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CIRCULAR ECONOMIC CHALLENGES IN THE NIGERIAN CONSTRUCTION INDUSTRY

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Abstract
The construction industry all over the world is shifting to Circular Economy (CE) which is associated with the need to implement innovative construction models, but the adoption of circular construction strategies in the industry has been limited. This paper investigates the level of awareness and challenges faced by the construction industry in implementing a circular construction model and the solutions adopted to overcome them. A quantitative research approach was adopted through the use of primary and secondary data, using a purposive sampling technique and structured questionnaire were distributed to 15 construction companies in Abuja- Nigeria. The result from the study indicates that, the most prevalent challenges considered among the practicing practitioners for the adoption of CE, is the Lack of CE knowledge as a result of the creation of the required incentives for training of the operators and which of course made the awareness level moderate. In conclusion, it is evidence that the knowledge of the practicing practitioners in the industry needs to be adequately intensify through training and retraining to meet the global challenge of the industry. Finally, the paper suggested the need for practitioners to develop an interest and acquaint themselves on the benefit of CE during the construction process in other to reduce the risk of financial expenditure during the offer of design and build process.

Keywords: *Awareness, Challenges, Circular economy, Construction, Design, Implementation*

Introduction

The construction industry in Nigeria, contributes between 5.5 –7.5% of Gross Domestic Product (GDP) growth in 2019 (NBS, 2019). The impact of Covid-19 pandemic affects the activities of the construction industry demand and supply of construction material in Sub-Sahara African Nations' transformation there by reducing the growth in national income. Other effects of Covid-19 on construction activities in Sub-Sahara African Nations' includes; job lost, delay in project delivery as schedule, increase in cost of construction projects, waste of resources and project depletion as well as supply chain.

In Sub-Sahara African nations' especially Nigeria, the construction industry is a material intensive sector, consuming between 1·2 and 1·8 Metric Ton (Mt) of construction materials per annum in Europe (Ecorys, 2014). Research over time has largely focused on recycling Construction and Demolition Waste (CDW) with little attention on the reuse of products and there is a subsequent decrease in the materials reclaimed for reuse in the construction industry (Yuan and Shen, 2011). Saidu and Shakantu (2015) observe that Sub-Sahara African nations' dependency on the construction raw material has led to high volume of material wastages resulting in cost overrun of construction projects.

Depletion of resources and the degrading of the built environment, driven by globalization and consumerism phenomena in Sub-Sahara African Nations', worldwide pushing the interest on Circular Economy (CE) concept (Sassanelli *et al*., 2019). Sassanelli *et al*. (2019) further reitrate that to substitute the end-of-life notion with restoration and closed-loop product lifecycles, CE wants to eliminate wastes, retain the value embedded into products and materials, foster the use of renewable energies and eliminate toxic chemicals. Therefore, the new direction and uncommon changes in Sub-Sahara African Nations' Transformation is the adoption and implementation of CE in the built environment sector of the economy. The application of the concept of CE thinking in Sub-Sahara African Nations' construction, which is in its infancy, has been largely limited to construction waste minimisation and recycling (Adams *et al*., 2017).

Circular economy is defined as "that is restorative and regenerative by design and aims to keep products, components and materials at their highest utility

and value at all times" and aims to decouple economic growth from resource consumption (Hart *et al*., 2019).

Circular economy brings the idea of restoration and circularity in order to replace the traditional concept of end-of-life, shifting towards the use of renewable energy, eliminating the use of toxic chemicals, and aims for the elimination of waste through the superior design of material, products, systems and construction business models in Sub-Sahara African Nations' (Michelini *et al*., 2017). Transforming the Sub-Sahara African Nations' built environment, particularly the construction industry, there is a need on new direction which CE is a response to the inefficient management of the resources in the traditional linear model to support this transition from a linear to a CE model. Thus construction business managers should rely on new construction business models to enhance its development.

Nigeria has one of the Sub-Sahara African Nations' where its stakeholders in the construction industry are the least informed about the concept of CE, and this is a key challenge for greater adoption and implementation on nations' transformation due to lack of awareness about the concept. Other significant challenge in the Nigerian construction industry is the absence of incentives to environmental design products for the built environment and buildings for disassembly and reuse at their end of life.

Concept and principles of circular economy in construction industry

Circular Economy (CE) is a concept currently promoted in the European Union (EU), and several national governments like China, Japan, United Kingdom, France, Canada, The Netherlands, Sweden and Finland as well as several construction around the world (Korhonen *et al*., 2018). The concept of CE has been proposed as a promising economic avenue for addressing current environmental and socio-economic issues and creating a more sustainable society in construction industry business (Sousa-zomer *et al*., 2018).

CE is becoming increasingly common place in countries such as, China and Germany whom have used the term within their legislation, although the emphasis can vary (Benton, 2015). Construction waste avoidance and closed-loop recycling of construction materials are the key components within the German legislation (Bilitewski, 2012), while in the Chinese policy, the term is

directed at design, cleaner production and eco-industrial parks and net-works to create a recycling-oriented society (Geng *et al.*, 2012).

The common elements include eliminating the concept of waste and maximising the value of materials using the term restorative and regenerative by designers emphasising systems thinking and the need to design out negative externalities in the Nigerian Construction Industry (NCI).

CE arises from the prose of diverse implementation principles adopted worldwide through three main act of 3R's principles: Reduction, Reuse and Recycle (Ghisellini *et al.*, 2016). In china the policy adopted for the promotion of CE expresses it as a generic term for reducing, reusing and recycling activities conducted in the process of production, circulation and consumptions (CCICED, 2008). On the contrary, other countries such as Europe, Japan, USA, Korea and Vietnam seems to identify CE and its founding principles (3R) in more sectorial initiatives mainly related to waste management policies (Sakai *et al.*, 2011).

It is an economic tool and a modern version of the polluter pay principle, that aims to enhance the circularity of products and materials (that is reuse and recycling) acting on the producer's side (Sakai *et al.*, 2011). The principle believe that the costs of disposal and recovery must be transferred to the producers who will therefore have a strong incentive to reuse, recycle or dispose of waste materials. Furthermore, Ghisellini *et al.* (2016) argues that if a product cannot be reused and recycled then the industry should not produce such a product and consumers should not buy it. This preceding issue highlights the need for a common responsibility among all stakeholders, including consumers, to achieve more determined results in terms of collection of waste to be reused or recycled.

According to Stahel (2013) CE is often identified with recycling principle and these must be highlighted as the least sustainable solution compared to the other CE's principles (Reduction and Reuse) in terms of resource efficiency and profitability. Lastly reuse, repair and remanufacturing have a local or regional dimension and are able to avoid or reduce packaging, transport costs and transaction costs through the maintenance of ownership, while recycling has a global dimension and works following the "principles of industrial production, such as economies of scale, specialization and employing the cheapest labour" (Stahel, 2013).

The 3R principles can be integrated by three additional principles developed within the Ellen Macarthur Foundation (2012). The principles are as follows:

i. Appropriate design stresses on the importance of design stage in finding solutions to avoid waste discharge in landfills: "Products are designed for a cycle of disassembly and reuse".
ii. Introduction of reclassification of the materials into "technical" and "nutrients". The technical materials (as metals and plastics) are designed to be reused at the end of the life cycle while the nutrients or biological nutrients, that in general are nontoxic, "can return safely to the biosphere or in a cascade of consecutive uses".

Challenges of circular economy

Sub-Sahara African construction innovation is necessary for circular activities model implementation (Sousa-zomer *et al.*, 2018). Model implementation should start with organizational development that recognizes change management and managerial mindset (Lieder and Rashid, 2016). The implementation of the new circular business required a mindset change, from the nations' industries focusing on the construction and utilisation of the products to the industry through services, which involved new partnerships, new revenue model, and a revised cost structure. Indeed, mindset change has been reported as one of the most important aspects of circular construction model implementation (Lacy *et al.*, 2014; Rizos *et al.,* 2016). The solutions adopted by the company to overcome the main challenges to circular construction model implementation are summarized in Table 1.

Table 1: Challenges and solutions adopted by the industry to implement the new circular construction model

Groups	Challenges	Solution
Cultural aspects	Leadership behavior	Autonomy was given to the leadership in order to involve them
	Difficulties in construction definition/change in mindset	Involvement of the leadership, cross-functional team, and multiple stakeholders in the construction development and implementation and development of an independent

		construction unit aligned with the industry sustainability principles
	Attitudes and behavior of employees	Specific training to develop new capabilities
	Knowledge and transition procedures	Partnerships with all stakeholders toward knowledge creation. Complete involvement of employees
	Cultural adaptation	Creation of a new and independent construction unit
Risk	Risk of cannibalization	Creation of a separate construction unit, new product, and consumer niche
	Operational risk	Conducting an experiment with focus groups before launching the product
	Financial risk for the producer if the offer	Development of a new form of relationship with customers through contracts
	involves leasing/renting	
Stakeholder relationships	Creation of the required incentives for key partners	Creation of a reward program and exclusive partnerships with suppliers that are aligned with the company's requirements
	Compatibility with the construction models of partners	Development of a supplier certification program, integrated management system, and supplier incentives program
	Lack of supply network support	
	Conflict of interest within industry	
	Misaligned profit-share along supply chain	

Internal processes	Need for design capabilities	Development of cross-functional capabilities through full integration of all functions and employees
	Need for sourcing and manufacturing capabilities	
	Need for sales and marketing capabilities	
	Lack of technical and technological knowhow	

Source: Sousa-zomer *et al.*, 2018

A number of challenges for external and internal factors that may influence circular construction activities model implementation in the Sub-Sahara African Nations' have been outline by different related review literature as shown in Table 2.

Table 2: External and internal factors that may affect circular business model implementation

Challenges/factors that impact CE implementation	Reference
Firm's structure (management systems, long-term investments), contextual factors (government regulations, uncertainty regarding the product marketing), and cultural factors (leadership issues, risk aversion)	Liu and Bai (2014)
Adoption of specific technologies (e.g., recycling technologies), legal barriers (e.g., complexity of regulations), difficulties defining the construction strategy, mindset change	Roos (2014)
Customer irrationality (some customers might prefer ownership of a product even if temporary usage is more economical), conflict of interest within	Planing (2015)

industry, misaligned profit-share along the supply chain, and geographic dispersion	
Societal factors (stakeholder relations/inter-firm collaboration), regulatory factors (laws, subsidies, taxation), services and infrastructure, products and technology	Fischer and Pascucci (2017), Scheepens *et al*. (2016)
Lack of capital, administrative burden (new practices can be considered complex and entail more complex and costly management and planning processes), industry environmental culture, lack of legislation, information, technical and technological knowhow, and support from the demand and supply network	Rizos *et al*. (2016)
Professional barriers (knowledge development, dissemination, and innovation), social and people-related barriers (consumer acceptance), economic barriers (lack of investment power), institutional barriers (current practices)	van Buren *et al*. (2016)
Customer-specific restrictions (only certain types of customers are suitable for remanufactured products), technological expertise requirements, return flow, product categories (some types of products may not be suitable for remanufacturing), risk of cannibalization, fashion vulnerability, tied up capital, operational risk, lack of supporting regulation, and partnership restrictions	Linder and Williander (2017

Source: (Liu and Bai, 2014; Linder and Williander, 2017)

The development of new capabilities also represents a key factor in construction circular activity model innovation. New capabilities are essential for adopting a construction circular activity approach representing another challenge (Lacy *et al.,* 2014). Lewandowski (2016) posit that organizational capabilities affect the adaptation of activity model to CE principles, but the development of such capabilities for circular activity model implementation requires intangible resources from the industry, such as team motivation and organizational culture, knowledge, and transition procedures. Lewandowski

(2016) further emphasised these mechanisms as the basis for developing human resources and team building, applying change management instruments, and using activity model design methods and tools.

Although a wide range of challenges have been reported in the literature, there is limited understanding of the connection between changes for circular construction implementation and the factors that affect this change (Lewandowski, 2016). In addition, there are some types of challenges that manufacturing firms do not have control over (e.g., legislation and social issues). The challenges that industry practitioners do have influence over and can take action on, have rarely been explored in practice, despite their value in supporting the practical transition toward circular construction for national transformation.

Methodology

Quantitative research approach was adopted through the use of primary and secondary data. This is to investigate the individual opinion on the level of awareness and challenges on the implementation of CE by the practitioners in the construction industry in Nigeria as one of the Sub-Sahara African nation, in achieving these the statistical inference aimed at identifying their level of awareness in the participation of CE during the project execution. The respondents were asked to rate awareness level on a 5 points Likert scale, ranging from 1 (very little awareness) to 5 (very high awareness). However, the respondents selected for the survey study are: Architects, Builders, Engineers, Clients, Quantity Surveyors, Contractors, Project Managers, and Manufacturers of the construction materials based on their constant involvement in the projects execution. In a similar manner the respondents were asked to rate the challenges of CE from very unchallenged to very high challenged in a way to identify critical problems facing the implementation in the construction industry in Nigeria.

Structured questionnaire was administered to some selected construction industry using a purposive sampling technique on 15 construction companies in Abuja. A total of 150 questionnaires were used for the sample size and frame. A total number of 122 questionnaires were filled and returned by the respondents representing 81.33%. The obtained data were analysed using mean score from the response of the respondents to investigate the level of

awareness on CE of the practitioners and the challenges militating the implementation of CE in the industry. The obtained results from the descriptive analysis using mean score was summarised in a tabular form for ease of understanding. Hence, the decision on the results of the descriptive analysis was based on the class range in table 3 as shown below.

Table 3: Class Range of Average Index

Mean Range	Likert Scale
1.00 ≤ Average index < 1.50	Very little awareness
1.51 ≤ Average index < 2.49	Little awareness
2.50 ≤ Average index < 3.49	Moderately aware
3.50 ≤ Average index < 4.49	High awareness
4.50 ≤ Average index < 5.0	Very high awareness

Source: Kasimu *et al.* (2016)

Results and discussion

Awareness level of the practitioners of CE in the construction industry

Table 4: Levels of Awareness for CE by Construction Practitioners

S/No	Practitioners	1	2	3	4	5	Mean Score
1	Architects	21	13	35	20	33	3.25
2	Builders	17	30	11	45	19	3.16
3	Engineers	26	20	24	24	28	3.06
4	Quantity Surveyors	24	23	25	25	25	3.03
5	Clients	26	30	16	27	25	3.01
6	Contractors	22	20	35	25	20	3.01
7	Projects Managers	35	13	18	30	26	2.99
8	Manufacturers	29	27	22	33	11	2.75

Source: Field Survey 2019

The construction industry consists of five main sub sectors:- clientele, design, manufacturing, supply and assembly (Shakantu, 2012). However, by default the production process that facilitates the built environment products and finished products (building) in the construction industry involves relationships among clients, architects, engineers, surveyors, planners, manufacturers, materials suppliers and contractors. From the results

obtained as summarised in table 4. The respondents generally are moderately aware of the concept of CE were majority of the professionals fall within the mean score range of 2.50 - 3.49 in Likert scale as indicated in table 3. Architects and Builders top the score with (3.25) and (3.16) respectively, while other professionals like the Engineers, Quantity Surveyors, Clients and Contractors have their mean score range from (3.06), (3.03) and (3.01) respectively. The results however, diminishes with the Projects Managers and Contractors having their mean as (2.99) and (2.75) respectively. This indicates that waste generation is high in the construction sector and corroborate the study by Saidu and Shakantu (2015) where they assented that the construction industry is with high material wastages, management and cost overruns and material grasping.

Table 5: Challenges Confronting CE Implementation in the Construction Industry

Challenges	1	2	3	4	5	Mean Score	Ranking
Lack of circular economy knowledge and practices	10	12	30	45	25	3.51	1
Creation of the required incentives for the operators	20	10	32	30	30	3.33	2
Low value of material/products at end of life	18	20	29	20	35	3.28	3
Need for design capabilities	20	25	20	22	35	3.22	4
Leadership behavior of most managers	22	20	25	20	35	3.21	5
change in mindset during construction	20	25	22	23	32	3.18	6
Fragmented nature of the supply chain	20	22	28	27	25	3.12	7
Operational risk involve at the time of construction	21	26	25	20	30	3.10	8
Attitudes and behavior of employees	22	25	25	20	30	3.09	9

Lack of consideration for end-of-life issues (buildings)	19	25	28	28	22	3.07	10
Limited awareness across supply chain	30	18	20	25	29	3.04	11
Conflict of interest within industry	28	20	25	20	29	3.02	12
Compatibility with the construction models of operators	22	32	22	26	20	2.92	13
Lack of incentive to design for end of life (products)	28	21	25	30	18	2.91	14
Need for materials sourcing and construction capabilities	25	27	28	22	20	2.88	15
Complexity of the construction activities	28	31	18	20	25	2.86	16
Lack of technical and technological know-how	30	25	20	28	19	2.84	17
Unclear financial involvement during implementation	20	25	25	30	22	2.83	18
Cultural adaptation of the system	25	20	40	25	12	2.83	18
Lack of market mechanisms for recovery	25	37	18	22	20	2.80	20
Lack of interest by the operators	32	28	20	25	17	2.73	21
Financial risk for the producer if the offer involves design & build	37	23	30	15	17	2.61	22

Source: Field Survey 2019

In other to under study the challenges of Circular Economy (CE) implementation in the construction sector, 22 construct were developed as shown in table 5. The most significant challenge, which was ranked high by all practitioners in the industry is lack of CE knowledge and practice (3.51). This indicate that most practitioners do not have the requisite knowledge and the firm's inability to practice CE. The mean score of (3.33) is the creation of the required adequate incentives for the operators not given attention resulting

into lack of knowledge thereby leading to waste of resources and cost overrun in construction and these also result in delay of completion of the projects on schedule, sometimes even project abandonments as well as corruption in construction sector. Low value of material/products at end of life, the need for design capabilities and Leadership behavior of most managers are moderately challenging factors with the mean scores of (3.28), (3.22) and (3.21) respectively. Therefore, change in mindset during construction (3.18), Fragmented nature of the supply chain (3.12), Operational risk involve at the time of construction (3.10), Attitudes and behavior of employees (3.09), Lack of consideration for end-of-life issues (buildings) (3.07), Limited awareness across supply chain (3.04) and Conflict of interest within industry (3.02) were equally moderately challenging factors by operators in construction sectors in Nigeria. Consequently, Compatibility with the construction models of operators (2.92), Lack of incentive to design for end of life (products) (2.91), Need for materials sourcing and construction capabilities (2.88), Complexity of the construction activities (2.86) and Lack of technical and technological know-how (2.84) form the top - bottom list of the moderate factors the professionals are confronted with in the industry, finally, these therefore diminished down to Unclear financial involvement during implementation to (2.83), Cultural adaptation of the system (2.83), Lack of market mechanisms for recovery (2.80), Lack of interest by the operators (2.73) and Financial risk for the producer if the offer involves design and build (2.61) are all moderate challenging factors facing the implementation of CE by the practitioners in the industry. These are considered as a breakout knowledge as an important issue that required urgent attention in the industry, if affordable construction must be achieved in the country.

Conclusion

The low level awareness of CE is characterized by lack of CE knowledge and creation of the required incentives for the operator in the industry as an indication that majority of the practicing professional in the Nigerian construction industry Sub-Sahara Africa are not versatile about the CE in construction that added value in times of waste minimisation, the use of 4R (reduce, reuse, recycle, recovery) and low value of materials/ products at end of its life due to the need for design capabilities. High cost of construction

resulted in Nigeria Sub-Sahara African country could also be as a result of these problem of lack of knowledge on CE and leadership behavior of most managers as well as changes in mindset during construction. However, due to literacy level of the CE by the practicing specialist there tend to be an operational risk at the time of construction by the attitude of the operators.

Recommendations

The paper therefore recommends the following suggestions:

- ✓ There is need for practitioners to develop an interest and acquaint themselves on the benefit of CE during the construction process in other to reduce the risk of financial expenditure during the offer of design and build process.
- ✓ Less difficulty in building a strong financial case for CE in the construction sector.
- ✓ Training and retraining should be organised frequently on new ideas that promote advancement in construction sector by the researchers and practitioners in the industry.
- ✓ Construction industries should also key into these ideas of training and retraining as well as the manufacturers and contractors participating. These will no doubt reposition the industry in the country to a global competitiveness among other nations.
- ✓ There should be the reuse of reinforced concrete elements; and of composite products in general
- ✓ Developing a value chain engagement for instance prioritising CE in procurement using innovation specifications for recycled materials, and for re-used structures.
- ✓ Needs to adopt a system technique that includes design tools and guides covering design for CE, design for disassembly (DFD), design for adaptability, a range of collaboration tools, building and material information tools, and circularity metrics.

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