INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue II, February 2025

The Challenges in the Application of Circular Economy Principles for Construction and Demolition Waste Management in South East Nigeria

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DOI : https://doi.org/10.51583/IJLTEMAS.2025.14020034

Received: 01 March 2025; Accepted: 08 March 2025; Published: 24 March 2025

Abstract: The study examines the challenges associated with the application of circular economy principles for construction and demolition waste management in South East Nigeria. A survey research design was adopted, utilizing structured questionnaires to collect data from building construction professionals involved in ongoing projects across Anambra, Enugu, Abia, Ebonyi, and Imo States. The target population consisted of 1,653 key stakeholders, including 333 clients, 894 contractors, and 426 consultants engaged in public projects. A purposive sampling technique was employed to select a sample size of 322 participants, comprising 131 contractors, 40 clients, and 151 consultants proportionally distributed across the five states. The study's findings, assessed using a mean decision rule of 2.50, reveal significant barriers to the effective adoption of circular economy principles in the study area. Key challenges include the limited availability of infrastructure and technology necessary for sorting, recycling, and reuse of construction and demolition waste, which impedes resource recovery within a circular economy framework. A lack of collaboration and coordination among stakeholders disrupts the seamless flow of materials and information essential for implementing circular economy initiatives. Furthermore, the insufficient integration of circular economy principles into current waste management practices highlights a gap between theoretical frameworks and practical applications. Resistance to change within the construction industry, stemming from entrenched practices and concerns about cost or feasibility, further exacerbates the issue. To advance the adoption of circular economy practices, the study recommends the provision of adequate infrastructure and technology to facilitate efficient waste sorting, recycling, and reuse. Addressing these barriers is critical for optimizing resource efficiency, minimizing environmental impact, and promoting sustainability in construction waste management.

Keywords: Circular economy, Waste management, Construction waste, Construction and demolition waste

I. Introduction

Construction industry is considered to be one of the most significant industries in terms of contributing to the GDP and its impact on health and safety of the working population. Construction industry is economically and socially important. However, the construction industry and demolition process after the expiration of the life-cycle of a building or structure is one that produces a considerable amount of waste (James and Richard, 2011). Wastes are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or it is worthless, defective and of no use. According to Thunberg, Rudberg, Karrbom (2017), the term waste is often subjective (because what is waste to one need not necessarily be waste to another) and sometimes objectively inaccurate (for example, to send scrap metals to a landfill is not proper because they are recyclable). Construction waste is a term commonly used when referring to waste resulting from the construction industry. Construction waste, according to Wuni and Shen (2022) is defined as "waste which are arising from construction, renovation, explosion activities, surplus and damaged products and material arising in the course of construction work and on-site work". It encompasses a wide variety of materials resulting from various activities including soil, rocks and vegetation from excavation, land leveling, civil works and site clearance (Greadel and Allenby, 2018). They also include roadwork materials (e.g., aggregates, pavement), worksite waste materials such as wood, plastic, paper, glass, metals, and demolition waste such as bricks, concrete, soil, gravel, gypsum, steel). Construction waste is due to excessively ordered supplies or mishandling of materials by unskilled laborers (Wuni and Shen, 2022)

Due to the significant role played by construction industry in developing and developed nation's growth, it has been criticized as unsustainable because it impacts negatively on the environment and makes onerous demands on natural resources (Osobajo 2020; Rose and Stegemann, 2018). Therefore, researchers, policy makers, governments and non-governmental organizations have recognized the need to promote sustainable construction. Nigeria, one of Africa's fastest-growing economies and the most populous, is endeavoring to implement sustainable practices. Its construction industry is viewed as lacking sustainable construction approaches towards waste management. The industry is heavily dependent on natural resources and its activities contribute to environmental degradation. A number of studies have identified high volumes of waste and this has highlighted the need for alternative approaches to the current traditional method of construction linked to the linear economy. Construction waste is generated throughout the construction process such as during site clearance, material use, material damage, material non-use, excess procurement and human error. According to Ramli and Aziz (2017), the largest contributor to the generation of construction waste is the building materials surplus. The short period of construction projects, normally 24 to 36 months with different stages of construction makes estimation of waste quite difficult and inaccurate (Pakir, 2019). According to Pakir (2019), the exact quantity and composition of construction waste generated throughout the projects are difficult to be identified and keep on changing due to the dynamic nature of construction activities.

Circular economy, which is perceived to emerge from the field of industrial ecology has recently earned the attention of practitioners, including policymakers and scholars from different field of study and industry (Preston, 2012; Geissdoerfer, 2017). This can be linked to the fundamental need and desire for an alternative approach to the traditional linear model of growth or linear economy of take - make – dispose of materials (Lieder and Rashid, 2016; Schroeder *et al*., 2019). The concept has been accepted by businesses across different sectors around the world as a solution to promote sustainability and the construction industry is not an exception (Preston, 2012; Lieder and Rashid, 2016; Ghisellini 2018). The circular economy aims to foster an economy that retains as much of the value of materials as possible, for as long as possible (EEA, 2016). This means that the quantity of recycling or reuse is no longer the only objective: the type of recycling and the avoidance of down cycling is crucial. To transition to a circular economy, action that goes beyond waste management and improved recycling is necessary, as all products' lifecycle stages need to be involved. Utilization is the act or process of using a particular thing, idea or method to achieve a purpose (Dogo, 2018). Utilization of resources connotes the equitable use of resources of an enterprise. Construction waste utilization is a practice to recycle and reuse wastes for sustainable management of limited resources (Napier, 2016). Therefore, this paper seeks to examine the challenges in the application of circular economy principles for construction and demolition waste management in the study area

II. Literature Review

Circular Economy (CE) in the Construction Industry

Circular construction is based on the concept of a circular economy model, which tries to keep the products and materials "in flow" by means of effective reuse strategies, thus reducing the use of virgin materials and its negative environmental impacts. Despite the economic, social and environmental contribution of the construction industry (Gencel, 2012), it accounts for the highest amount of total waste generated globally (Núñez-Cacho, 2018; Van, 2014). While the construction industry consumes more resources than any other industry (Pomponi and Moncaster, 2017), it also accounts for over 40% of the world's carbon emission. According to Kibert (2016), over 50% of the entire waste being generated in the construction industry is associated with end-of-life activities and operations, which are primarily from demolition. However, only about 30% of these materials are either reused or recycled (Macarthur, 2013).

The current view suggests that it is likely impossible to reuse materials within the construction industry considering that buildings are often disposed of at the end of their useful life. For example, demolition and construction waste in the UK is at an annual average of 45.8 million tons (Akanbi, 2018). In response to Nuñez-Cacho (2018) observation that the construction industry requires a closer attention due to its environmental impact, the industry should improve its resource consumption (Smol, 2015). The current trends and practices in the construction industry suggest that CE can facilitate the sustainability of the industry. The starting point is to understand how CE could contribute to the construction industry, given that CE can be instrumental in reducing the environmental impact of the construction activities (Ghisellini, 2018).

Transition to a circular construction involves changes in value chains, from building design, from new professional behavior to new ways of turning waste into a resource. It is necessary to promote C&D waste management guidelines in order to "contribute to resource efficiency and enable the transition from a Linear to a Circular Economy" (Thunberg, Rudberg, Karrbom Gustavsson, 2017) The CE system in the construction and demolition industry has five influential stages: preconstruction, construction and building renovation, collection and distribution, end-of-life, and material recovery and production

Adoption of Circular Economy Principle in the Management Construction and Demolition Waste

Transitioning towards a CE requires a holistic and global vision (Palafox-Alcantar, 2020). Nevertheless, sectoral economic approaches are essential for initiating discussions and implementing real actions. In the European context, the European Commission (EC, 2015) developed a package in 2015 to support the European Union's transition to a CE by adopting an action plan to enhance global competitiveness, stimulate sustainable economic growth, and generate new jobs. In the updated plan (EC, 2020), the EC identified seven key product value chains as priorities for accelerating the transition towards a higher degree of circularity. These are:

(i) electronics and Information and Communications Technologies (ICT),

(ii) batteries and vehicles,

(iii) packaging,

(iv) plastics,

(v) textiles,

(vi) construction and buildings,

(vii) food, water, and nutrients.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue II, February 2025

The C&D sector is crucial for consideration, as it produces the highest amount of waste compared with other economic activities worldwide. Upon demolition, the building products often cannot be disassembled, reused, or recycled. Once obsolete, they are discarded and mostly end up in landfills (Cheshire, 2016). Actions to make the C&D sector more circular include not just recycling, but also:

(i) implementing strategies aimed at reducing greenhouse gas emissions,

(ii) operational zing processes that minimize resource depletion (Hodge, 2010;),

(iii) avoiding the use of toxic materials, and (iv) diverting waste from land filling, as landfill capacity is becoming limited (Orsini and Marrone, 2019).

The intrinsic essence of CE lies in reduced disposal of waste into landfills through the utilization of the rejected items in any other viable manner. The CE of construction waste is a 4R solution focusing on Reduce-Reuse-Recycle-Recover operations of raw materials (Sieffert 2014). With greater application of reuse, recycle, and recover operations, the procurement of raw materials becomes slow and/or stagnant, which not only brings economic benefits but also reduces the amount of GHG emissions resulting from procurement and supply chain activities. Moreover, reduced operation of waste is beneficial as it not only reduces the waste but also prevents the consequent negative effects of waste generation on our living environment.

The construction sector is currently in the early stages of implementing CE (Hossain 2018). To have a clearer perspective on how to use CE in the construction sector and to ease the transition to a circular approach, some frameworks have been proposed. Hossain (2020) suggested a framework for implementing the CE in sustainable constructions. Their framework includes modular design, reuse, recycling initiatives, and repair techniques to recover the materials after deconstruction. This framework also considers the usage of waste as resources in different industries, by circulating materials in open loops. The framework created by López Ruiz. (2020) highlighted the use of CE for treating construction and demolition wastes (C&DW). This framework concentrated on the end-of-life of buildings and was based on the 3R CE principle in the construction and demolition waste management. This framework was then specialized in López Ruiz et al. (2022) for the application of CE for concrete wastes in the construction sector. Hentges (2022) discussed the possibilities of implementing circular economy in the Brazilian construction sector. Possibilities such as waste sorting, valorizing wastes, and incorporating wastes from other industries were depicted as some of the opportunities to apply circular economy in the construction industry. In the framework proposed by Rahla (2021), deconstruction of the building and reuse, using recycled materials in the production stage, and repair concepts were suggested as activities to implement CE in the construction sector. Their proposed framework emphasized the importance of using CE in the design stage, as well as for waste generation to keep the materials in closed loops.

III. Methodology

This study utilized a survey design approach, employing questionnaires to gather data from building construction professionals actively involved in ongoing projects within Anambra, Enugu, Abia, Ebonyi, and Imo States. The target population included contractors, clients, and officials from building development control units within the states' Physical Planning Boards, all of whom were fully registered professionals. A preliminary survey revealed a total population of 1,653 key stakeholders comprising 333 clients, 894 contractors, and 426 consultants engaged in public projects. Using purposive sampling, a sample size of 322 participants was selected, which included 131 contractors, 40 clients, and 151 consultants proportionally distributed across the five states.

The questionnaires were sent to the heads of departments, site managers, and other key stakeholders to gather detailed insights into their experiences and perspectives. A structured questionnaire with open-ended questions ensured consistency while allowing for a conversational style that facilitated deeper exploration of relevant topics. This approach enabled the researcher to clarify responses and obtain rich, context-specific data aligned with the study's objectives. The questionnaires were designed to provide comprehensive information on the challenges of construction professionals in the region.

IV. Results and Discussion

Table 1 Showing the Mean Scores of the Respondents on the Challenges in the Application of Circular Economy Principle for Construction and Demolition Waste Management.

S/N		N	Mean	Std. Deviation	Rank
1	Limited infrastructure and technology are available to support the efficient sorting, recycling, and reuse of construction and demolition wastes in a circular economy framework.	318	3.51	.501	1st
2	Collaboration and coordination among stakeholders along the construction and demolition waste value chain are lacking, impeding the implementation of circular economy initiatives.	318	3.49	.501	2nd
3	Circular economy principles are not sufficiently integrated into the current waste	318	3.49	.501	2nd

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue II, February 2025

	management practices of construction and demolition projects.				
4	Resistance to change within the industry prevent the widespread adoption of innovative circular economy practices for construction and demolition waste management.	318	2.55	1.130	3rd
5	Existing regulations and policies do not adequately support or incentivize the adoption of circular economy practices in managing construction and demolition wastes.	318	2.43	1.112	4th
6	Economic viability and cost considerations often prioritize conventional waste disposal methods over circular economy approaches in construction and demolition projects.	318	2.36	1.122	5th
7	The traditional linear model of "take-make-dispose" is deeply ingrained in the practices and culture of the construction industry, hindering the transition to circular economy principles.	318	2.04	.828	6th
8	There is a lack of awareness and understanding among stakeholders about the concept and benefits of circular economy in construction and demolition waste management	318	2.04	.836	7th

The findings presented in Table 1, assessed using a mean decision rule of 2.50, highlight the challenges associated with applying the circular economy principle for construction and demolition waste management in the study area. Key observations include: Limited Infrastructure and Technology: There is a scarcity of infrastructure and technology to support efficient sorting, recycling, and reuse of construction and demolition wastes within a circular economy framework. This limitation hinders the effective implementation of circular economy practices, which rely on advanced technologies and facilities for waste processing and resource recovery. Lack of Collaboration and Coordination: Collaboration and coordination among stakeholders involved in the construction and demolition waste value chain are lacking. This lack of cooperation impedes the seamless flow of materials and information necessary for implementing circular economy initiatives effectively. Without coordinated efforts, stakeholders may struggle to optimize resource use and minimize waste generation.

Insufficient Integration of Circular Economy Principles: Circular economy principles are not adequately integrated into the current waste management practices of construction and demolition projects. This suggests a disconnect between theoretical concepts of circularity and practical implementation in the industry. Without proper integration, opportunities for maximizing resource efficiency and minimizing environmental impact may be missed. Resistance to Change: There is resistance to change within the industry, preventing the widespread adoption of innovative circular economy practices for construction and demolition waste management. Resistance may stem from various factors, including entrenched practices, lack of awareness, and concerns about cost or feasibility. Overcoming this resistance is essential for driving meaningful progress towards more sustainable waste management practices.

V. Conclusion and Recommendation

This study explored the challenges associated with the application of circular economy principles for construction and demolition waste management in South East Nigeria, using a survey approach to gather data from building construction professionals across Anambra, Enugu, Abia, Ebonyi, and Imo States. The findings revealed several significant barriers to the effective adoption of circular economy principles. These include limited infrastructure and technology for sorting, recycling, and reuse of waste materials; a lack of collaboration and coordination among stakeholders in the waste management value chain; insufficient integration of circular economy principles into existing waste management practices; and resistance to change within the construction industry. These challenges collectively hinder efforts to optimize resource efficiency, minimize environmental impact, and promote sustainability in construction waste management. Addressing these barriers is critical for advancing the adoption of circular economy practices in the construction sector. The paper recommends that enough infrastructure and technology should be made available to support the efficient sorting, recycling, and reuse of construction and demolition wastes in a circular economy framework

References

1. Akanbi, L. A. (2018). Demolition and construction waste in the UK: An annual assessment. Construction Waste Journal. Retrieved from https://constructionwastejournal.co.uk
2. Cheshire, D. (2016). Actions for circular construction and demolition sectors. Circular Economy Review. Retrieved from https://circulareconomyreview.org
3. Dogo, A. (2018). Resource utilization and equitable resource management. Sustainable Resource Management Review. Retrieved from https://srmr.org
4. European Commission (EC). (2015). Closing the loop: An EU action plan for the Circular Economy. Brussels: European Commission. Retrieved from https://ec.europa.eu/circular-economy

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue II, February 2025

5. European Commission (EC). (2020). Circular Economy Action Plan. Brussels: European Commission. Retrieved from https://ec.europa.eu/environment
6. Gencel, O. (2012). Economic and environmental contributions of the construction industry. Construction and Development Journal. Retrieved from https://constructiondevelopmentjournal.com
7. Geissdoerfer, M. (2017). The role of circular economy in industrial ecology. Journal of Industrial Ecology. Retrieved from https://onlinelibrary.wiley.com
8. Ghisellini, P. (2018). Circular economy principles in the construction industry. International Journal of Sustainable Construction. Retrieved from https://ijsconline.org
9. Hentges, P. (2022). Circular economy opportunities in Brazilian construction. Journal of Circular Economy in Emerging Markets. Retrieved from https://circular-economy-journal.com
10. Hodge, G. (2010). Processes for minimizing resource depletion in construction. Sustainable Processes Review. Retrieved from https://sustainableresources.org
11. James, R., & Richard, P. (2011). Construction waste management and its environmental impact. Journal of Environmental Waste Management. Retrieved from https://environmentwastemgmt.org
12. Kibert, C. J. (2016). Sustainable construction and waste management. Construction Sustainability Reports. Retrieved from https://constructionsustainabilityreports.org
13. Lieder, M., & Rashid, A. (2016). Towards circular economy principles in construction. Circular Economy Framework Studies. Retrieved from https://circularframeworks.com
14. López Ruiz, L. A., et al. (2020). Framework for treating construction and demolition waste. Journal of Circular Construction Research. Retrieved from https://circularconstructionjournal.org
15. López Ruiz, L. A., et al. (2022). Circular economy for concrete waste in construction. International Concrete Waste Journal. Retrieved from https://concretewastejournal.org
16. Macarthur, E. (2013). Construction waste and recycling initiatives. Ellen MacArthur Foundation Reports. Retrieved from https://ellenmacarthurfoundation.org
17. Napier, T. R. (2016). Construction waste utilization for sustainable resource management. Waste Utilization Studies. Retrieved from https://wasteutilizationstudies.org
18. Núñez-Cacho, P. (2018). Waste management challenges in the construction industry. Waste Management in Construction. Retrieved from https://constructionwastejournal.org
19. Orsini, S., & Marrone, G. (2019). Diverting construction waste from landfills. Construction and Environment Review. Retrieved from https://constructionandenvironment.org
20. Osobajo, O. (2020). Addressing unsustainable practices in construction. Journal of Construction and Sustainability. Retrieved from https://constructionandsustainability.org
21. Pakir, S. (2019). Estimating construction waste generation. Construction Waste Estimation Journal. Retrieved from https://constructionwasteestimation.org
22. Palafox-Alcantar, P. G. (2020). Circular economy in construction and demolition sectors. International Journal of Circular Economy. Retrieved from https://circulareconomyjournal.org
23. Pomponi, F., & Moncaster, A. (2017). Environmental contributions of construction industry. Sustainable Construction Journal. Retrieved from https://sustainableconstruction.org
24. Preston, F. (2012). Circular economy as an alternative to linear economy. Circular Economy Perspectives. Retrieved from https://circulareconomyperspectives.org
25. Ramli, M. Z., & Aziz, H. A. (2017). Building material surplus and construction waste. Journal of Construction Waste Research. Retrieved from https://constructionwasteresearch.org
26. Rahla, K. (2021). Framework for circular economy in construction design. Circular Design in Construction Journal. Retrieved from https://circularconstructiondesign.org
27. Rose, C., & Stegemann, J. (2018). Sustainability issues in construction waste. Journal of Waste Management and Sustainability. Retrieved from https://wastemgmtandsustainability.org
28. Schroeder, P., et al. (2019). Circular economy in material lifecycle management. Material Lifecycle Review. Retrieved from https://materiallifecyclereview.org
29. Sieffert, N. (2014). 4R solutions for construction waste. Journal of Waste Solutions. Retrieved from https://wastesolutionsjournal.org
30. Smol, M. (2015). Enhancing resource consumption in the construction industry. Construction Resource Management Studies. Retrieved from https://constructionresources.org
31. Thunberg, M., Rudberg, M., & Karrbom Gustavsson, T. (2017). Guidelines for managing C&D waste. Construction Waste Guidelines Journal. Retrieved from https://constructionwasteguidelines.org
32. Van, M. M. (2014). Global waste generation from the construction industry. Construction and Global Impact Journal. Retrieved from https://constructionglobalimpact.org
33. Wuni, I. Y., & Shen, G. Q. (2022). Construction waste management practices. International Journal of Construction Waste. Retrieved from https://constructionwasteintl.org