building may be assessed in relation to established factors which drive or impede sustainable development. Other multivariate analyses would be possible in relation to sustainable development if a common and unified classification of the barriers and drivers to sustainable development was available in the field.

For the Zambian construction industry, the study shows that the most important barriers to the implementation of sustainable construction are lack of government incentives, economic needs are of a higher priority than environmental needs and the high perceived cost associated with sustainable construction. These barriers are generally in line with findings in Zambia by Aghimien et al. (2018). The main drivers of sustainable construction are the need for energy efficiency, setting standards for future design and construction and return on investment. These drivers are quite different from those identified in Zambia by Oke et al. (2019) which are legislation and legal requirements, building regulation, advocacy and awareness, developing regulatory mechanisms and client demand. Further research is required to reconcile these major differences in drivers to sustainable construction in Zambia. Notwithstanding, measures aimed at increasing sustainable construction practices in Zambia should start by putting in place some incentives for clients to construct sustainably. Further, legislation should by created which would compel clients to build sustainably so that economic needs and the cost of building sustainably become secondary to environmental sustainability.

However, the results are subject to some limitations. The most significant ones are that the data were collected conveniently and so may not be representative of the population of interest. Also, the items selected as barriers and drivers of sustainable construction were not exhaustive and so other barriers and drivers may have been omitted from the study. Further research could focus on factor analysing an exhaustive list of items in order to establish more valid and reliable clusters of barriers and drivers to sustainable construction and subsequently establish which of the clusters have the most impact on improving the uptake of sustainable construction in developing countries which are behind on the issue.

Declaration of interest statement

None

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Tables

Table 1: Consolidated list of Drivers for Sustainable Construction

Drivers	**Key Reference**
The need for greater energy efficiency	Durdyev et al. (2018); Tokbolat et al. (2019); Darko et al. (2017a)
Reducing the whole lifecycle costs	Durdyev et al. (2018); Serpell et al. (2013); Tokbolat et al. (2019); Darko et al. (2017a)
Enhancing company image and reputation	Durdyev et al. (2018); Tokbolat et al. (2019); Darko et al. (2017a); Dubem and Stephen (2014)
Buildings that enhance occupants' health and well-being	Durdyev et al. (2018); Tokbolat et al. (2019); Darko et al. (2017a)
Reducing environmental impact	Durdyev et al. (2018); Darko et al. (2017a); Organ et al. (2012)
Improving indoor environmental quality	Durdyev et al. (2018); Tokbolat et al. (2019); Darko et al. (2017a)
Improving water efficiency	Durdyev et al. (2018); Tokbolat et al. (2019); Darko et al. (2017a)
Commitment to social responsibility	Darko et al. (2017a); Bukarica and Robić (2013)
Waste reduction	Durdyev et al. (2018); Tokbolat et al. (2019); Darko et al. (2017a); Dubem and Stephen (2014)
High return on investment	Durdyev et al. (2018); Tokbolat et al. (2019); Darko et al. (2017a)
Enhancing marketability of buildings	Darko et al. (2017a); Bukarica and Robić (2013)
Increasing the monetary value of building	Durdyev et al. (2018); Darko et al. (2017a)
Setting a standard for future design and construction	Darko et al. (2017a)
Facilitating a culture of best practice sharing	Darko et al. (2017a)
Government policies and regulations	Bond and Perrett (2012); Phatak and Sople (2018); Opoku, Agyekum, and Ayarkwa, (2019)
Building regulations	Serpell et al. (2013);

Increased education and training	Bond and Perrett (2012);
Greater availability of green products	Bond and Perrett (2012);
Financial incentives	Serpell et al. (2013); Ohionah et al. (2019); Musanya and Chileshe (2018); Dalirazar and Sabzi (2020)
Client are demanding environmentally friendly buildings	Serpell et al. (2013); Ohionah et al. (2019);

Table 2: Consolidated list of Barriers of Sustainable Construction

Barriers	**Key Reference**
The higher cost associated with sustainable buildings	Akadiri (2015); Musanya and Chileshe (2018); Bond and Perrett (2012); Durdyev et al. (2018); Tokbolat et al. (2019); Ohionah et al. (2019); Alsanad (2015); Darko et al. (2017b); Zhang (2011); Dalirazar and Sabzi (2020); Aghimien et al. (2018)
Lack of government incentives	Bond and Perrett (2012); Durdyev et al. (2018); Serpell et al. (2013); Tokbolat et al. (2019); Ohionah et al (2019); Alsanad (2015); Darko et al. (2017b)
Economic needs are of higher priority	Durdyev et al. (2018); Serpell et al. (2013)
Lack of statutory requirements that cover sustainable procurement	Durdyev et al. (2018); Tokbolat et al. (2019); Alsanad (2015); Aghimien et al. (2018)
Lack of professional capabilities/designers	Durdyev et al. (2018); Tokbolat et al. (2019); Alsanad (2015); Darko et al. (2017b); Ohionah et al. (2019);
Lack of client demand	Durdyev et al. (2018); Darko et al. (2017b); Häkkinen and Belloni (2011); Dalirazar and Sabzi (2020); Park and Tucker (2017)
Lack of training and education	Durdyev et al. (2018); Tokbolat et al. (2019)
Long pay-back periods from sustainable practices	Durdyev et al. (2018); Tokbolat et al. (2019); Dalirazar and Sabzi (2020)
Resistance to change to current building practices	Akadiri (2015); Tokbolat et al. (2019); Ohionah et al. (2019); Alsanad (2015); Darko et al. (2017b); Ofori et al. (2015)
Lack of environmental concern	Durdyev et al. (2018); Serpell et al. (2013)
Lack of financial incentives	Bond and Perrett (2012); Serpell et al. (2013); Tokbolat et al. (2019); Ohionah et al. (2019); (2017b); Luthra, et al. (2015); Aghimien et al. (2018)

Lack of awareness of sustainable building practices and materials	Häkkinen and Belloni (2011); Alsanad (2015)
Knowledge of benefits of sustainable is limited	Tokbolat et al. (2019); Ohionah et al. (2019); Shari and Soebarto (2014)
Knowledge on sustainable technologies is limited	Serpell et al. (2013); Tokbolat et al. (2019); Zhang (2011)
Lack of demonstration projects	Tokbolat et al. (2019); Darko et al (2017b)
Inadequate building regulations to promote sustainable practices	Tokbolat et al. (2019); Darko et al. (2017b); Park and Tucker (2017)
The extra time incurred when using sustainable practices	Akadiri (2015); Darko et al. (2017b)
Sustainable materials are low in quality	Akadiri (2015)
Limited availability of suppliers of sustainable products and materials	Akadiri (2015); Darko et al. (2017b); Ohionah et al. (2019)

Table 3: Sample characteristics

	Frequency	Percent
Education attainment		
Up to Undergraduate qualification	78	70
Secondary Education	2	2
College diploma	6	5
University degree	70	63
Postgraduate qualification	34	30
Master's degree	33	29
PhD	1	1
Total	112	100
Sector		
Private	77	68.8
Public	35	31.3
Total	112	100.0
Organisation type		
Consulting organisations	54	48.2
Contractor	25	22.3
Client organisation	11	9.8
Other	22	19.6
Total	112	100.0
Number of years in the current job		
Less than 1 year	7	6.3
1-2 Years	18	16.1
3-5 Years	30	26.8
6-10 Years	38	33.9
More than 10 Years	19	17.0
Total	112	100.0
Number of years in the Architecture Engineering and Construction (AEC) industry		
Less than 1 year	1	0.9
1-2 Years	8	7.1
3-5 Years	18	16.1
6-10 Years	47	42.0
More than 10 Years	38	33.9
Total	112	100.0
Organisation size (employees)		
Less than 5	20	17.9
From 5 to 50	37	33.0
From 51 to 100	23	20.5
Above 100	32	28.6
Total	112	100.0

Table 2: Relative importance index ranking of drivers of sustainable construction

Drivers of Sustainable construction	Factor scores: Factor 1	Factor 2	Factor 3	Cronbach's alpha	RII	Rank by category	Overall Rank	Importance Level*
Environment and health related factors (Factor 1)				*0.938*				
The need for greater energy efficiency	0.860				0.8321	1	1	H
Improving indoor environmental quality	0.840				0.8304	2	2	H
Improving water efficiency	0.817				0.8250	3	3	H
Reducing environmental impact	0.796				0.8232	4	4	H
Waste reduction	0.735				0.8179	5	5	H
Buildings that enhance occupants' health and well-being	0.676				0.8054	6	7	H
Reducing the whole lifecycle costs	0.672				0.7857	7	13	H-M
Regulatory and Industry related factors (Factor 2)				*0.929*				
Setting a standard for future design and construction		0.797			0.8107	1	6	H
Building regulations		0.739			0.8018	2	8	H
Government policies and regulations		0.737			0.7911	3	10	H-M
Increased education and training		0.699			0.7911	3	10	H-M
Facilitating a culture of best practice sharing		0.692			0.7875	5	12	H-M
Financial incentives		0.668			0.7732	6	14	H-M
Greater availability of green products		0.538			0.7679	7	16	H-M
Client are demanding environmentally friendly buildings		0.501			0.7143	8	20	H-M
Economy and firm related factors (Factor 3)				*0.876*				
High return on investment			0.842		0.7982	1	9	H-M
Enhancing marketability of buildings			0.818		0.7661	2	17	H-M
Increasing the monetary value of building			0.766		0.7536	3	18	H-M
Enhancing company image and reputation			0.736		0.7339	4	19	H-M

*L = low, M-L = medium-low, M = medium, H–M = high-medium, H = high

Table 5: Relative importance index ranking of barriers of sustainable construction

Barrier to sustainable construction	Factor scores			Cronbach's alpha	RII	Rank by category	Overall Rank	Importance Level*
	Factor 1	Factor 2	Factor 3					
Awareness and Knowledge related factors				*0.863*				
Resistance to change to current building practices	0.572				0.7875	1	6	HM
Lack of environmental concern	0.597				0.7643	2	8	HM
Lack of awareness of sustainable building practices and materials	0.787				0.7536	3	9	HM
Knowledge of benefits of sustainable construction is limited	0.826				0.7357	4	10	HM
Knowledge on sustainable technologies is limited	0.813				0.7286	5	11	HM
Lack of training and education					0.6804	6	12	HM
Regulation related factors				*0.688*				
Lack of statutory requirements that cover sustainable buildings		0.734			0.8018	1	2	H
Inadequate building regulations to promote sustainable practices		0.788			0.8018	1	2	H
Lack of professional capabilities/designers		0.578			0.5786	3	13	M
Economic and cost factors				*0.772*				
Lack of government incentives			0.756		0.8411	1	1	H
Economic needs are of higher priority			0.737		0.8018	2	2	H
The higher cost associated with sustainable buildings			0.727		0.7911	3	5	HM
Lack of financial incentives			0.562		0.7875	4	6	HM

*L = low, M-L = medium-low, M = medium, H–M = high-medium, H = high