PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 28 (7) 2141-2147 July 2024

# Factors Influencing Circular Economy Practices in Building Construction Projects In Ondo State, Nigeria

***OGUNJOBI, VO; AKINOLA, OR**

*Department Of Project Management Technology, Federal University Of Technology Akure, Ondo State, Nigeria*

**Corresponding Author Email: voogunjobi@futa.edu.ng*
**ORCID: https://orcid.org/0009-0009-6405-7704*
**Tel: +234703166 5803*

*Co- Author Email: akinolaolatunde37@gmail.com; Tel: +234 907 953 7174*

**ABSTRACT:** The primary consumer of natural resources is the construction industry. Therefore, the objective of this paper is to assess the factors influencing circular economy practices in building construction projects in Ondo State, Nigeria using appropriate standard methods. Data obtained reveals that economic factors, such as cost-effectiveness (mean = 3.61) and financial viability (mean = 4.11), emerged as primary drivers for adopting CE practices. However, regulatory frameworks were found lacking in promoting CE principles (mean = 1.95). While technological factors like advanced technology usage scored low (mean = 2.29), the employment of innovative technologies for material repurposing was higher (mean = 3.92). Organizational commitment to integrating CE principles received a moderate score (mean = 3.23). The study recommended the need for improved regulatory support, stronger economic incentives, enhanced technological integration, and increased organizational and community engagement to effectively foster CE practices in the construction sector.

**DOI: https://dx.doi.org/10.4314/jasem.v28i7.27**



**Cite this Article as:** OGUNJOBI, V. O; AKINOLA, O. R. (2024). Factors Influencing Circular Economy Practices in Building Construction Projects In Ondo State, Nigeria. *J. Appl. Sci. Environ. Manage.* 28 (7) 2141-2147

**Dates:** Received: 21 May 2024; Revised: 17 June 2024; Accepted: 23 June 2024 Published: 02 July 2024

**Keywords**: Project Technology; Construction Industry; Sustainable Development; Regulatory Frameworks.

Traditionally, the construction sector, a major user of natural resources, operates on a linear economic model that follows the pattern of take, make, and dispose. This approach has become increasingly unsustainable amidst global sustainability and greening initiatives. The sector is not only the largest consumer of resources but also a significant emitter of greenhouse gases (GHGs), contributing approximately 38% of total energy-related emissions worldwide (United Nations Environment Programme, 2020). Additionally, it generates about 35% of global waste, much of which is either landfilled or incinerated (Akanbi *et al.*, 2018; Akinade and Oyedele, 2019). These effects highlight the critical necessity for the construction industry to shift toward more sustainable methods. The circular economy (CE) model presents a viable option, seeking to separate economic development from the consumption of limited resources and optimizing the efficiency of resources. This approach promotes the reduction, reuse, recycling, and recovery of resources, considerably diminishing environmental impacts and prolonging material lifespans (Ellen MacArthur Foundation, 2016). In the realm of construction, embracing CE methods can result in longer-lasting structures and more sustainable use of materials. Policy frameworks and regulations are being developed to incentivize and regulate sustainable practices in the construction sector but the implementation of Circular Economy (CE) principles in the Construction Industry (CI) remains limited (Heeren, 2019; Ghisellini *et al.*,2018). Studies highlight that sustainable building practices can be evaluated through various indicators such as maintenance and operational costs, initial costs, long-

**Corresponding Author Email: voogunjobi@futa.edu.ng*
**ORCID: https://orcid.org/0009-0009-6405-7704*
**Tel: +234703166 5803*

term savings, and lifespan (Olanrewaju and Ogunmakinde, 2020). These indicators also encompass environmental impacts like resource conservation and energy savings. Although the circular economy (CE) holds considerable benefits, its implementation in the construction industry has been gradual, hindered by obstacles such as technological constraints, lacking infrastructure, and a deficit in political commitment (Heeren, 2019; Ghisellini *et al.,* 2018).

The Circular Economy (CE) offers a sustainable shift from the conventional linear production and consumption model, focusing on the reuse, recycling, and recovery of materials to reduce waste and lessen environmental damage. In the construction industry, a significant source of global waste and carbon emissions, CE provides a strategy for lowering resource use and mitigating environmental harm. (Pomponi and Moncaster, 2017; Ruiz *et al.,* 2020). Implementing CE in construction involves a shift toward sustainable practices such as designing for disassembly, using renewable and non-toxic materials, and maintaining and upgrading materials to prolong their lifespan (Cavalliere *et al.,* 2019; Mangialardo and Micelli, 2020). Shifting to a Circular Economy (CE) in the construction industry encounters numerous obstacles, such as moving away from conventional procurement and construction practices, a deficit in stakeholder knowledge, and inadequate cooperation throughout the supply chain. (Jones and Comfort, 2018; Hossain *et al.,* 2020). Governments and industry leaders are encouraged to foster policies and create incentives that support CE practices (Droege *et al.,* 2021). In urban settings, the integration of CE principles is crucial due to the significant impact of cities on resource consumption and waste generation. Cities, which are major economic drivers, are now focusing on sustainable development that integrates CE principles to mitigate their environmental footprint (Barrie, 2017; World Economic Forum, 2018). The construction sector's approach to CE involves stakeholders at all levels—from architects and designers to demolishers and material suppliers—working together to incorporate sustainable and circular practices across the building's lifespan. (Munaro and Travares, 2023; Gupta *et al.,* 2019). The circular method goes beyond just improving the sustainability of construction projects; it also boosts the functionality and flexibility of urban environments to accommodate an expanding population (Geipele et al., 2018). However, despite its advantages, shifting to a Circular Economy in construction is intricate and involves navigating through financial, technical, and social hurdles. These include the current design practices focused on disposability, the lack of integrated policies, and resistance to change among stakeholders (Zvirgzdins *et al.,* 2019; Adams *et al.,* 2017). Additionally, sustainable projects often involve adaptive reuse of existing structures, conserving resources and cultural heritage. Community engagement is essential, ensuring that projects meet local needs and promote social equity (Chen *et al.,*2022). By integrating these practices, sustainable construction projects aim to create long-lasting, low-impact buildings that positively impact both environmental and community health.

In Ondo State, Nigeria, the construction sector primarily operates under a linear model, significantly contributing to GHG emissions and resource depletion (Ghisellini; Ripa; Ulgiati, 2018). The shift towards a circular, resilient, and inclusive economic model is imperative to address both environmental and public health challenges. Incorporating CE practices like sharing, leasing, and recycling into sustainable building construction projects in Ondo State could reduce environmental harm and also offer economic advantages by prolonging the lifespan of construction materials. However, globally, the adoption of circular practices in construction remains limited, with less than 10% of projects employing such methods (Swiss Life Group, 2022). This indicates a significant gap in both policy and practice, necessitating enhanced collaboration, redesigned value chains, and supportive policies. These efforts should aim to align circular practices with business interests and promote behaviors conducive to sustainability. This study filled the existing research gap by quantitatively examining the factors influencing the adoption of CE practices in building construction projects in Ondo State. Therefore, the objective of this paper is to assess the factors influencing circular economy practices in building construction projects in Ondo State, Nigeria.

## MATERIALS AND METHODS

A descriptive survey design will be adopted for this study because it enhances the systematic description of existing situation and objective to be addressed in the research work. The research will be conducted in Akure, which serves as the capital of Ondo State, Nigeria, and also the administrative center of Akure South Local Government. Akure is situated within the southwestern region of Nigeria, positioned between latitudes 7.151°N and longitudes 5.151°E. It is located approximately 700 kilometers to the south of Abuja, Nigeria's Federal Capital, and approximately 350 kilometers away from Lagos, the nation's former capital. Ondo State, predominantly urban, boasts diverse and favorable ecological and climatic conditions. It has the sixth largest economy in Nigeria, primarily driven by agriculture, as well as abundant

resources in oil and gas, including significant deposits of bitumen, granites, crude oil, and glass sand. The state, particularly its capital, Akure, holds significant potential for swift infrastructural expansion and development, making it an ideal location for this study. Also Akure has strong presence of construction firms and adequate for determining circular economy practices and sustainable building construction projects in Ondo State.

The participants targeted for this research consist of building construction professionals from registered construction firms in the study area. The professionals include Project managers, Builders, Quantity Surveyors, Engineers, and Architects who possess relevant experience in building construction within the study area. The population consists of 39 registered construction firms as obtained from their association directory. The study employed a simple random sampling method to determine the sample size for the research. From the 39 construction firms in the study area, a sample of thirty-six (36) firms were selected using the Yamane formular.
The Yamane (1973) sample size formula was used to calculate the sample size as follows;

$$n = \frac{N}{(1 + Ne^2)} \quad (1)$$

*Where n is the sample size, N is the population size and e is the margin of error* (5%).
*Therefore substituting the values;*

$$n = \frac{39}{1 + 39(0.05^2)} = 36 \quad (2)$$

From the 36 construction firms, there were a total of one hundred and eighty (180) professionals which formed the sample size for the study.

Questionnaires were used as a means of collecting the primary data from the respondents through a designed survey, which were self-administered. A Likert scale was utilized in the questionnaire and it employed a 5-point rating system.

The research instrument's content was validated by two experts, one from the Department of Project Management and another from the Department of Building Technology at FUTA. The reliability of the instrument was also assessed by determining the internal consistency of the questionnaire through the Cronbach's Alpha threshold of 0.7.

The study utilized descriptive statistics, mean ranking, and frequency tables to analyze and present the distribution of the variables.

## RESULTS AND DISCUSSION

A set of 180 questionnaires was administered to building construction professionals in the study area, 167 of these were adequately and comprehensively filled out, representing 92.8% of the overall distributed questionnaires.

*Demographic Characteristics of Respondents:* The demographic profile of respondents from building construction projects in Ondo State, Nigeria, provides insights into industry participation trends (Table 1).

**Table 1:** Table Showing Demographic Characteristics of Respondents

| Variable | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 20 | 12.0 |
| Female | 147 | 88.0 |
| **Age** | | |
| Less than 20 years | 28 | 16.8 |
| 21-30 years | 41 | 24.6 |
| 31-40 years | 36 | 21.6 |
| 41-50 years | 42 | 25.1 |
| Over 50 years | 20 | 12.0 |
| Total | 167 | 100.0 |
| **Highest Educational Qualification** | | |
| OND | 36 | 21.6 |
| B.Sc./HND | 65 | 38.9 |
| PGD/MSc. | 51 | 30.5 |
| Ph.D | 15 | 9.0 |
| Total | 167 | 100.0 |
| **Professional/Owners category** | | |
| Project Manager | 21 | 12.6 |
| Engineer | 50 | 29.9 |
| Quantity Surveyor | 37 | 22.2 |
| Architect | 13 | 7.8 |
| Builder | 46 | 27.5 |
| Total | 167 | 100.0 |
| **Years of Experience** | | |
| Less than 5 years | 81 | 48.5 |
| 5 – 10 years | 32 | 19.2 |
| 10-15 years | 40 | 24.0 |
| Over 20 years | 14 | 8.4 |
| Total | 167 | 100.0 |

*Source: Field Survey (2023)*

Notably, there is a significant female majority (88%) compared to males (12%), suggesting an increase in female involvement in the construction sector. The age distribution shows a predominance of participants aged 21-50 years, indicative of a youthful workforce. Educational backgrounds are diverse, with most respondents holding B.Sc./HND (38.9%), followed by PGD/MSc. (30.5%), OND (21.6%), and a smaller fraction holding Ph.D. (9.0%), reflecting a highly educated pool of professionals. The professional breakdown shows Engineers (29.9%) and Builders (27.5%) as the largest groups, with Quantity Surveyors, Project Managers, and Architects also contributing significantly. Experience levels vary, with many respondents (48.5%) having less than five

years in the industry, suggesting a recent influx of new entrants, alongside a solid base of more experienced practitioners. These demographic characteristics underline a shift towards more gender diversity and indicate the importance of higher education in the sector. The data suggests the necessity for effective collaboration among various professional groups to ensure successful project outcomes. Additionally, the mix of novice and veteran professionals highlights the potential benefits of mentorship and continuous professional development to sustain innovation and skill enhancement in Ondo State's construction industry.

*Factors Influencing Circular Economy Practices in Building Construction Projects in the Study Area:* The analysis of factors influencing circular economy practices in building construction in Ondo State, Nigeria, was conducted using a 5-point Likert scale response to 20 statements categorized under five dimensions: regulatory, economic, technological, social, and organizational. The study's findings, presented in Table 2, indicate varying degrees of influence across these dimensions. In the regulatory sector, average scores suggest a moderate impact from current regulations on circular economy practices, with a mean score of 3.26, indicating that existing regulations somewhat encourage these practices. However, the scores for regulatory frameworks that support circular economy principles are lower (mean = 1.95), and the priority given to complying with these regulations is also not very high (mean = 2.36). The fostering of a sustainability culture through regulations scored slightly better but still indicates room for improvement (mean = 2.23). Economic factors appear to strongly influence circular economy adoption, with the economic advantages of these practices scoring high (mean = 3.96). This is in line with the study of Vandana (2023) that economic barriers are the major challenges in the implementation of Circular Economy (CE) practices in Construction and Demolition Waste (CDW) management. The cost-effectiveness of implementing circular principles has a mean score of 3.61, and the financial considerations in decision-making processes score even higher (mean = 4.11). However, the influence of economic incentives such as tax benefits and grants is less pronounced (mean = 2.51). Technological factors have a varied impact, with the general influence of advanced technology scoring relatively low (mean = 2.29). This is in tandem with Vidyadhar *et al.* (2021), and Bello and Abdullahi (2023), who posited that CE's technological interventions and innovation should be encouraged as a way to decrease obstacles to CE. In contrast, the role of innovative technologies in identifying and repurposing materials is viewed favorably (mean = 3.92), as is the use of digital tools for effective resource management (mean = 3.19). The overall importance of cutting-edge technology in the successful implementation of circular economy practices is moderately perceived (mean = 3.25). Social factors are important, with general community awareness and support for sustainable building initiatives scoring a mean of 3.27. The active collaboration between builders and local communities scores slightly lower (mean = 3.05), while the contribution of social initiatives to the widespread acceptance of these practices is higher (mean = 3.70). The standard deviation in community support and awareness, however, indicates diverse opinions (standard deviation = 2.460). Organizational factors show that companies within the construction sector generally prioritize circular economy principles, with a mean score of 3.23 for their integration into missions and values. Internal policies that encourage circular economy practices score a mean of 3.08, and training programs aimed at enhancing knowledge within organizations score higher (mean = 3.29). The alignment of these objectives with the strategic goals of construction companies is also seen positively (mean = 3.44). These results underscore the multi-faceted nature of the factors influencing circular economy practices in building construction projects in Ondo State, offering important insights for enhancing policy, technological adoption, and stakeholder engagement to foster sustainable practices in the sector. In the regulatory domain, the responses suggest moderate incentivization by existing regulations (mean = 3.26), though the overall support through regulatory frameworks is relatively weak (mean = 1.95). Compliance and fostering a sustainability culture also scored low, suggesting a need for stronger regulatory support. Economic factors show a strong influence, with respondents acknowledging the significant role of economic benefits (mean = 3.96) and financial viability (mean = 4.11) in adopting circular practices. However, economic incentives like tax breaks are less impactful (mean = 2.51). Technological factors received mixed responses, with innovative technologies for material repurposing scoring high (mean = 3.92), whereas the general use of advanced technologies was less influential (mean = 2.29). Social factors indicated moderate influence, with community awareness and support scoring relatively higher (mean = 3.27). Organizational factors revealed that circular economy practices are somewhat integrated into company missions and strategies, with strategic alignment scoring the highest (mean = 3.44). This agrees with the work of Singh; Khan; Dsilva, (2023), that top management participation is one of the most significant factors influencing CE adoption.

**Table 2:** Table showing factors influencing CE practices in building construction projects

| Category | Statement | Min | Max | Mean | Std. Dev. | Mean Rank |
|---|---|---|---|---|---|---|
| **Regulatory** | | | | | | |
| | Existing regulations in Ondo State incentivize and mandate circular economy practices in construction. | 1 | 5 | 3.26 | 1.120 | 2 |
| | Regulatory frameworks encourage builders to adopt circular economy principles. | 1 | 4 | 1.95 | 1.115 | 1 |
| | Compliance with circular economy regulations is a priority for construction projects in the region. | 1 | 4 | 2.36 | 0.687 | 3 |
| | The regulatory environment fosters a culture of sustainability within the construction industry. | 1 | 4 | 2.23 | 0.864 | 4 |
| **Economic** | | | | | | |
| | Economic benefits drive the adoption of circular economy practices in the construction sector. | 1 | 5 | 3.96 | 1.052 | 1 |
| | Builders in Ondo State recognize the cost-effectiveness of circular economy principles. | 1 | 5 | 3.61 | 1.124 | 2 |
| | Economic incentives, such as tax breaks and grants, motivate construction projects to embrace circular practices. | 1 | 4 | 2.51 | 0.891 | 3 |
| | The financial viability of circular economy approaches is a key consideration in construction decision-making. | 3 | 5 | 4.11 | 0.732 | 4 |
| **Technological** | | | | | | |
| | The construction industry in Ondo State leverages advanced technologies to enhance circular economy practices. | 1 | 4 | 2.29 | 0.996 | 1 |
| | Innovative technologies are employed to identify and repurpose materials in construction projects. | 1 | 5 | 3.92 | 1.000 | 2 |
| | Digital tools and platforms facilitate efficient resource management in the construction sector. | 1 | 5 | 3.19 | 1.023 | 3 |
| | The adoption of cutting-edge technologies is integral to the successful implementation of circular economy practices. | 1 | 5 | 3.25 | 0.810 | 4 |
| **Social** | | | | | | |
| | Social awareness and responsibility play a crucial role in promoting circular economy practices in construction. | 1 | 5 | 3.17 | 0.766 | 2 |
| | There is strong community awareness and support for sustainable building initiatives. | 1 | 33 | 3.27 | 2.460 | 1 |
| | Builders actively engage with local communities to promote the benefits of circular economy practices. | 1 | 5 | 3.05 | 1.339 | 3 |
| | Social initiatives and campaigns contribute to the widespread acceptance of circular economy principles in construction. | 1 | 5 | 3.70 | 1.073 | 4 |
| **Organizational** | | | | | | |
| | Organizations within the construction industry prioritize circular economy practices in their mission and values. | 1 | 5 | 3.23 | 1.217 | 2 |
| | Internal policies and guidelines promote the integration of circular economy principles in organizational practices. | 1 | 5 | 3.08 | 1.217 | 1 |
| | Training programs and capacity building initiatives are conducted to enhance circular economy knowledge within organizations. | 1 | 5 | 3.29 | 1.121 | 3 |
| | Circular economy objectives are embedded in the strategic goals of construction companies operating in Ondo State. | 1 | 5 | 3.44 | 1.139 | 4 |

*Source: Field Survey (2023)*

Training and internal policies also reflect moderate influence. The "Mean Rank" column is to give an ordinal representation of the mean values within each category, where "1" represents the lowest mean score and higher numbers represent higher mean scores. The mean rank helps identify which statements within each category are perceived as more or less influential. Overall, the data highlights the need for stronger

regulatory and economic incentives, better technological integration, and more active community and organizational engagement to promote circular economy practices in construction.

*Conclusion:* This study identified key regulatory, economic, technological, social, and organizational factors as factors influencing adoption of circular economy (CE) practices in the building construction sector in Ondo State, Nigeria. It sheds light on the nuanced roles that regulatory frameworks, economic incentives, technological advancements, social dynamics, and organizational strategies play in driving sustainable practices. By highlighting the gaps in regulatory compliance and the potential for economic incentives to enhance CE adoption, this research offers a critical pathway for policymakers and the construction industry stakeholders. Recommendations include developing stricter regulations, introducing financial incentives, fostering technological innovations, enhancing community engagement, and integrating CE goals within corporate strategies.

*Declaration of Conflict of Interest:* The authors declare no conflict of interest.

*Data Availability Statement:* Data are available upon request from the corresponding author.

## REFERENCES

Adams, K; Osmani, M; Thorpe, T; Thornback, J (2017). Circular economy in construction: current awareness, challenges and enablers. *Wast. Res. Manage.* 170(1): 15-24.

Akanbi, LA; Oyedele, LO; Akinade, OO; Ajayi, AO; Delgado, MD; Bilal, M; Bello, SA (2018). Salvaging building materials in a circular economy: A BIM-based whole-life performance estimator. *Res., Conserv. Recycl.*, 129: 175-186.

Akinade, OO; Oyedele, LO. (2019). Integrating construction supply chains within a circular economy: An ANFIS-based waste analytics system (A-WAS). *J. Clea. Prod.*, 229: 863-873.

Barrie, K (2017). Future Cities: driving the circular economy philosophy. Retrieved from https://www.globalrealestateexperts.com/2017/10/future-cities-driving-circular-economic-philosophy/

Bello, A; Abdullahi, I (2023). Strategies for Adoption of Circular Economy in the Nigeria Construction Industry. *J. Managem. Sci. Engi. Res.*. 6 (10): 30564/jmser.v6i2.5846.

Cavalliere, C; Dell'Osso, GR; Favia, F; and Lovicario, M (2019). BIM-based assessment metrics for the functional flexibility of building designs. *Autom Construct. 107*: 102925.

Chen, T; Ramon GJ; Gasco-Hernandez, M (2022). Understanding social sustainability for smart cities: The importance of inclusion, equity, and citizen participation as both inputs and long-term outcomes. *J. Sma Citi Soci. 1*(2): 135-148.

Droege, H; Raggi, A; and Ramos, TB (2021). Overcoming current challenges for circular economy assessment implementation in public sector organisations. *Sustain. 13*(3): 1182.

Ellen Macarthur Foundation (2016). Circularity in the Built Environment: Case Studies. P. 7.

Geipele, I; Plotka, K; Wirzhbitskis, Y; Zvirgzdins, J (2018). The Synergy in Circular Economy. 10.2991/febm-18.2018.15.

Ghisellini, P; Ripa, M; Ulgiati, S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review. *J. Clea. Prod.*, *178*: 618-643.

Gupta, S; Chen, H; Hazen, BT; Kaur, S; Gonzalez, EDS (2019). Circular economy and big data analytics: A stakeholder perspective. *Techn. Forecas. Soc. Chang.144:* 466-474.

Heeren, N; Hellweg, S (2019), Tracking Construction Material over Space and Time: Prospective and Geo-referenced Modeling of Building Stocks and Construction Material Flows. *J. Ind. Ecol*. 23: 253–267

Hobson, K (2016). "Closing the Loop or Squaring the Circle? Locating Generative Spaces for the Circular Economy." *Prog. Hum. Geogra.* 40: 88–104. DOI: 10.1177/0309132514566342

Hossain, MU; Ng, ST; Antwi-Afari, P; Amor, B. (2020). Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction. *Renewa. Sust. Energ. Rev., 130*: 109948.

Jones, A; Murphy J (2010b). Theorizing Practice in Economic Geography: Foundations, Challenges, and Possibilities. *Prog. Hum. Geogra.* 35: 366–392. DOI: 10.1177/ 0309132510375585.

Mangialardo, A; Micelli, E (2020). Innovation of off-site constructions: Benefits for developers and the community in an Italian case study. *Val. Funct. Fut. Cit.* 217-228.

Munaro, MR; Tavares, SF (2023). A review on barriers, drivers, and stakeholders towards the circular economy: The construction sector perspective. *Clea. Respo. Cons.*100107.

Olanrewaju, SD; Ogunmakinde, OE (2020). Waste minimisation strategies at the design phase: Architects' response. *Was. Manag.*118: 323-330.

Pomponi, F; Moncaster, A (2017). Circular economy for the built environment: A research framework. *J. Clea. Prod.* 143: 710-718.

Ruiz, LAL; Ramón, XR; Domingo, SG (2020). The circular economy in the construction and demolition waste sector–A review and an integrative model approach. *J. Clea. Prod.* 248: 119238.

Singh, R; Khan, S; Dsilva, J. (2023). A framework for assessment of critical factor for circular economy practice implementation. *J. Mode. Manage.* 18(5): 1476-1497.

Swiss Life Group (2022) What is the Lifespan of a House? Available online: https://www.swisslife.com/en/home/hub/what-is-thelifespan-of-a-house.html (accessed on Feb. 14, 2024).

The United Nations (2015), "Proposal for Sustainable Development Goals - Sustainable Development Knowledge Platform," 2015. [Internet]. Available: https://sustainabledevelopment.un.org/focussdgs.html. [Accessed: 10 -July -2023].

Vandana B; Srividhya R; Sudarsan, JS (2023). Barriers to circular economy practices during construction and demolition waste management in an emerging economy, Resources, *Conserva. Recycl. Adv.* 20 (200198), ISSN 2667-3789, https://doi.org/10.1016/j.rcradv.2023.200198.

Vidyadhar V; Gedam, RD; Raut, AB; Lopes de Sousa J; Ajinkya N; Tanksale, B;. Narkhede, E (2021). Circular economy practices in a developing economy: Barriers to be defeated. *J. Clea. Produ.* 311: 127670, ISSN 0959-6526,

World Economic Forum. (2018). Circular economy in cities: Evolving the model for a sustainable urban future. 29p. Retrieved from http://www3.weforum.org/docs/White_paper_Circular_Economy_in_Cities_report_2018.pdf

Zvirgzdins, J; Plotka, K; Geipele, S (2019, May). Circular economy in built environment and real estate industry. In *Proceedings of the 13th International Conference "Modern Building Materials, Structure. Technique,* Vilnius, Lithuania (pp. 16-17).