Global Scientific JOURNALS

GSJ: Volume 8, Issue 12, December 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

THEORETICAL AND CONCEPTUAL FRAMEWORK FOR INTEGRATED APPROACH TO UTILISATION OF ALTERNATIVE BUILDING MATERIALS IN THE NIGERIAN CONSTRUCTION INDUSTRY

Johnson Josiah MARUT, Natalia A. ANIGBOGU, Maren Mallo DANIEL

Johnson Josiah MARUT[1]
Department of Building, Faculty of Environmental Sciences, University of Jos, Nigeria.
Email: josiahmarut@gmail.com (Corresponding Author)
Natalia A. ANIGBOGU[2]
Department of Building, Faculty of Environmental Sciences, University of Jos, Nigeria.
Email: natashaanigbogu@yahoo.com
Maren Mallo DANIEL[3]
Department of Estate Management, Faculty of Environmental Sciences University of Jos Nigeria
Email: mallod@unijos.edu.ng

KEY WORDS

Alternative Building Materials, Theoretical and Conceptual framework, Integrated Approach, Utilisation.

ABSTRACT

The importance of the development of theoretical and conceptual framework for integrated approach to utilisation of Alternative Building Materials in the Nigerian construction industry in a doctorate (PhD) research cannot be overephasied as it reinforces the calls for the utilisation of Alternative Building Materials. The research is aimed at development of theoretical and conceptual framework for integrated approach to utilisation of Alternative Building Materials in the Nigerian construction industry, this has been achieved through three independent but interrelated theories including stakeholders' theory, knowledge management theory and innovation diffusion theory have been adopted for the development of conceptual framework for the utilisation of Alternative Building Materials (ABM) in the Nigerian construction industry. This is based on the need to identify the different stakeholders with respect to ABM, determine their roles and emphasise the need for integration among them. Knowledge management effort is key towards integration among the stakeholders which emphasises interaction procedure or value chain linking up individual knowledge to create social value. The diffusion of any innovation emphases scientific, technological, organiational, financial, commercial, social, business in terms of knowledge, persuasion, decision, implementation and confirmation of the innovation. The methodology of systematic literature and content analysis has been used to gather and analysed relevant data for the development of theoretical and conceptual framework for integrated approach to utilisation of Alternative Building Materials in the Nigerian construction industry through identification of strategies and benefits for utilisation of Alternative Building Materials which include low embodied energy (often leading to reduced greenhouse gas emissions), ease of construction, widespread availability and low cost.

1. INTRODUCTION

Building material is any material which is used for building construction purposes [1]. Building materials can be classified as either natural or man-made. Natural building materials are those materials which occur naturally such as sand, clay, etc, while man-made materials undergo synthesis and have been refined by man for construction purposes; examples include tiles and paints etc [2]. Building materials production is divided into modern or conventional building materials; traditional and Alternative Building Materials (ABM) [3, 4, 5]. There is the rise of ABM which is due to the cost of available conventional building materials and sustainability concerns [5]. Researchers in the field of building materials have various definitions of ABM from different contextual, narrow and wide range points of views [6]. The definitions of ABM remain elusive and its use inconsistent [7, 8, 3]. Due to its ambiguity, it becomes apparently difficult for researchers to adopt a single theory or approach in explaining the concept of Alternative Building Materials. Theory use and citation practices are all issues which distinguish academic disciplines from other ways of knowing [9]. Therefore the research is aimed at the development of theoretical and conceptual framework for integrated approach to utilisation of Alternative Building Materials in the Nigerian construction industry. This would be achieved through the following two-fold objectives: firstly; to systematically review the stakeholders' theory, knowledge management theory and innovation diffusion theory towards the development of theoretical and conceptual framework for integrated approach to utilisation of Alternative Building Materials in the Nigerian construction industry and secondly; to develop theoretical and conceptual framework for integrated approach to utilisation of Alternative Building Materials in the Nigerian construction industry through identification of strategies for the materials utilsation and benefits.

2. METHODOLOGY

The research has adopted literature review method of data collection with sources from journals, conference proceedings, reports, policy collected online and libraries based to be analysed using content analysis. It is an excellent way of synthesising research findings to show evidence on a meta level and to uncover areas in which more research is needed, which is a critical component of creating theoretical frameworks and building conceptual framework [10]. Systematic review is also for synthesising both quantitative and qualitative studies [11, 12]. A systematic review can be explained as a research method and process for identifying and critically appraising relevant research, as well as for collecting and analysing data from said research [13]. Systematic review helps to identify all empirical evidence that fits the pre-specified inclusion criteria to answer a particular research question or hypothesis [10]. Content analysis involves counting and comparisons, usually of key words or content, followed by the interpretation of the underlying context [14]. Content analysis is a research tool used to determine the presence of certain words or concepts within texts or sets of texts. Texts can be defined broadly as books, book chapters, essays, interviews, discussions, newspaper headlines and articles etc or really any occurrence of communicative language [15].

3. THE STUDY

The study is basically the areas that this study would discuss in order to achieve the aim and objectives of the research work. This includes three independent but interrelated theories including: stakeholders' theory; knowledge management theory; and innovation diffusion theory, strategies for utilisation of Alternative Building Materials (experiences in some selected countries) and benefits of utilising Alternative Building Materials for the development of conceptual framework towards the utilisation of Alternative Building Materials in the Nigerian construction industry. The interest of all the stakeholders in the effort towards the utilisation of ABM must consider and appropriate mechanism put in place for the integration of all these interests. Therefore, there is the need to conceptualise the idea of effort towards the utilisation of ABM based on the established theories of stakeholders, knowledge management and innovation diffusion.

3.1 Stakeholders' Theory

Stakeholder theory is one of the most influential theories in business ethics; the theory provides a framework for developing and implementing broad strategic solutions [16]. The stakeholders' theory states that for any business to be successful it has to create value for customers, suppliers, employees, communities and financiers, shareholders, banks and other people [17]. Stakeholders are crucial for the success of any innovation [18].

The Stakeholders' theory for this study is based on stakeholder integration theory, contingent stakeholder theory and stakeholder salience theory. Generally, stakeholder integration theory can be understood as a merging of diverse actors, which

have different objectives and needs by default, into a mutually coherent team [19]. Stakeholder integration theory is a combine concepts and central propositions from two or more prior existing concept into a new single set of integrated concepts and propositions [20]. Integration of stakeholders is important for developing a shared vision and for accommodating different visions so as to bridge disciplines; develops new and integrative knowledge [21]. Interactions between stakeholders are one of the driving and characterising elements of innovation processes which has the capacity to facilitate communication, mutual understanding, participative decision making and promoting awareness and understanding of the issue that needed to be integrated [22, 23]. Integration should not be confined to that between contractors and clients only, but should involve the whole supply chain [24, 25]. Creating a cohesive, integrated culture demands a strong commitment and perseverance from every stakeholder [26].

Stakeholder salience theory developed by Mitchell represents a tool for both the prioritisation and identification of stakeholder groups [27]. Stakeholders' identification is a critical component of the initial scoping phase and should occur before an engagement plan is formulated and consultations begin [28, 26]. The stakeholders that can be identified and integrated include: (1) Primary team members (2) Key supporting participants (3) Tertiary stakeholders (4) Extended stakeholders; which can be broken into; customers, competitors, suppliers, government, banks, owners, transporters, media, management, educational institutions, consultancy firms, local communities, suppliers and distributors, media, the public in general, business partners, future generations, founders of organisations, academics, etc [29, 30, 31, 32, 33, 26, 34]. Stakeholders can be internal or external and they can be at senior or junior levels [18].

Innovation will be successful when all the expectations of the stakeholders are taken care of [35]. The stakeholder salience theory tries to understand the stakeholder community based on the application of three main criteria of power, legitimacy, urgency [36]. Power refers to how probable an entity is to carry out their will despite resistance. Legitimacy refers to whether something is at risk to the potential stakeholder. Urgency refers to whether the relationship with the potential stakeholder is time-sensitive and critical to the stakeholder[37]**.** Stakeholder salience thus can be defined as a degree to which managers give priority to competing stakeholder claim [38]. There are three main stakeholder groups identified in the stakeholder salience theory; latent stakeholders, expectant stakeholders and definitive stakeholders. Latent stakeholders are stakeholders who possess only one attribute. Stakeholders with two attributes are expectant stakeholder and stakeholders with all attributes are definitive stakeholders [31]. Latent stakeholders that possess only power are called dormant stakeholders. Latent stakeholders that possess legitimacy are called *discretionary stakeholders.* Latent stakeholders that possess legitimacy, but none of the other two attributes, are called demanding. Expectant stakeholders are the stakeholders that possess any two of the three attributes and therefore expect something from innovation **[**37]. The contingency theory of stakeholder is a theory that is based on social issues and the strategies and structures which would benefit a stakeholder of an innovation. [39] classify social issues according to three kinds of expectational gaps: gaps concerning what is, what ought to be, and what is.

Stakeholders that are without knowledge on the importance of integration among all the stakeholders towards utilisation of ABM can stand as impediment towards the achievement of this effort. Therefore, there is the need to understand knowledge management theory for the effective utilisation of ABM in the Nigerian construction industry.

3.2 Knowledge Management Theory

Knowledge management is a systematic process for acquiring, organising, sustaining, applying, sharing, and renewing both tacit and explicit knowledge to enhance the innovation performance, increase innovational adaptability, increase values of existing products and services, and/or create new knowledge-intensive products, processes and services [40, 41, 42]. Knowledge management is the process of making relevant information available quickly and easily for people to use productively [43].

Knowledge is intangible, dynamic and difficult to measure, but without it no innovation can survive. Therefore, there are two kind of knowledge according to [40] Tacit or unarticulated knowledge and Explicit (written down and codified). Explicit knowledge exists in the form of words, sentences, documents and organised data [44]. Knowledge comprises of know what, know-how and know why levels of knowledge, the highest level of knowledge is known-why knowledge [45]. Knowledge management is not one single discipline; rather, it is an integration of numerous endeavours and fields of study [46]. All schools of thought agree that knowledge is something different from information and data [47]. Knowledge can be seen as belief in mind, process, or object [48].

Knowledge management theory consists of an interaction procedure or value chain linking up individual knowledge to create social value [48]. The procedure includes creation, storage, distribution, and application. Knowledge creation is mainly related to finding more sources of knowledge, as well as the extension of the knowledge network. Knowledge storage is about offering a wider and deeper historical knowledge base, and facilitating ease of knowledge retrieval. Knowledge distribution is about offering more communication channels, and enhancing the collective mind. Knowledge application is about offering knowledge integration methods to solve various problems [49] [48] [42]. Knowledge management must therefore create/provide the right tools, people, knowledge, structures (teams) and culture, so as to enhance learning [49].

In the new economy, knowledge has become the primary factor of production and not machinery or financial capital as in the old industrial economy [50]. Knowledge should flow with developing channels or networks between knowledge provider and seeker and should be practical [48]. Knowledge networks of universities and industry can link the explicit, codified scientific knowledge with working knowledge, practical know-how [51]. Knowledge transferred from research development to manufacturing, marketing and services by internal linkages moves inside and outside processes through external linkages is important towards making innovation implemented [52]. The desirability of interaction between universities and firms varies considerably; the boundaries between these institutions are becoming increasingly diffuse [44].
The benefits of knowledge management include improving customer orientation, increasing motivational level, cost reduction, improved decision speed, process improvement, higher level of innovation, improved quality of decisions, improved level of co-operation [53]. If stakeholders on the use of ABM are identified and their roles clearly spelt out, knowledge on ABM is created, retent and stored, mechanism for it to be transferred as an innovation should be in place that is why stakeholders' theory and knowledge management theory alone cannot be the only footing upon which integrated approach to utilsing ABM can stand, knowledge must be diffused among the stakeholders for it to be effective.

3.3 Innovation Diffusion Theory

Innovation is an idea, behaviour, or object that is perceived as new by its audience [54]. Innovation can be defined as the successful introduction of new technologies or procedures into industry [55]. Innovation is also the implementation of a new or significantly improved product (good or service), or process, a new marketing method [56]. Innovation is also seen as the creation of a new product-market-technology-organisation [57]. Innovation is the successful production, assimilation and exploitation of novelty in the economic and social spheres [58]. The scope of innovation in the construction industry is broad and applies to everything from building products, materials and systems to construction techniques, equipment and business operations [55]. The true value of innovation is that it is a means to an end. Diffusion patterns vary across industries, and building construction materials as an industry is significantly different from other industries; decision about using new building products, materials and practices is quite different which normally takes long time [59].
Innovation Diffusion Theory (IDT) seeks to explain how innovations are taken up in a population [54]. IDT focuses on understanding how, why and at what rate innovative ideas and technologies spread in a social system [60]. In diffusion of innovations, it is not people who change, but the innovations modality [54]. The most striking feature of diffusion theory is that, for most members of a social system, the innovation-decision depends heavily on the innovation-decisions of the other members of the system [61].
IDT can be divided into four main elements, these are: communication system, time, social system and decision process [62]. The communication system is a channel through which users share the information with each other. [63] classified the communication systems into mass media and interpersonal channels. While mass media can disperse information more rapidly, [63] believes that it is the interpersonal channel that is more important for the diffusion of new innovations or technology. The time aspect of the innovation diffusion process actually records adopter categorisation and rate of adoptions [62]. An innovation is of no important unless it is accepted as one by a social system [63] [64]. Innovation process thus depends on three main sources [44]: organisational capabilities; scientific and technological developments; and the marketplace. The success of an innovation depends on how well it evolves to meet the needs of more and more demanding and risk-averse individuals in a population [54]. [61] identified innovation diffusion decision that follows a 5-step process: knowledge; persuasion; decision; implementation and confirmation.

4. DEVELOPMENT OF CONCEPTUAL FRAMEWORK FOR ALTERNATIVE BUILDING MATERIALS

A concept is a relationship between a word (symbol) and an idea or conception [65]. Concepts enable us to impose some sort of meaning on the world and through concepts reality is given sense, order and coherence [66]. A framework is a research tool intended to assist a researcher to develop awareness and understanding of the situation under scrutiny and to communicate this [67]. A conceptual framework is defined as a network, or "plane," of linked concepts that together provide a comprehensive understanding of a phenomenon [68]. The conceptual framework tends to explain the overall structure for carrying out this research work which is an innovation that focuses on integrated approach to the utilisation of Alternative Building Materials. Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations [69]. Concept of integrated innovation can be focus from three dependent points of view: scientific/technological innovation; social innovation and business innovation [70]. Knowledge

networks of universities and industry can link the explicit, codified scientific knowledge with practical know-how [51]. Appropriate stakeholder identification, classification and management are crucial for innovation diffusion [26].

The architects and engineers are the first stakeholders for materials selection and specifications in building construction. Builders and quantity surveyors sometime assume the role of specifiers by virtue of their role as, professional advisers [71] [34]. Any attempt to neglect stakeholders can result to failure of any innovation endeavour [18].

The conceptual framework of the integrated approach to utilising Alternative Building Materials is hinged on theories that are independent but interrelated. These theories include: stakeholders' theory, knowledge management theory and innovation diffusion theory as discussed above. Having in mind the strategies needed for the utilisation of Alternative Building Materials which all constitute the independent variables without which the benefits for the utilisation of Alternative Building Material (dependent variable) would be a challenge (figure 1).

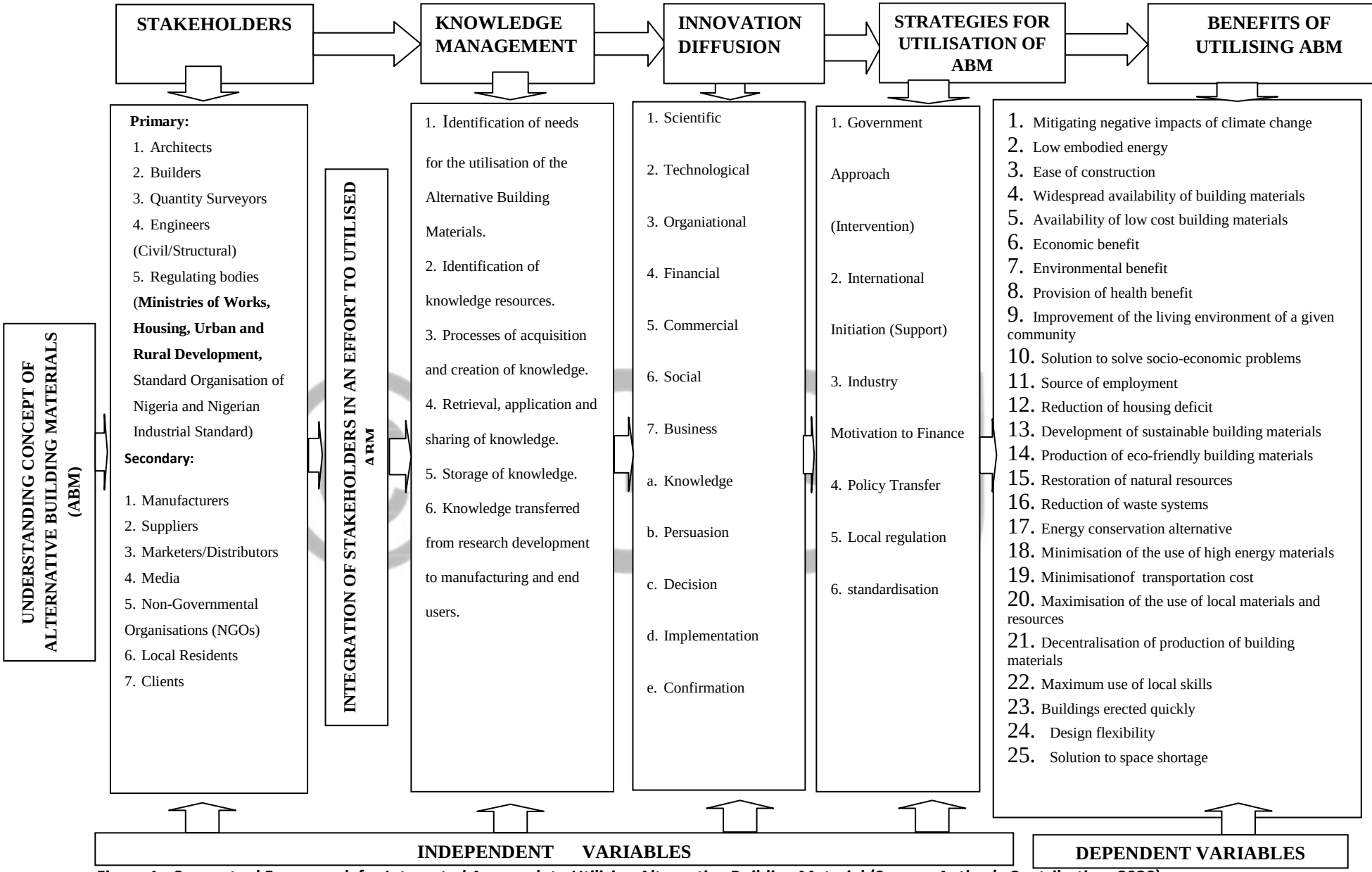

Figure 1: Conceptual Framework for Integrated Approach to Utilising Alternative Building Material (Source: Author's Contribution, 2020)

5. STRATEGIES FOR UTILISATION OF ALTERNATIVE BUILDING MATERIALS (EXPERIENCES IN SOME SELECTED COUNTRIES)

The approaches for utilising Alternative Building Materials across the globe happened at different times. As a result, the levels of knowledge management as well as rate of diffusion of these materials leading to subsequent utilisation also differ from one country to another. The strategies for the utilisation of the materials could be through government approach (intervention), international initiation (support), industry motivation to finance, policy transfer, local regulations and standardisation.

5.1 Government (Approach) Intervention

Governments in different countries offer various mechanisms to encourage private firms to leverage their Research and Development (R&D) investments, ranging from direct grants to R&D tax concessions and incentives in an attempt to encourage the utilisation of innovative building materials [72]. Governments can play a significant role in innovation diffusion, by creating a market environment that is conducive for companies to take up innovative construction materials through a range of measures including, economic incentives and fiscal methods, create demand for new alternatives and increase awareness of different actors in the construction process [73]. [51]) emphasised that different countries have different means of funding innovative building materials in construction for example: in Australia there is collaborative grants for public/private sector collaborations; R&D tax incentives; and encouragement for Small and Medium Enterprise (SME) investment, in Canada there is indirect support mechanisms encouraging SME investment via higher tax exemptions though the private sector contributes only a small portion of formal R & D while in China there is generous tax reductions for R & D firms. In Sweden there is the

Development Fund of the Swedish Construction Industry (SBUF) provides the largest source of private sector grants with financing for many university-based research innovations complementing targeted government innovation funding [72]. Governments can help reduce cost on research and development (R&D) thereby spur innovation in building materials, by ensuring intellectual property is protected, subsidising research in scholastic institutions and some companies, and providing tax incentives [74]. In the United States of America, federal government support innovation in materials towards provision of mass housing. The congress and federal agencies have, in fact, been doing this for more than three decades through investment in research and programmatic activities [75]. In India, the central government has taken an initiative to set up the Building Materials & Technology Promotion Council (BMTPC) to promote cost-effective, eco-friendly and energy efficient building materials which are the Alternative Building Materials [76]. These materials are allowed to be used for building construction works through Bureau of Indian Standards (BIS) and Nation Building Code of India [77].
The approach for utilising Alternative Building Materials in South Africa is through the South African Bureau of Standards in the Ministry of Human Settlements [78]. A process is usually initiated where it invites presentations for innovative products quarterly. In Nigeria, Standards Organisation of Nigeria (SON) is the sole body empowered by law to standardise products, materials and processes in Nigeria [79]. The production of good quality building/construction materials cannot be possible without the availability of minimum basic quality requirements as specified in national and international standards which form a basis of assessment and guide to manufacturers in their production and quality control processes [80]. Nigerian Building and Road Research Institute (NBRRI) was established towards evolving technologies and process to increase local content and capacity utilisation of Alternative Building Materials and evolving cost-effective methods of providing shelter [81]. [82] revealed that for years NBRRI have contributed positively in research of Alternative Building Materials towards providing affordable housing for Nigerians. NBRRI have been able to develop compressed stabilised earth block which is an alternative walling material for sustainable building over the conventional sandcrete and burnt brick [81].

5.2 International Approach (Intervention)

International charity organisations, but locally operating technical and social aid, mostly Non-Government Organisation (NGO), do most of the work with the residents to help provide affordable building materials [74]. [83], a worldwide network for coordinating and facilitating the technical assessment of innovation in the construction field has the responsibility to provide a means of demonstrating the fitness for purpose of building materials. The [84] is a collaborative global movement towards adequate use of local materials and components in lower-income countries while striving for climatic appropriateness, energy-efficiency and environmental friendliness of the production processes of building materials, and for energy efficiency in their use. The use of imported materials should be systematically avoided [84].

5.3 Industry Motivation to Finance

Motivation is a critical dimension of capacity, defined as “the ability of people, institutions and societies to perform functions, solve problems and set to achieve objectives”. Incentives and incentive systems are fundamental to developing capacities and to translating developed capacities into better performance [85]. Motivation could be intrinsic or extrinsic which are usually exhibited by both private and government companies. The private construction companies are able to play a certain role in the development of ABM leading to construction of affordable accommodation in developing countries as well as developed countries [86]. The bulk of investment in R&D however must come from companies themselves and must be as much as possible economically feasible. Since critical materials are an international issue, international cooperation is necessary on both a governmental scale and company scale [74]. Some companies manufacturing products that use critical elements have invested in Alternative Building Materials in order to prepare for a shortage of materials and gain advantage in the competitive market [74].
Most governments offer monetary incentives to attract Alternative Building Materials [87]. Financial incentives are direct incentives in the form of tax credits or grants to developers who propose to use Alternative Building Materials. Financial incentives including tax credits/abatement, fee reduction/waiver, grants and revolving loan funds are a highly successful means of encouraging developers to follow Alternative Building Materials [88].

5.4 Policy Transfer

Policy transfer is important as it encourages growth of innovation and technology sharing [89]. Policies can be transferred from one country to another for example, Nigeria could learn from the provisions of Malaysian Green Building Index (GBI) policy by adopting some GBI policies, programmes and incentives especially in the area of green technology that is effective to sensitise green building in Nigeria [90]. Malaysia and Nigeria are in the same tropical zone. Both countries are in the same latitude characterised by hot and humid climate. Thus, regions such as Malaysia and Nigeria could adopt policies and programmes suitable for green building materials that would help in reducing high temperature. However, developing country policies on technology transfer are necessarily complex and cross linked with a range of issues in the broader development agenda ([91].

Exposing all decision makers to a carbon price provides a common basis to facilitate climate friendly material choices. If climate friendly options deliver cost savings, then they will be used at larger scale [92]. Similarly, Policymakers need to recognise that there is a virtuous circle whereby successful technology transfer and the resulting innovation leads to improved technological absorptive capacities, and hence more effective further transfer of technology. Building national systems of innovation that enable both domestic innovative capabilities and absorptive capacity to effectively acquire technology from abroad is a long-term, complex effort that calls for policy persistence, coordination and integration [91].

5.5 Local Regulation

Regulations are viewed by many designers and builders as an additional burden with which they have to conform. For manufacturers they set performance limits for components and materials. For clients, local authorities, and government regulators, they provide the instruments with which product standards are maintained. There is, however, very little systematic debate about the relationship between regulation and innovation in building materials [93]. Some regulators assert that the regulations should not be a driver for changing practices and that if changes are induced, these should be connected to the primary purpose of the regulation. Detailed sector-specific knowledge is required to develop an appropriate regulatory framework for building materials, particularly if accommodation and stimulation of technological innovation is one of the desired outcomes. Manufacturers can choose to reach technical acceptance for new products either by concentrating on a product's performance, or by designing it into a larger set of technical systems making up the building. A combination of these approaches can also be used. Clarity and simplicity is needed in the regulatory process to enable the up-take of good practice and encourage innovation [93].

5.6 Standarisation

Standard is an exact value, a physical entity, or an abstract concept, established and defined by authority, custom, or common consent to serve as a reference, model, or rule in measuring quantities or qualities, establishing practices or procedures, or evaluating results, a fixed quantity or quality [94]. Standards are instruments that support technological change, process improvement and technology transfer among sectors and across borders [95]. Standards must become a tool for teaching at universities so that dissemination of information and training becomes easy for innovation to be accepted and diffuse into larger society. Sometimes standardisers consider standards to be an end in themselves, whereas policy makers see standards as a means to an end [95]. Performance standards which specify minimum requirements for end products but do not prescribe the means or components of production may be an appropriate form for encouraging systemictechnological change. However, building processes involve flows of products and services from upstream extractive and manufacturing sectors through design and construction activities to final end-users [93]. Standards are a repository of knowledge and this knowledge must be used at university, but not only at university. We have to use that knowledge for dissemination, for training, for education, and for creating a culture of standards [95]. It is possible, however, to envisage a new regulatory process in which the order caused by standards can create a stable and supportive environment for focused change [93]. There is the need for a qualification procedure for "new" building materials (innovative materials) instead of being rigid on the so called standarised materials [95].

Due to the absence of comprehensive standards for building materials in Nigeria, the British Standards (BS) and the American Society for the Testing of Materials (ASTM) standards are commonly used. The standards that exist are

for modern building materials such as cement, concrete products [71]. Therefore, there is the need for a Nigerian Standard that will accommodate ABM and indeed other innovative building materials.

6. BENEFITS OF UTILISING ALTERNATIVE BUILDING MATERIALS

The use of Alternative Building Materials (ABM) can promote locally (natural) available resources and to enhance the inefficient consumption of the natural resources and the protection of excessive use of such resources on which most of the low income communities rely in most developing as well as developed countries. The use of ABM is considered as a way of curbing the environmental impacts attributed to the building sector ([5]. Alternative Building Materials are quite economical, durable, sanitary and safe in construction [96]. The essence of ABM is to address and solve socio-economic problems such as unemployment, shortage of residential spaces while ensuring economic feasibility [97] [98] [99].The major benefits of ABM over conventional materials typically include; a low embodied energy (often leading to reduced greenhouse gas emissions), ease of construction, widespread availability and low cost [100]. Development of Alternative Building Materials can help reduce house production costs, which is a very important aspect for the successful access to decent housing by low-income earners as well as those that are well to do in the society; it protects the eco-system, and it contributes to the improvement of the living environment of a given community through the prudent use of local resources [101]. Using ABM walls can be erected quickly, usually within hours. Interlocking blocks as an ABM to conventional blocks offer several benefits such as design flexibility, cost effectiveness, reduced construction time, environmental friendliness and solution to space shortage, desirable qualities and thermal properties [102] [103]. [104] highlighted some of the benefits of ABM to include: construction costs typically much lower than the conventional building materials, walls absorb sound and serve as a "thermal mass," which keeps the indoor temperature stable by heating up during the day and then slowly releasing the heat throughout the evening. Locally produced building materials shortens transport distances, thus reducing air pollution produced by vehicles. Often, local materials are suited to climatic conditions, and their purchases support area economies [105]. Alternative Building Materials can help in: energy conservation alternative; minimise the use of high energy materials; conservation of the environment, environment-friendly technologies; minimise transportation and maximise the use of local materials and resources; decentralised production and maximum use of local skills [106].

7. CONCLUSION AND RECOMMENDATIONS

The conceptualisation of Alternative Building Materials towards its utilisation in the Nigerian construction industry is very opt considering the high demand for accommodation in the country and the need for sustainability in the terms of building materials supply. The research has adopted three independent but interrelated theories including; stakeholders' theory, knowledge management theory and innovation diffusion theory for the development of conceptual framework towards the integrated utilisation of Alternative Building Materials in the Nigerian construction industry.the strategies for the utilization of the Alternative Building Materials have been highlighted. The interest of all the stakeholders in the effort towards the utilisation of ABM must consider and appropriate mechanism put in place for the integration of all these interests. National and regional institutes can play a very importance role in the development of Alternative Building Materials, by facilitating knowledge transfer to groups of stakeholders. Government institutions as well as educational and research institutes can do this by sharing their experiences in other regions and with other institutions.

REFERENCES

[1] V.Singh, "What is the importance of building material?" 2018, Retrieved from https://www.quora.com/What is-the-importance-of-building-material

[2] O.G. Ogbuagu, "Structural design of a duplex using theorem of three moments method of structural analysis". *Unpublished B.Sc thesis, Department of Building, Abia State University, Uturu, Nigeria*, 2008.

[3] A.P. Opoko, "Prospects and challenges of local building materials development and use in Nigeria'. The Professional Builder. *Journal of the Nigerian Institute of Building*, 13-17, 2006.

[4] United Nations Centre for Human Settlement, Building materials and construction technologies, 2012. Retrieved from http://www.chs.ubc.ca/archives/files/HS-688.pdf

[5] E. C., Mpakati-Gama, S. C., Wamuziri, & B. Sloan "The Use of alternative building materials in developing countries: Addressing Challenges Faced by Stakeholders" 2012. Retrieved from https://Www.Researchgate.Net/Publication/264693164

[6] A.Vidya, & A. Radha, "Alternative low-cost building materials" 2019. Retrieved https://www.scribd.com/document/408806248/Alternative-Low-Cost-Building-Material

[7] B. Milani, "Building materials in green economy community-based strategies for dematerialization". *Paper delivered to the biennial conference of the Canadian Society for Ecological Economics* (CANSEE), McGill University, and Montreal 2005. Retrieved from http://greeneconomics.net/index.ht ml

[8] P. Ross, "Best practice guidelines for the use of alternative materials and processes in road construction with respect to environmental issues final report" 2006. Retrieved from www.nzta.govt.nz/...use.../guide.pdf

[9] L. Schweber, "Putting theory to work: The Use of Theory in Construction Research". *Construction Management and Economics*, 33(10) 840–860. DOI: 10.1080/01446193

[10] H. Snyder, "Literature review as a research methodology: An overview and guidelines". *Journal of Business Research* 104, 333–339, 2019. Retrieved from https://doi.org/10.1016/j.jbusres.2019.07.039

[11] J. Davis, K., Mengersen, S., Bennett, and L. Mazerolle, "Viewing systematic reviews and meta-analysis in social research through different lenses". Springer Plus, 3, 511, 2014. Retrieved from https://doi.org/10.1186/2193-1801-3-511.

[12] C. Okoli, and K. Schabram, "A Guide to conducting a systematic literature review of information systems research" 2017. Retrieved from http://chitu.okoli.org

[13] A. Liberati, D.G.Altman, J. Tetzlaff, C. Mulrow, P.C. Gøtzsche, J.P. Ioannidis, D. Moher, "The PRISMA statement for reporting systematic reviews and meta-analyses of studies that

evaluate healthcare interventions: Explanation and elaboration". *Annals of Internal Medicine*, 151, 65, 2009. Retrieved from https://doi.org/10.7326/0003-4819-151-4-200908180-00136.

[14] H. Hsieh and S. E. Shannon, "Three Approaches to Qualitative Content Analysis". *Research Gate* 2014. Retrieved from https://www.researchgate.net7

[15] Colorado State University, "An introduction to content analysis" 2020. Retrieved from http://writing.colostate.edu

[16] N. Egels-Zandén, and J. Sandberg, "Distinctions in descriptive and instrumental stakeholder theory: A Challenge for Empirical Research". *Business Ethics: A European Review* 19(1) 35-49 2014. Retrieved from https://fek.handels.gu.se/digitalAssets/1456/1456

[17] R. E. Freeman, "Stakeholder analysis, Project Management, templates and advice" 2010. Retrieved from https://www.stakeholdermap.com/index.html

[18] T. Morphy, "Stakeholder Analysis, Project Management, templates and advice" 2017. Retrieved from https://www.stakeholdermap.com/index.html

[19] S.A., Austin, A.N. Baldwin, and J.L. Steele, "Improving building design through integrated planning and control" . *Engrg., Constr., and Arch. Mgmt*., 9 (3) 249–258, 2002.

[20] D. Elliott, "Integrated theory"*Oxford Bibliographies*, 2018. Online. doi: 10.1093/obo/9780195396607-0135

[21] D.,Mcdonald, G. Bammer and P. Deane, "Research Integration Using Dialogue Methods" 2009. Retrieved from http://epress.anu.edu.au/dialogue_methods_ citation.html

[22] G. Nardelli, A., Scupola and P. A. Jensen, « Innovation in services and stakeholder interactions: Cases from Facilities Management". *Roskilde University*, 2014. Retrieved from orbit.dtu.dk

[23] S. J. Cork and W. Proctor, "Implementing a process for integration research: Ecosystem Services Project, Australia". *Journal of Research Practice, 1*(2), Article M6, 2005. Retrieved from http://jrp.icaap.org/index.php/jrp/article/view/15/25

[24] S. Bertelsen and L. Koskela "Construction beyond Lean: A new understanding of construction management", *Proceeding of IGLC-12 Elsinore, Denmark*, 2004.

[25] R. Vrijhoef and L. Koskela, "The four roles of supply chain management in construction", *European Journal of Purchasing and supply chain* 6 169-178, 2002.

[26] A. Aapaoja and H. Haapasalo, "A Framework for stakeholder identification and classification in construction projects. *Open Journal of Business and Management*, 2, 43-55, 2014. Retrieved from http://www.scirp.obm

{27] A.Majoch, A. G. Hoepner and T. Hebb, "Sources of stakeholder salience in the responsible investment movement: Why Do Investors Sign the Principles for Responsible Investment?", *Electronic Journal*, 2017. doi:10.2139/ssrn.2487351

[28] J.T.Karlsen, K. Græe and M.J. Massaoud, "Building trust in project-stakeholder relationships" . *Balt J. Manag*, *3*, 7–22, 2008.

[29] J. McManus, "Managing Stakeholders in Software Development Projects (Computer Weekly Professional)", Amazon Book Club, 2004. Retrieved from https://www.amazon.com/Managing-Stakeholders-Development-Professional-2004-12-13/dp/B01FEPWIDW

[30] American Institute of Architects, "Integrated project delivery a guide". *The American Institute of Architects, Washington, DC,* 2008. Retrieved from: http://www.aia.org/contract

[31] M. Slabá, "Stakeholder salience theory in management of small and medium enterprises". *The 12th International Days of Statistics and Economics*, Prague, 2018.

[32] F. Charles, H. Antoine and S. Stefan, "The Stakeholder theory", 2006. Retrieved from https://pdfs.semanticscholar.org/606a/828294dafd62aeda92a77bd7e5d0a39af56f.pdf

[33] B . Cova and R. Salle, "Marketing solutions in accordance with the S-D logic: Co-creating value with customer network actors" . *Industrial Marketing Management*, 37 (3) 270-277, 2008. doi.org/10.1016/j.indmarman.2007.07.005

[34] A. Olanrewajua and P. J. Anahve, "Duties and responsibilities of quantity surveyors in the procurement of building services engineering". Creative Construction Conference 2015 (CCC2015) *Procedia Engineering352 – 360,* 2015*. Retrieved from: www.elsevier/locate/proc*

[35] J.T. Karlsen, K. Græe and M.J. Massaoud, "Building trust in project-stakeholder relationships". *Balt J. Manag*, *3*, 7–22, 2008.

[36] R. K. Mitchell, B. R. Agle, and D. J. Wood, "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts". *The Corporation and Its Stakeholders,* 1998. doi:10.3138/9781442673496-014

[37] O. Pop, "Solving the 'Who Are My Stakeholders? Dilemma: A Quick Innovation Managers' Guide". *The Innovation Manager,* 2018*.* Retrieved from https://www.hypeinnovatio

[38] R. K., Mitchell, B. R., Agle, J. J. Chrisman, and L. J. Spence, "Toward a Theory of Stakeholder Salience in Family Firms". *Business Ethics Quarterly, 21*(02), 235-255, 2011. doi:10.5840/beq201121215

[39] B. W. Husted, "A Contingency theory of corporate social performance". *Business & Society* 39 (1), 24-48, 2000. doi: 10.1177/000765030003900104

[40] M. Gerami, "Knowledge management" . *International Journal of Computer Science and Information Security*, 7 (2), 234–238, 2010. Retrieved from http://sites.google.com/site/ijcsis

[41] E. Hajric, "Building knowledge management frameworks and models" 2018. Retrieved from https://www.knowledge-management-tools.net/know

[42] I. B., Fernandez, A. Conzalez and R. Sabherwal, "Knowledge management challenges, solutions, and technologies", Pearson Education, Inc., New jersey, United states of America, 2004.

[43] National Aeronautics and Space Administration, "Wide knowledge management team, Kickoff Meeting" 2000. Retrieved from https://trs.jpl.nasa.gov/bitstream/handle/2014/1e=1

[44] J.Kessels and K. Kwakman, " Interface: Establishing Knowledge Networks between Higher Vocational Education and Businesses". *Higher Education*, 54 (5). 689-703, 2007. Retrieved from http://www.jstor.org/stable/29735142

[45] G. Gunday, G.Ulusoy, K., Kilic, and L. Alpkan, "An Integrated innovation Model: How Innovations Are Born and What Are Their Impacts on Firm Performance?" *Proceedings of 15th European Operations Management Association (Euroma) Conference,* 92-101, 2012. Gröningen, the Netherlands. Retrieved from http://research.saban

[46] B. Newman, and K. W. Conrad, " A Framework for characterizing knowledge management methods, practices, and technologies", 1999. Retrieved from http://www.km-forum.org/KM-Characterization-Framework.pdf

[47] G. V. Krogh, "Care in knowledge creation". *California Management Review*, 40 (3), 133-153, 1998.

[48] M. Shin, T. Holden, & R. A. Schmidt, "From knowledge theory to management practice: Towards an Integrated Approach". *Information Processing and Management* 37, 335 – 355, 2001. Retrieved from www.elsevier.com/locate/infoproman

[49] A.M. Altaher, "Knowledge management process implementation". *International Journal of Digital Society*, 1 (4), 265-271, 2010.

[50] A. M. Tzortzaki and A. Mihiotis, "A Review of Knowledge Management Theory and Future Directions". *The Journal of Corporate Transformation,* 21 (1), 2014. Retrieved from https://doi.org/10.1002/kpm.1429

[51] Organisation for Economic Co-operation and Development (OECD) "Knowledge management in the learning society". *Education and Skills. Paris: Organisation for Economic Co-operation and Development,* 2000. Retrieved from http://www.oecd.org/educ

[52] S. E. Khilji, T. Mroczkowski, and B. Bernstein, "From invention to innovation: Toward Developing an Integrated Innovation Model for Biotech Firms". *The journal of product innovation management*,2 3, 528–540, 2006. Retrieved from https://www.utwente.nl/en/bm/

[53] K. North, R. Reinhardt, and A. Schmidt, "The Benefits of knowledge management: Some Empirical Evidence". 1-17, 2013. Retrieved from https://www.google.com/url?

[54] L. Robinson, "A summary of diffusion of innovations," ChangeoLogy, the Book, 2009. Retrieved from https://www.enablingchange.com.au/Summary_Diffusion_Theory.pdf

[55] H. Goodland, C. Lindberg, and P. Shorthouse, "Construction innovation project" . Building BC'S vision. Construction innovation in BC, 2015. Retrieved from www.brantwoodreci.com

[56] R. Tiwari, "Defining innovation" . *Research Project Global Innovation*, Hamburg University of Technology, 2008. Retrieved from http://www.global-innovation.net

[57] H. Boer, and W. E. During, "Innovation, what innovation? A comparison between product, process and organisational innovation". *International Journal of Technology Management*, 22 (1/2/3), 2001. doi: 10.1504/IJTM.2001.002956

[58] European Commission, "Definition of innovation. *European Commission's Green Paper on Innovation,* 2015. Retrieved from *www.scienceportal.org.by › upload › June › 2 Spinoglio*

[59] K. C. Theodore, M. Papadakis, E. Hudson, and M. Cavell, "The diffusion of innovation in the residential building industry". *U.S. Department of Housing and Urban Development Office of Policy Development and Research*, 2003. Retrieved from https://pdfs.semanticscholar.o

[60] T. A., Wani, and S. W. Ali, "Innovation diffusion theory review & scope in the study of adoption of Smartphone in India". *Journal of General Management Research*, 3, 101–118, 2015.

[61] G. Orr, "Diffusion of innovations, by Everett Rogers" 2003. Retrieved from https://cs.nyu.edu/courses/fall10/V22.0480-002/Rogers1985.pdf

[62] I. Sahin, "Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory". *The Turkish Online Journal of Educational Technology 5 (2),* 2006.

[63] E.M. Rogers, "Diffusion of innovations. Fourth edition". *New York. Free Press,* 2003. Retrieved from https://www.d.umn.edu/~lrochfor/ireland/dif-of-in-ch06.pdf

[64] E. Kaasinen, "User acceptance of mobile services-value, ease of use, trust and ease of adoption", 2005. Retrieved from http://www.vtt.fi/inf/pdf/

[65] L. Cohen, M. Lawrence and K. Morrison, "Research methods" in education (5th ed) (London, RoutledgeFalme, 2000.

[66] S. Leshem and V. Trafford, "Overlooking the conceptual framework". *Innovations in Education and Teaching International,* 44(1), 93–105, 2007.doi: 10.1080/14703290601081

[67] R. Smyth, "Exploring the usefulness of a conceptual framework as a research tool: A researcher's reflections". *Issues in Educational Research, 14,* 2006. *Retrieved from* http://www.iier.org.au/iier14/smytml

[68] Y. Jabareen, "Building a conceptual framework: philosophy, definitions, and procedure". *International Journal of Qualitative Method*, 8(4), 49-62, 2009. Retrieved from http://creativecommons.org/licensesy/2.0

[69] European Committee for Standardisation, "An integrated approach for standardization, innovation and research" 2011. Retrieved from www.cen.eu

[70] Grand Challenges Canada/Grand Défis Canada, "Integrated Innovation", 2010. Retrieved from http://www.grandchallenges.ca/who-we-are/scientific-advisory-board/

[71] K.J. Adogbo, and B. A. Kolo, "The perception on the indigenous building materials by professionals in the Nigerian building industry" 2011. Retrieved from: www.abu.edu.ng

[72] \K. D. Hampson, J. A. Kraatz, & A. X. Sanchez, "The Global construction industry and R&D". *Sustainable Built Environment National Research Centre,* 2014. Retrieved from https://www.researchgate.net/publication/316675783_The_global_construction_indust

[73] V. S. Emiliya and A. S. Rodney, "Construction innovation diffusion in the Russian Federation". *Construction Innovation*, 15 (3), 278 – 312, 2015. doi.org/10.1108/CI-07-2014-0038

[74] Massachusetts Institute of Technology, "The future of strategic natural resources: Alternative Technology", 2016. Retrieved from http://web.mit.edu/12.000/www/m2016/final

[75] U.S. Department of Housing and Urban Development, " Innovation in housing: Chapter One", 2017. Retrieved from https://www.rand.org/content/dam/rand/pubs/monograp

[76] Q. Wasim, "Innovative building materials in India: Need Sustainable Innovation", 2014. Retrieved from http://greencleanguide.com/innovative-building-materials-in-india-need-sustainable-innovation/

[77] Nation Building Code of India, "Bureau of Indian Standards", 2005. Retrieved from http://lgpunjab.gov.in/upload/uploadfiles/files/NBC%20Part%20Complete%20Book.pdf

[78] Ministry of Human Settlement of South Africa, "Policy guidelines on the use of innovative technologies within the kwazulu-natal department of human settlements". 1-17, 2014. Retrieved from https://www.kzndhs.gov.z

[79] Standards Organisation of Nigeria (SON) "e-Product registration step by step guide", 2018. Retrieved from http://son.gov.ng/wp-content/uploads/2018/02/e_Product_Registratio

[80] C. V. Amaechi, "Standards as tools for durable infrastructures in Nigeria" , *Nigeria Society of Engineers (NSE) Monthly General Meeting/Seminar Presentation, Aba Chapter*. Pp. 1-5, 2014. Retrieved From https://www.researchgate.net/publication/316940301

[81] T. Danjuma, "Eco-friendly benefits of the NBRRI interlocking compressed stabilised earth blocks over the conventional sandcrete & burnt brick". *International Journal of Advanced Engineering and Science*, 7(1), pp. 24-34, 2018. Retrieved from http://ijaes.elitehall.

[82] D. S. Matawal, "Linking academia to industry: a case study of the building and construction industry". *Director-General/Chief Executive Officer Nigerian Building and Road Research Institute, NBRRI,* 2011. Retrieved from: http://www.notap.gov.ng

[83] World Federation of Technical Assessment Organisations, "How does WFTAO help companies to sell?", 2019. Retrieved from http://www.wftao.com/

[84] UN-Habitat, "Global Housing Strategy: Framework Document". *Housing and Slum Upgrading Branch,* 2006. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s

[85] United Nations Development Programme, "Incentive systems: Incentives, Motivation, and development", *Performance, Conference Paper #8,* 2006. Retrieved From Www.Capacity.Undp.Org

[86] J. Bredenoord, "Sustainable building materials for low-cost housing and the challenges facing their technological developments: examples and lessons regarding bamboo, earth-block technologies, building blocks of recycled materials, and improved concrete panels". *Journal of Architectural Engineering Technology*, 6 (1), pp. 1-11, 2017. doi: 10.4172/2168-9717.1000187

[87] T. Häkkinen, and K.Belloni,".Barriers and drivers for sustainable building" .VTT Technical Research Centre of Finland, Espoo, Finland. *Building Research and Information,* 39 (3), pp. 239 – 255, 2011. Retrieved from: http://virtual.vtt.fi/virndf

[88] D. A., Nurul and A, N. Zainul, "Motivation and expectation of developers on green construction: A Conceptual View". World Academy of Science, Engineering and Technology. *International Journal of Humanities and Social Sciences*, 7 (4), 914– 918. Retrieved from waset.org/Publication/11588

[89] U. F. Iroegbu, R. Du, B. Hira, I. P. Iroegbu, and E.T. Chia, "Technology Transfer in Construction and Management: A Case for Nigeria Construction and Management Sectors". *Management Science and Engineering*, 11(2), 28-34, 2017. Retrieved from http://www.cscanada.net/index.php/mse/article/view/91

[90] I . J. Onuoha, N. Kamarudin, G. U. Aliagha, S. A. Okeahialam, M. I. Atilola and F. O. Atamamen, "Developing policies and programmes for green buildings: What Can Nigeria Learn From Malaysia's Experience?" *International Journal of Real Estate Studies*,11 (2), 49–58, 2017. Retrieved From http://www.utm.my/intrest/files/2017/09/06-developing-policies-and-programmes-for-green-buildings.pdf

[91] United Nations Conference on Trade and Development, "Transfer of technology and knowledge sharing for development science, technology and innovation issues for developing countries", 2014. Retrieved from www.unctad.org.

[92] Climate Strategies, "Innovation and use of policies required to realise investment and mission reduction in the materials sectors", 2017. Retrieved from www.climatestrategies.org

[93] D. M. Gann, Y. Wang, and , R. Hawkins, "Do regulations encourage innovation? - the case of energy efficiency in housing". *Building Research & Information*, 26(5), 280-296, 2010. doi: 10.1080/09613219836960

[94] United States Department of Defense, "The Definition of Standard by the free online Dictionary/Thesaurus and Encyclopaedia", 2005. from http://encyclopedia2.thefreedictionary.

[95] International Standard Organisation. "Standardisation and innovation", *International Conference on Standardisation and Innovation Proceedings,* 2014. Retrieved from https://www.google.com/url?sa=t&rctq

[96] J. Magutu, "Towards populisation of low cost building materials and technologies for urban housing in developing countries". *International Journal of Scientific Research and Innovative Technology* 2 (1), 20-43, 2015.

[97] S. Madhusudanan, and L. R. Amirtham, "Alternative building material using industrial and agricultural wastes". *Key Engineering Materials,* 650, 1-12, 2015. doi:10.4028/www.sci

[98] M. A. Gbadebo, "Promoting the use of alternative building technologies in Nigerian construction industry: The Problems and Recommendations". *International Journal of Advancements in Research & Technology*, 3 (11) 69-74, 2014. Retrieved from: www.ijoart.org

[99] C. Chanlers, "Alternative building materials", 2018. Retrieved from https://chandlersbs.co.uk/

[100] K. Vercillo, "History of alternative home building", 2011. Retrieved From https://kathrynvercillo.hubpages.com/\

[101] J.C. Moreal, A. Mesbah, M. Oggero, & P. Walker, "Building houses with local materials means to drastically reduce the environmental impact of construction". *Building and Environment*..36 (10) 1119-1126, 2001.

[102] Y. M. D. Adedeji, and G. Fa, "Sustainable housing provision: Preference for the Use of Interlocking Masonry in Housing Delivery in Nigeria". *Journal of Environmental Research and Management*, 3(1), pp. 009-016, 2012. Retrieved from: http://www.e3journals.og

[103] O. F. Job, and J.E. Afunanya, "Innovation in material production and utilization in the building industry". *Proceeding of the 46th Buildings' Conference/Annual General Meeting Ed*o 2016, 23-32, 2016.

[104] M. Bernard, "Straw, Cobs, and Rammed Earth: Alternative Building Materials". *The spruce,* 2017. Retrieved from https://www.thespruce.com/murrye-bernard-1820959

[105] K. Jong-Jin, and R. Brenda, "Sustainable architecture module: Qualities, Use, and Examples of sustainable building materials", 2008. Retrieved from: www.umich.edu/~nppb/

[106] B.V. Venkatarama Reddy, "Sustainable building technologies". *Current Science*, 87 (7), pp. 899- 907, 2004.