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A Quantitative Study of the Circular Economy's Potential Barriers and Drivers for India's Construction Sector

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Abstract:

The construction industry follows a linear development strategy, which is a common approach in a variety of other industries. Additionally, it could be contended that this particular industry is significantly responsible for India's disquieting history of inefficient resource utilization. The results of a quantitative study that investigated the advantages and disadvantages of circular economy (CE) practices in the Indian construction sector are presented in this paper. In order to assess the perceived benefits of circular economy (CE) and the significant impediments to its implementation, questionnaires were distributed to construction enterprises, parliamentarians, and suppliers in the current study. The results suggest that there is potential for development in sustainability, cost reductions, and adherence to regulatory requirements, despite the persistent challenges that developing nations encounter in integrating circular economy (CE) best practices. Tables and diagrams are employed to visually represent the quantitative results of the descriptive statistical analysis.
Keywords: *Circular Economy; Indian Construction Industry; Barriers and Drivers.*

INTRODUCTION

As the detrimental effects of our industrial activities on the environment and society have become more apparent the current linear economic model of take-make-use-dispose has come under criticism, and a new more sustainable concept has been presented. Circular Economy (CE) is a systematic approach which aims to reshape our industrial processes by minimizing the consumption of finite resources and keeping resources in productive use in the economy for as long as possible. The concept has been steadily gaining attention recently and is also viewed by legislators as an essential policy for the construction industry due to its positive environmental impacts [1].

Indian Construction Industry is highly employment intensive and accounts for approximately 50% of the capital outlay in successive 5-Year Plans of our country. The Projected investment in this industrial sector continues to show a growing trend. Construction activity leads to generation of solid wastes, which include sand, gravel, concrete, stone, bricks, wood, metal, glass, plastic, paper etc. The management of construction and demolition waste is a major concern for town planners due to the increasing quantum of demolition's rubble, continuing shortage of dumping sites, increase in transportation and disposal cost and above all growing concern about pollution and environmental deterioration. Central Pollution Control Board has estimated current quantum of solid waste generation in India to the tune of 48 million tons per annum of which waste from Construction Industry accounts for 25%. Management of such high quantum of waste puts enormous pressure on solid waste management system. Construction waste is bulky and heavy and is mostly unsuitable for disposal by incineration or composting. The growing population in the country and requirement of land for other uses has reduced the availability of land for waste disposal. Re-utilization or recycling is an important strategy for management of such waste [2].

According to United Nations Environment Program report, the construction industry is responsible for almost 38 percent of total energy-related Greenhouse Gas (GHG) emissions globally. The numbers clearly state the problematic state of the industry and the importance of transitioning to a more environmentally responsible business model. As is described by many scholars CE aims to keep materials, components and products at their highest value all the time with aiming to decouple growth from the consumption of finite resources and to keep the resources in productive use in the economy for

as long as possible. However, the majority of the research in the field of Circular Economy has focused on short-lived manufactured products in contrast, constructions are unique entities with a complex supply chain with various actors, components and materials [3].

This complex structure of the industry still works in favor of linear business models currently. However, CE and circular business models hold immense opportunities for the construction industry where firms can reduce waste production, energy use and greenhouse gas emissions [4]. Also, constructions, as entities show great potential in terms of benefitting from additional value creation with CE that the industry can utilize circular practices in a broader context to explore hidden opportunities [5].

Circular Economy as a theory has its roots in sustainable development and industrial ecology. The most common definition of sustainable development is that it is an economic, environmental, and social development that meets the needs of the present without compromising the needs of future generations. These theories share a lot of similar aspects as they are closely linked. Due to the unclear conceptual contours and constraints, many use them interchangeably [5].

Circular Economy has three main principles: designing out waste and pollution, keeping products and materials in use and regenerating natural systems. The first one of these principles addresses the immense number of resources that we spend and use without a thought. Currently, about two-thirds of the material we extract from the planet ends up as waste and only 9 percent of the materials are recycled [6]. In CE, the target is close to 0 percent waste and pollution. CE unveils the negative economic activities that harm the environment or society and then excludes them. In essence, this includes food waste, hazardous materials, greenhouse gases, one-use plastics and other substances that would pollute the water, land or air.

The second principle extends product and material life. Activities that preserve energy, labor, and materials are promoted. Designing for durability, reuse, remanufacturing, and recycling keeps goods, components, and resources in the economy. Businesses that embrace the Circular Economy offer long-lasting goods and encourage maintenance and refurbishing. CE promotes recycling and reuse, which reduces virgin material consumption.

Finally, CE seeks to construct a nature-regenerating industrial system. It can reach net positive via restorative models by preferring renewables and eliminating waste. Economic activity will replenish nature rather than deplete it.

CE detractors believe the notion overprioritizes economic benefits and has a market-liberal mindset, neglecting social concerns [5]. CE supports reducing virgin materials but not reducing consumption or questioning economic progress. It is also believed that technology advancement would allow us to circularize the industrial system.

Statement of Problem

The idea of sustainable development has gained prominence in the last several decades as a means to solve critical global problems in a way that doesn't compromise the health of future generations or the planet's natural resources. Environmental, social, and economic problems all affect one another, making them difficult to solve without new approaches. The advent of the Circular Economy (CE) model offers hope for solving these problems. Circular Economy (CE): a more comprehensive understanding of the factors that drive and hinder its implementation from the perspective of industry professionals requires the inclusion of quantitative data.

Objectives

1. To identify the barriers to the adoption of CE practices in the Indian construction industry.
2. To assess the drivers of CE practices as recognized by professionals in the sector.

LITERATURE REVIEW

Circular Economy discusses Buckminster Fuller's book-length essay Operating Manual for Spaceship Earth's finding that the globe has finite resources. CE lacks a general definition. Therefore, this thesis will mostly employ the two most cited definitions. The Ellen MacArthur Foundation, a Circular Economy foundation, defined the term most often. The authors call it "an industrial economy that is restorative by design and aims to keep products, components, and materials at their highest utility and value at all times". Another is by Peter Lacy, who produced two volumes on the issue (Lacy, et al., (2020) [7] characterizes CE as a systematic approach to economic development that strives to divorce growth from resource consumption and retain resources in productive use as long as feasible.
The regulatory framework in India hinders CE adoption. Everyone agrees that current national restrictions don't allow broad CE processes. CE programs struggle with unclear and unenforceable resource efficiency and waste management rules.

Kharola et al. (2020) [8] looks at potential barriers to organic waste management solutions. The objective of his study is to identify the barriers to organic waste management solutions from an actor's perspective, and to explore their causal relationships to overcome the organic waste management problem from a system perspective. Several key challenges were identified regarding organic waste management solution,
Ghosh and Dutta's (2022) [9] focus on the environmental behavior of firms classified according to their ownership structure observing that Government-Owned Firms (GOFs) tend to rely less on their internal and debt capital to finance their environmental investment, whereas Private-Owned Firms (POFs) rely mainly on their internal capital.

Malik et al. 2021 [10] develop a multilevel theoretical framework grounded in CE and change management literature, which presents the nature and extent of CE activities, barriers and contextual enablers of SMEs' adoption of CE in emerging markets. Implications for policy, theory and practice are also discussed.

The circular economy concepts are useful for resource conservation, eliminating waste and enhancing the efficiency of production to improve the sustainability of the system. The application of CE in Indian manufacturing industry is in nascent stage. India's manufacturing sector significantly contributes to the economic development of the nation; therefore, Chhimwal et al. (2022) [11] identify and analyze the sustainability related challenges faced during the implementation of the circularity concept.

Circular and efficient material use faces challenges stemming from present practices. The current way of managing waste needs revising if material circularity is to increase. Earlier studies on key factors promoting the circular economy (CE) have been theoretically oriented, whereas Salmenperä et al (2021) [12] aims to increase understanding of the critical factors faced by practitioners in the transition towards a CE. Practitioners from 25 pilots promoting waste prevention and recycling in various industries were interviewed on the barriers and success factors encountered when implementing pilots.

The investigations concluded that a lack of information, regulation, and finance are three of the main challenges to implementing CE in India. However, due to factors including rising costs, rising demands for sustainability, and regulatory requirements, CE is rapidly becoming an absolute must in the industry.

RESEARCH METHODOLOGY

The quantitative descriptive research technique used in this study involved surveys of renowned Indian builders. The poll asked how individuals thought about factors that may aid or hurt CE implementation. This message targeted Indian environmental regulators, government organizations, and construction companies. Stratified random selection ensured that all business employees participated. Amazingly, 80% of 150 respondents answered the question. Data was collected from Indian construction workers via online survey. The survey included Likert, multiple-choice, and free-form items. We ranked each advantage and downside on a Likert scale and asked participants open-ended questions to get further information. Mode, standard deviation, median, and frequency distribution were used to analyse survey data. To simplify the data, tables and graphs were used.

RESULTS AND ANALYSIS

Table 1. Statistical analysis of responses (Barriers to CE adoption).

Barriers	Mean	Standard Deviation
Lack of Awareness	4.2	0.8
Regulatory Challenges	4.0	0.9
Financial Constraints	3.8	1.0
Technological Limitations	3.7	1.1

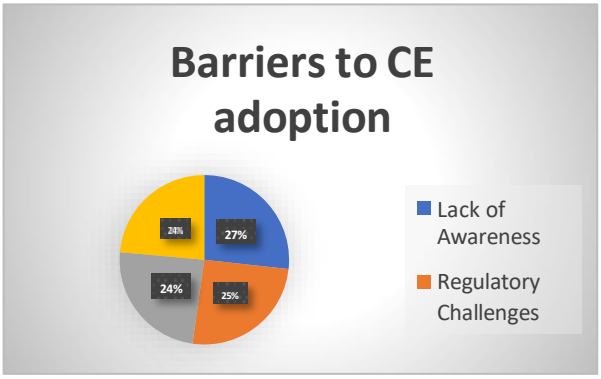

Figure 1. Shown Statistical analysis of responses (Barriers to CE adoption).

The survey revealed from Figure 1 and Table 1 a number of important obstacles to the Indian construction industry's adoption of CE.

1. Lack of Awareness (Mean = 4.2, SD = 0.8): Most respondents said that one key obstacle is a lack of knowledge and comprehension of CE principles. This is especially true for small and medium-sized businesses (SMEs), which make up the majority of the sector.
2. Regulatory Challenges (Mean = 4.0, SD = 0.9): Uncertain and inconsistent regulations were mentioned as yet another significant obstacle. While there are some regulatory frameworks in place, respondents noted that these are frequently not adequately implemented, which causes uncertainty and non-compliance.
3. Financial Constraints (Mean = 3.8, SD = 1.0): The significant upfront expenditures of implementing CE practices—such as purchasing new equipment and receiving training—were cited as barriers, particularly for smaller businesses.
4. Technological Limitations (Mean = 3.7, SD = 1.1): Another major barrier was the inability to obtain the infrastructure and suitable technology needed for recycling and reuse

Table 2. Statistical analysis of responses (Drivers to CE adoption).

Drivers	Mean	Standard Deviation
Cost Savings	4.3	0.7
Enhanced Sustainability	4.5	0.6
Regulatory Compliance	4.1	0.8
Improved Brand Reputation	4.2	0.7

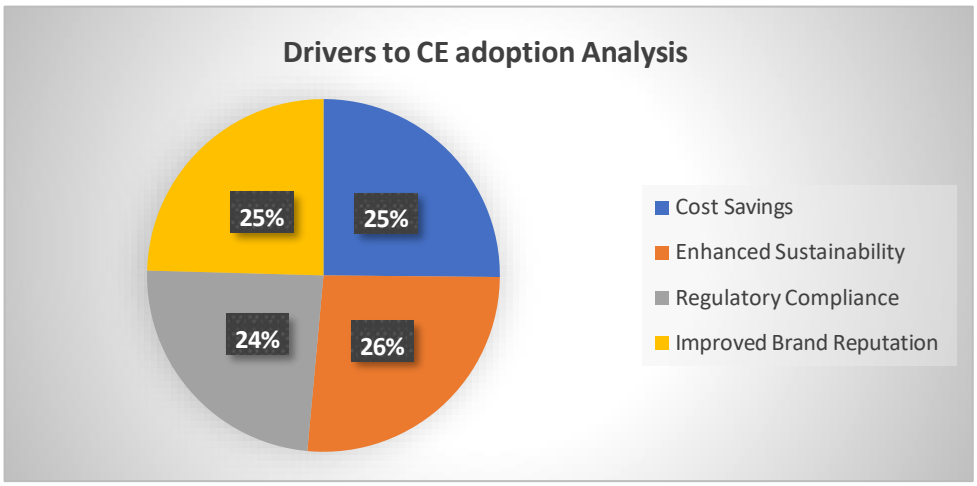

Figure 2. Statistical analysis of responses (Drivers to CE adoption).

In spite of these barriers, respondents identified a number of drivers that encourage the use of CE practices from Figure 1.2 and Table 1.2.

1. Cost Savings (Mean = 4.3, SD = 0.7): A sizable majority of participants mentioned that using CE techniques could result in long-term financial benefits, especially when it comes to lower material and waste disposal expenses.
2. Enhanced Sustainability (Mean = 4.5, SD = 0.6): It was generally agreed upon that CE had positive environmental effects, including lower carbon emissions and improved resource efficiency.
3. Regulatory Compliance (Mean = 4.1, SD = 0.8): Companies viewed compliance with current and upcoming rules as a crucial advantage since it can help them avoid fines and improve their standing in the marketplace.
4. Improved Brand Reputation (Mean = 4.2, SD = 0.7): A significant number of respondents said that implementing CE may enhance their business's reputation and attract more investors and environmentally conscientious clients.

DISCUSSION AND CONCLUSION

The results show that problems with regulations and ignorance about the technology are the main obstacles to implementing Circular Economy (CE) concepts in India's construction sector. Problems are exacerbated since rules are not uniformly enforced and because most businesses are small or medium-sized, which means they don't always have the capital to invest in CE initiatives. Industry partners acknowledge the potential advantages of CE, including cost savings and greater sustainability, notwithstanding these constraints. After the early hurdles are overcome, these advantages imply that CE procedures might greatly enhance the industry's economic and environmental performance. A mix of focused approaches is necessary to break through these obstacles. The implementation of educational initiatives aimed at increasing industry understanding and ability, the provision of financial incentives, and the reinforcement of regulatory frameworks are all possible approaches.

In conclusion, there are significant potential advantages to using CE principles in India's construction business, despite the fact that there exist obstacles such as a lack of resources, red tape, and outdated technology. Among the many benefits that CE may provide are financial savings, enhanced environmental sustainability, and ease of meeting regulatory standards. The establishment of transparent and legally binding standards that promote CE practices should be a top priority for legislators in order to hasten their broad adoption. The first investment in CE may be daunting for SMEs, so it's important that they have access to tailored financial assistance and technical support. At the national and regional levels, it is essential to educate stakeholders via training programs and awareness campaigns in order to maximise the advantages of CE. The long-term effects of CE adoption on sustainability and economic development in India's building industry should be the subject of longitudinal studies in the future. If these issues are successfully resolved, CE has the potential to improve the industry's environmental and economic performance.

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