ADOPTION OF CIRCULAR ECONOMY PRINCIPLES IN CONSTRUCTION PROJECT AND DEMOLITION WASTE MANAGEMENT

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Abstract

Construction and demolition waste is becoming an important concern due to the rapid growth of construction activities and the large amount of materials generated at construction sites. Improper disposal of materials such as bricks, concrete, steel, wood, and plastic can lead to environmental problems and unnecessary loss of useful resources. This study focuses on the adoption of circular economy principles, particularly Reduce, Reuse, and Recycle, as a practical approach to improving construction and demolition waste management. The study examines existing waste management practices, awareness of circular economy principles, reuse and recycling activities, major challenges, and opportunities for improvement. Primary data were collected through a structured questionnaire from construction professionals, supported by information from relevant literature. The collected responses were analyzed using frequency, percentage analysis, descriptive statistics, and percentage-based ranking methods. The findings show that construction waste generation is common at project sites, while proper waste segregation is not consistently followed. Awareness of circular economy principles is fairly good, and reuse of materials such as steel, bricks, and wood is already practiced to some extent. However, resistance to change, high implementation costs, lack of proper guidelines, and limited recycling facilities remain important barriers to wider adoption. The study also indicates that better planning, training, technology, improved recycling infrastructure, and government support can help overcome these challenges. Overall, the study concludes that proper implementation of circular economy principles can reduce construction waste, improve resource efficiency, and support more sustainable construction practices.

Keywords: Circular Economy, Construction and Demolition Waste, Waste Management, Reuse, Recycling, Sustainable Construction, Resource Efficiency.

1. Introduction

The construction industry plays an important role in economic and social development because it provides buildings, roads, bridges, and other infrastructure needed for everyday life. However, the rapid growth of construction activities also leads to a large amount of construction and demolition (C&D) waste. Materials such as bricks, concrete, steel, wood, and plastic are often wasted during construction, renovation, and demolition activities. When these materials are simply dumped or sent to landfills, useful resources are lost and additional environmental problems are created.

Traditional construction practices generally follow a linear approach in which materials are extracted, used, and finally discarded as waste. This approach increases the demand for natural resources and creates pressure on waste disposal systems. The **circular economy** provides a different approach by encouraging materials to remain useful for as long as possible. In construction, principles such as **reduce, reuse, and recycle** can help minimize waste generation and recover valuable materials from construction sites. Instead of treating waste only as something to be disposed of, circular economy practices consider many waste materials as resources that can be used again.

The present study focuses on understanding the existing construction and demolition waste management practices and examining the level of adoption of circular economy principles in construction projects. The study considers aspects such as waste generation, waste segregation, material reuse, recycling, awareness among construction professionals, and the major challenges affecting circular economy adoption. Primary information is collected from construction professionals through a structured questionnaire, while secondary information is obtained from existing research and literature related to circular economy and construction waste management. The collected data is analyzed using percentage analysis, descriptive statistics, and ranking methods to understand the current situation in a simple and practical manner.

The study also aims to identify the practical opportunities for improving circular economy practices in construction projects. Particular attention is given to issues such as resistance to change, implementation cost, availability of recycling facilities, worker training, technology, planning, and government support. By understanding these factors, the study seeks to provide practical suggestions for reducing construction waste, improving material recovery, and making better use of available resources. Overall, the research highlights the importance of moving from conventional waste disposal towards a more systematic and sustainable approach to construction and demolition waste management.

2. Review of Literature

Itumo I.C., Okolie K.C., and Okoye N.M. (2025) examined the challenges in applying circular economy principles to construction and demolition waste management. The study identified inadequate recycling infrastructure, limited technology, poor stakeholder coordination, resistance to change, and cost concerns as major barriers. The authors emphasized that better infrastructure, collaboration, and supportive policies are required for effective implementation.

Weerakoon, Zvirgzdiņš, Geipele, et al. (2025) developed a decision-making framework for integrating circular economy principles into construction waste management. Environmental and economic factors were found to be particularly important, while on-site waste segregation emerged as an effective strategy. The study also highlighted the potential of artificial intelligence and real-time data for improving waste management.

Sadiq and Khalfan (2024) conducted a bibliometric analysis of circular economy research in the construction and demolition industry. Their study showed growing research interest in

resource efficiency, waste reduction, and material recovery. The authors also emphasized interdisciplinary collaboration and the use of digital technologies for future circular economy implementation.

Saradara, Flores Lara, Swarnakar, et al. (2024) studied construction and demolition waste management in the UAE using the Reduce, Reuse, and Recycle principle. The study highlighted the importance of planning and design in reducing waste and recommended greater reuse and recycling of construction materials. Policy support and stakeholder involvement were also identified as important for sustainable waste management.

Bhavsar, Sridharan, Sudarsan, et al. (2025) reviewed global research on circular economy and construction demolition waste management. The study found that recycling is a major research focus, while BIM, life cycle assessment, and machine learning are emerging areas. The authors suggested stronger collaboration and wider development of circular business models and sustainable supply chains.

Swarnakar and Khalfan (2024) reviewed circular economy adaptation in construction and demolition waste management. The study found that although awareness is increasing, practical implementation remains limited. A conceptual framework was proposed covering waste reduction, resource recovery, recycling, technology, policy support, and stakeholder participation.

She, Udawatta, Tokede, et al. (2025) examined stakeholder engagement in circular economy-based construction waste management. The study found that lack of understanding and coordination among stakeholders is an important barrier. The proposed framework highlighted collaboration among contractors, designers, project managers, policymakers, and waste management organizations.

Swarnakar, Eltoukhy, Omar, et al. (2025) investigated success factors, barriers, benefits, and technologies related to circular economy adoption. Developing markets for recycled materials was identified as an important success factor, while limited demand and concerns about product quality were major barriers. The study also highlighted AI, IoT, blockchain, digital twins, and robotic systems as useful technologies.

Oliveira, Oliveira, and Fonseca (2021) examined circular economy strategies for construction and demolition waste management in Manaus, Brazil. The study identified limited recycling opportunities, weak monitoring, and inadequate policy enforcement as major problems. It recommended stronger government support and improved infrastructure to increase reuse, recycling, and resource recovery.

Sudarsan, Katare, and Gavali (2023) examined the role of BIM in construction and demolition waste management. The study found that BIM can support waste forecasting, material tracking, project planning, and identification of reuse and recycling opportunities. The authors concluded that BIM can improve resource efficiency and support circular economy practices.

Wu, Wang, Ye, et al. (2022) studied construction and demolition waste recycling from a circular economy perspective. The research proposed a framework for improving resource recovery throughout the project lifecycle. It highlighted that effective recycling can reduce landfill dependency, conserve natural resources, and provide both environmental and economic benefits.

Bello and Idris (2023) examined strategies for adopting circular economy principles in the Nigerian construction industry. Waste management systems, recycling facilities, design for disassembly, and renewable materials were identified as important strategies. The study also emphasized the role of policymakers and industry professionals in supporting circular economy adoption.

Rao, Rahman, and Duraman (2025) reviewed circular economy adoption in construction and identified 32 motivators, 35 challenges, and 31 implementation strategies. The study emphasized that technical, financial, organizational, and policy barriers must be addressed together. It concluded that circular economy can help reduce waste and improve resource efficiency.

She, Udawatta, Liu, et al. (2024) examined circular economy strategies for minimizing construction and demolition waste in Australia. The study emphasized early planning, sustainable design, stakeholder involvement, and material optimization. It concluded that circular economy principles should be considered throughout the project lifecycle to achieve effective waste reduction.

Shooshtarian, Maqsood, Wong, et al. (2023) studied the use of recycled-content products in construction projects. The findings showed that government support, organizational commitment, and stakeholder education can encourage the use of recycled materials. Material quality concerns, supply limitations, and lack of awareness were identified as important barriers.

López Ruiz (2023) evaluated circular economy strategies in the construction and demolition waste sector. The study found that circular approaches can provide better environmental and economic performance than traditional waste management. It also highlighted the importance of pre-construction planning and the effects of transportation and landfill disposal on overall performance.

Alhawamdeh, Lee, and Saad (2024) examined circular economy design practices in the architecture, engineering, and construction sector. The study highlighted adaptability, design for disassembly, material recovery, and long-term resource use as important practices. It concluded that circular economy considerations should be included at the design stage.

Alhawamdeh, Ferriz-Papi, and Lee (2024) reviewed the major drivers supporting circular economy-based construction waste management. Political support, economic incentives, technology, environmental awareness, and regulations were identified as important drivers. The study emphasized that successful implementation requires combined efforts from stakeholders and policymakers.

Spišáková, Mandičák, Mésároš, et al. (2022) examined construction waste management during the design stage. The study emphasized that early decisions regarding materials, technologies, and construction methods strongly influence future waste generation. It recommended considering waste management from the beginning of project planning rather than only after construction starts.

García Martín, Chebrolu, Chadee, et al. (2024) examined opportunities and barriers for circular economy-based construction waste management. Legal, managerial, and design-related barriers were found to be particularly important, while inefficient recycling policies were also identified as a major concern. The study recommended stronger policies, improved management practices, and suitable indicators for monitoring circular economy performance.

3. Objective of the Study

The objectives of the proposed study will be as follows:

1. To assess current construction and demolition waste practices.
2. To identify opportunities to apply circular economy principles on-site.
3. To evaluate the impact of reuse, recycling, and material recovery.
4. To suggest practical strategies to reduce waste in construction projects.
5. To propose a simple framework for adopting circular economy methods.

4. Methodology

Research Design

The study followed a descriptive and analytical research design to examine the adoption of circular economy principles in construction and demolition waste management. The descriptive approach was used to understand existing waste management practices, while the analytical approach helped in examining awareness, reuse and recycling practices, implementation challenges, and opportunities for improvement.

Research Approach

A quantitative approach was mainly used for collecting and analyzing responses from construction professionals. A structured questionnaire was used to obtain information in a simple and consistent manner. The study focused on practical aspects of construction waste management rather than laboratory-based testing.

Data Sources

Both primary and secondary data were used in the study. Primary data were collected directly from construction professionals through a structured questionnaire. Secondary data were obtained from research papers, journals, books, conference publications, and other relevant academic sources related to circular economy and construction and demolition waste management.

Sample and Data Collection

The questionnaire was distributed to 200 construction professionals, including site engineers, supervisors, contractors, project managers, and other personnel involved in construction activities. Based on an expected response rate of approximately 50%, around 100 usable responses were considered for analysis. The questionnaire covered demographic information, existing waste management practices, circular economy awareness, reuse and recycling practices, challenges, and possible improvement measures.

Questionnaire Design

The questionnaire was prepared using simple and clear questions related to the objectives of the study. It covered major areas such as construction waste generation, waste segregation, material reuse, recycling, awareness of circular economy principles, barriers to implementation, and willingness to adopt circular economy practices.

Data Analysis

The collected responses were organized and analyzed using frequency, percentage analysis, descriptive statistics, and percentage-based ranking. Frequency and percentage were used to present the distribution of responses, while descriptive statistics provided a general summary of the collected data. Percentage ranking was used to identify the relative priority of different challenges, practices, and improvement measures based on the responses.

Study Variables

The major variables considered in the study included construction and demolition waste generation, waste segregation, material reuse, recycling practices, awareness of circular economy, implementation barriers, stakeholder involvement, and willingness to adopt circular economy practices.

Presentation of Results

The analyzed data were presented through tables, graphs, and simple interpretations to make the findings easy to understand. The results were used to identify the existing level of circular economy adoption, major barriers, and possible opportunities for improving construction and demolition waste management.

Ethical Considerations

The collected information was used only for academic purposes. Respondents were informed about the purpose of the study, and the information provided by them was treated confidentially. The study did not disclose personal information of individual respondents.

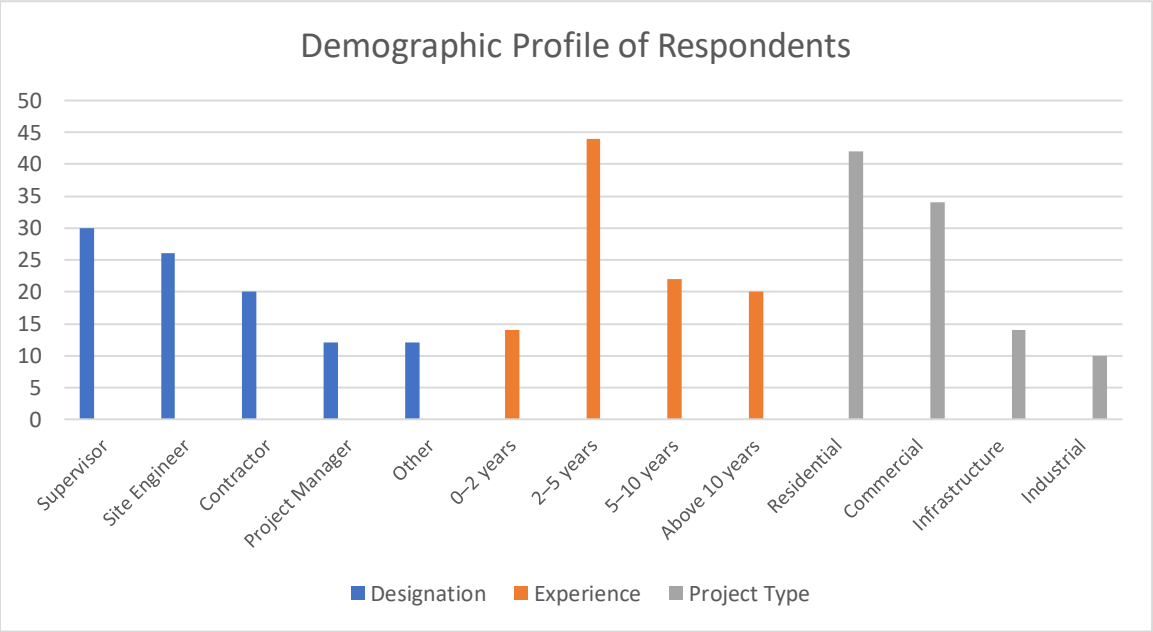
5. Results

Demographic Analysis

Table 1: Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Designation	Supervisor	30	30%
	Site Engineer	26	26%

	Contractor	20	20%
	Project Manager	12	12%
	Other	12	12%
Experience	0–2 years	14	14%
	2–5 years	44	44%
	5–10 years	22	22%
	Above 10 years	20	20%
Project Type	Residential	42	42%
	Commercial	34	34%
	Infrastructure	14	14%
	Industrial	10	10%
Total	—	100	**100%**



Graph 1: Demographic Profile of Respondents

The demographic results show that the study included respondents from different roles in the construction sector. Supervisors formed the largest group (30%), followed by Site Engineers (26%) and Contractors (20%). This indicates that the responses mainly came from professionals who are directly connected with construction site activities.

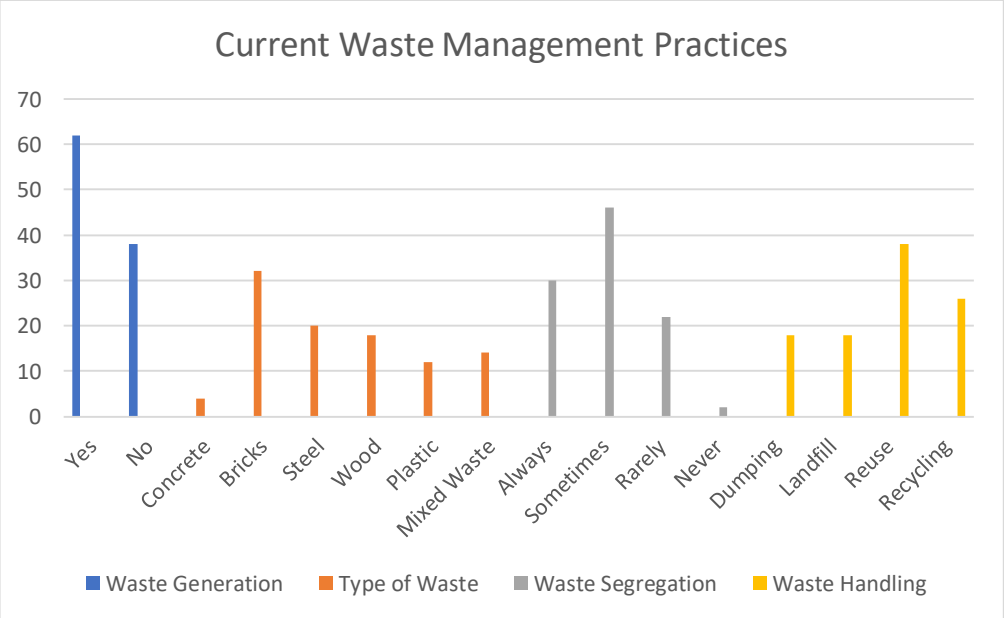
In terms of experience, the largest group of respondents had 2–5 years of experience (44%). This was followed by those with 5–10 years (22%) and above 10 years (20%). Therefore, the study includes a reasonable mix of relatively experienced construction professionals.

Residential projects represented the largest project category (42%), followed by commercial projects (34%). Infrastructure and industrial projects accounted for 14% and 10%, respectively. This shows that the findings mainly reflect waste management practices observed in residential and commercial construction projects.

Analysis of Construction Waste Management Practices

Table 2: Current Waste Management Practices

Variable	Category	Frequency	Percentage (%)
Waste Generation	Yes	62	62%
	No	38	38%
Type of Waste	Concrete	4	4%
	Bricks	32	32%
	Steel	20	20%
	Wood	18	18%
	Plastic	12	12%
	Mixed Waste	14	14%
Waste Segregation	Always	30	30%
	Sometimes	46	46%
	Rarely	22	22%
	Never	2	2%
Waste Handling	Dumping	18	18%
	Landfill	18	18%
	Reuse	38	38%
	Recycling	26	26%
Total	—	**100**	**100%**



Graph 2: Current Waste Management Practices

The results indicate that construction waste generation is a common issue, with 62% of respondents reporting regular waste generation at their sites. Bricks were the most commonly generated waste material (32%), followed by steel (20%) and wood (18%). This shows that different construction materials contribute to waste during project activities.

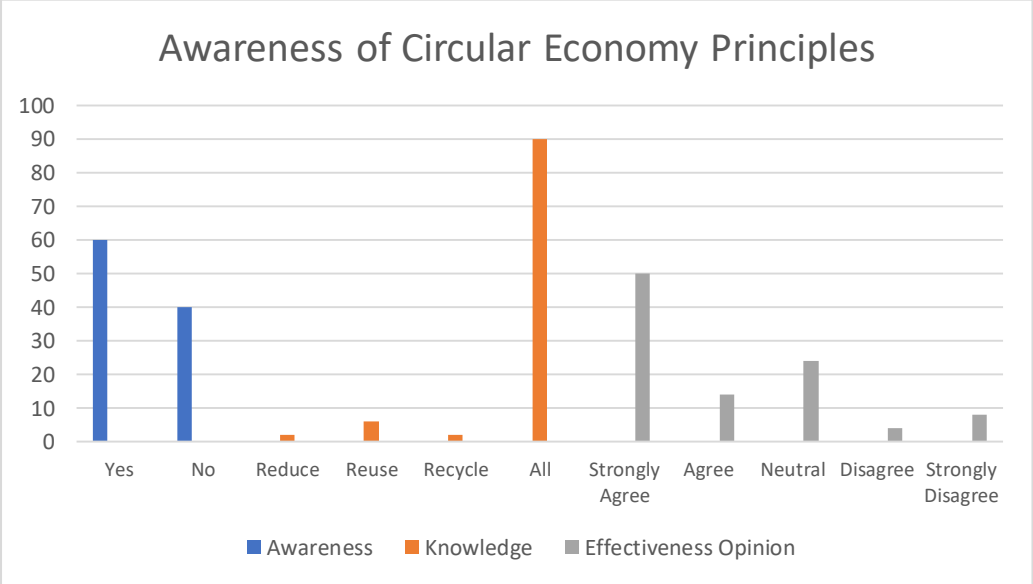
Waste segregation was not consistently practiced. While 30% of respondents reported that segregation was always followed, the largest group (46%) stated that it was done only sometimes. This suggests that waste is still frequently mixed at construction sites, which can make further reuse and recycling more difficult.

Regarding waste handling, reuse was reported by 38% of respondents, followed by recycling at 26%. However, dumping and landfill were still reported by 18% each. This indicates that although some circular practices are already being used, conventional disposal methods continue to exist alongside them.

Analysis of Awareness of Circular Economy

Table 3: Awareness of Circular Economy Principles

Variable	Category	Frequency	Percentage (%)
Awareness	Yes	60	60%
	No	40	40%
Knowledge	Reduce	2	2%
	Reuse	6	6%
	Recycle	2	2%
	All	90	90%
Effectiveness Opinion	Strongly Agree	50	50%
	Agree	14	14%
	Neutral	24	24%
	Disagree	4	4%
	Strongly Disagree	8	8%
Total	—	**100**	**100%**



Graph 3: Awareness of Circular Economy Principles

The findings show that 60% of respondents were aware of circular economy concepts, while 40% were not. A particularly high proportion (90%) reported knowledge of all three basic

principles—reduce, reuse, and recycle. This suggests that the basic idea of circular economy is familiar to many construction professionals.

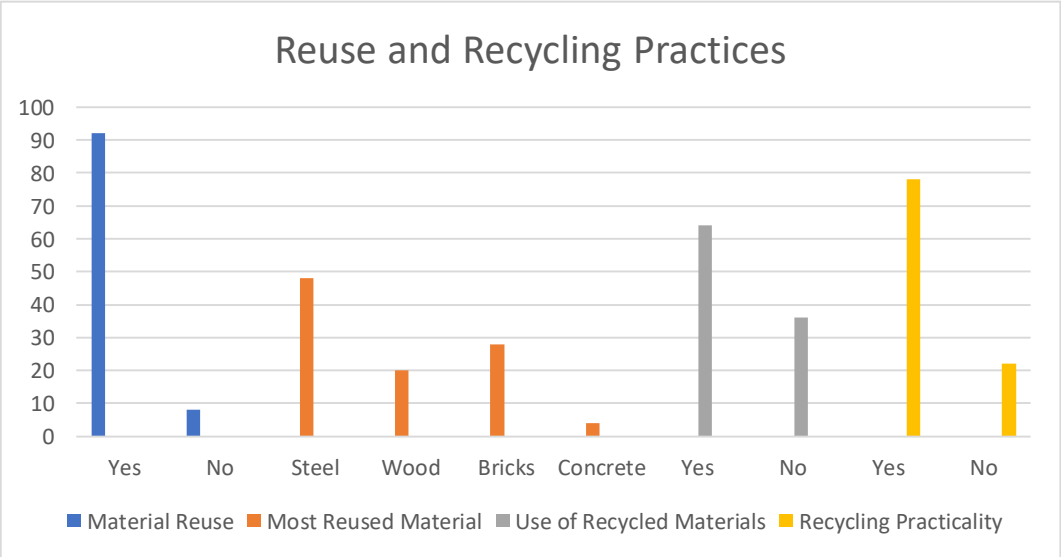
The respondents also showed a generally positive opinion about the role of circular economy in reducing construction waste. Half of the respondents (50%) strongly agreed that it can help reduce waste, while another 14% agreed. At the same time, 24% remained neutral, showing that some respondents may still be uncertain about its practical application.

Overall, the results suggest that basic awareness exists, but awareness alone does not guarantee proper implementation. The gap between knowing the principles and applying them consistently at construction sites remains an important area for improvement.

Reuse and Recycling Practices

Table 4: Reuse and Recycling Practices

Variable	Category	Frequency	Percentage (%)
Material Reuse	Yes	92	92%
	No	8	8%
Most Reused Material	Steel	48	48%
	Wood	20	20%
	Bricks	28	28%
	Concrete	4	4%
Use of Recycled Materials	Yes	64	64%
	No	36	36%
Recycling Practicality	Yes	78	78%
	No	22	22%
Total	—	**100**	**100%**



Graph 4: Reuse and Recycling Practices

Reuse was one of the strongest circular economy practices reported in the study, with 92% of respondents stating that materials are reused at their construction sites. Steel was the most

commonly reused material (48%), followed by bricks (28%) and wood (20%). This indicates that materials with good recovery value are already being reused in many projects.

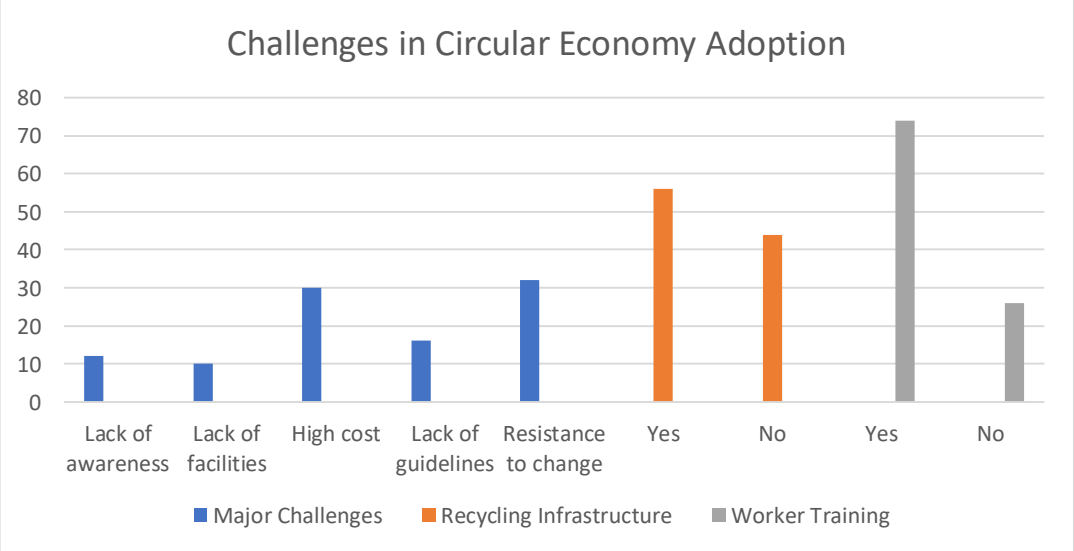
The findings also show that 64% of respondents use recycled materials in construction. In addition, 78% considered recycling practical at their sites. These responses indicate that construction professionals generally see value in recycling and are reasonably open to using recovered materials.

However, the difference between the willingness to recycle and actual use of recycled materials shows that practical limitations may still exist. Better facilities, proper planning, reliable sources of recycled materials, and suitable guidance could help convert this positive attitude into more regular recycling practices.

Challenges in Circular Economy Adoption

Table 5: Challenges in Circular Economy Adoption

Variable	Category	Frequency	Percentage (%)
Major Challenges	Lack of awareness	12	12%
	Lack of facilities	10	10%
	High cost	30	30%
	Lack of guidelines	16	16%
	Resistance to change	32	32%
Recycling Infrastructure	Yes	56	56%
	No	44	44%
Worker Training	Yes	74	74%
	No	26	26%
Total	—	**100**	**100%**



Graph 5: Challenges in Circular Economy Adoption

The major challenges identified were resistance to change (32%) and high cost (30%). These two factors received the highest responses, indicating that both human behavior and financial

concerns can affect the adoption of circular economy practices. Construction organizations may continue with familiar methods when new practices are considered costly or difficult to implement.

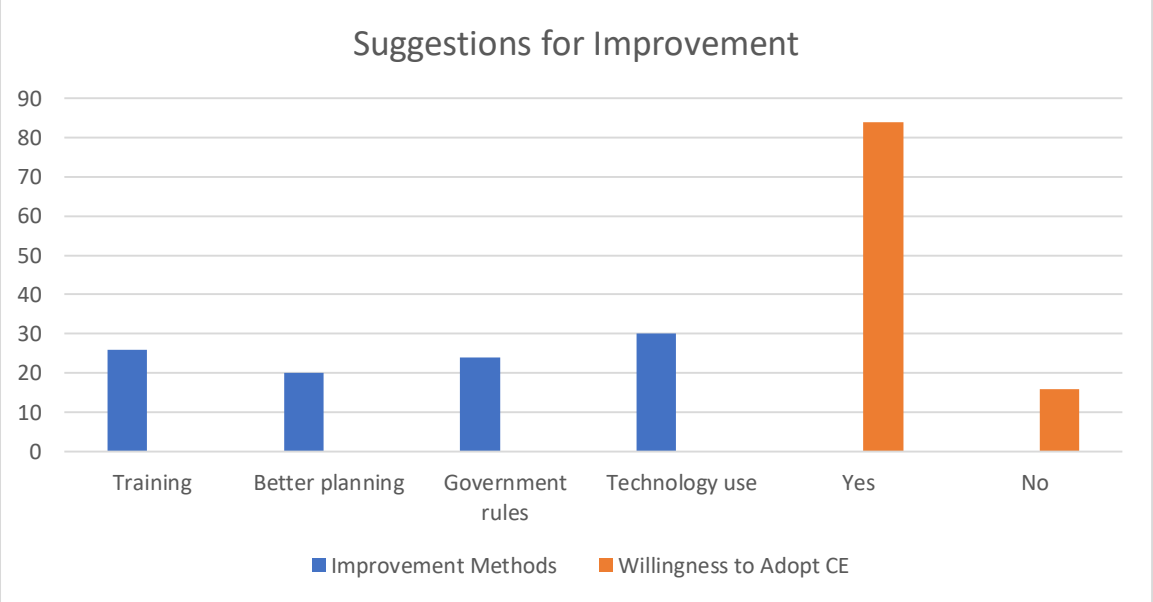
Other challenges included lack of guidelines (16%), lack of awareness (12%), and lack of facilities (10%). Although these percentages are lower, they still show that implementation is affected by the availability of proper support systems. Clear guidelines and better facilities can make circular practices easier to follow at project sites.

The availability of recycling infrastructure was also not uniform. While 56% reported that suitable infrastructure was available, 44% reported that it was not. At the same time, 74% stated that workers were trained in waste management. This suggests that training is relatively positive, but infrastructure and implementation barriers still need attention.

Suggestions and Improvement

Table 6: Suggestions for Improvement

Variable	Category	Frequency	Percentage (%)
Improvement Methods	Training	26	26%
	Better planning	20	20%
	Government rules	24	24%
	Technology use	30	30%
Willingness to Adopt CE	Yes	84	84%
	No	16	16%
Total	—	**100**	**100%**



Graph 6: Suggestions for Improvement

Technology use was identified as the most preferred improvement measure, with 30% of respondents selecting it. Training followed with 26%, while government rules and better

planning received 24% and 20%, respectively. These responses indicate that respondents see a need for both technical improvements and better management support.

The importance of training is also clear because proper waste segregation, reuse, and recycling depend on the understanding and participation of workers and site professionals. Similarly, better planning can help reduce material wastage before it occurs rather than dealing with waste only after it has been generated.

Most importantly, 84% of respondents were willing to adopt circular economy practices in future projects. This shows a strong positive attitude towards sustainable waste management. If this willingness is supported by suitable technology, training, clear government guidelines, better planning, and recycling infrastructure, the adoption of circular economy practices can become more practical and consistent.

6. Discussion

The findings of the study show that construction and demolition waste is still a common issue at construction sites, and the existing waste management practices are not fully systematic. Although 62% of respondents reported regular waste generation, waste segregation was followed consistently by only 30% of respondents, while 46% reported that segregation was done only sometimes. This indicates that there is still a clear gap between waste generation and proper waste management. Reuse was reported more frequently than recycling, with 92% of respondents reusing materials, while 64% reported using recycled materials. This suggests that construction professionals are already using some circular practices, but these practices need to become more organized and regular.

The study also shows that awareness of circular economy is fairly positive, as 60% of respondents were aware of the concept and 90% were familiar with reduce, reuse, and recycle. However, the findings indicate that awareness alone is not enough to ensure proper implementation. Resistance to change (32%) and high cost (30%) were identified as the main barriers, along with lack of guidelines and recycling facilities. These findings are consistent with the reviewed literature, where lack of infrastructure, cost concerns, limited stakeholder coordination, and the gap between knowledge and practical implementation were commonly identified as important challenges.

At the same time, the results show good potential for improving circular economy adoption in construction projects. Technology use (30%), training (26%), government support (24%), and better planning (20%) were identified as useful improvement measures. Most importantly, 84% of respondents expressed willingness to adopt circular economy practices in future projects. This suggests that the construction sector has a positive base for change, but practical support is required to convert willingness into regular action. Better planning from the early project stage, proper segregation, improved recycling facilities, worker training, and stronger coordination among stakeholders can help construction projects move towards more sustainable waste management.

7. Conclusion

This study examined the adoption of circular economy principles in construction and demolition waste management and found that waste generation remains a common issue across construction projects. Materials such as bricks, steel, wood, plastic, and mixed waste are regularly generated, while proper segregation is not yet followed consistently. Although reuse and recycling practices are present, traditional methods such as dumping and landfill disposal are still used. The findings also show that construction professionals have a reasonable level of awareness of the **Reduce, Reuse, and Recycle** principles, and reuse of materials such as steel, bricks, and wood is already common at many sites. However, there is still a gap between awareness and actual implementation. High costs, resistance to change, lack of clear guidelines, and limited recycling facilities were identified as important barriers. At the same time, the high willingness of respondents to adopt circular economy practices shows good potential for future improvement. Overall, the study concludes that effective planning, proper waste segregation, worker training, suitable technology, stakeholder involvement, improved recycling infrastructure, and supportive government policies can help the construction industry reduce waste, conserve resources, and move towards more sustainable and circular construction practices.

8. Future Scope

Future studies can include a larger number of construction projects and professionals from different regions to get a broader understanding of circular economy adoption. Further research can also examine the use of technologies such as BIM and digital tools for better waste planning, material tracking, reuse, and recycling.

There is also scope to study the effectiveness of government policies, recycling infrastructure, worker training, and stakeholder involvement in greater detail. Future research can further evaluate the economic and environmental benefits of circular economy practices to develop practical guidelines for sustainable construction waste management.

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