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# Implementation of Circular Business Models in Construction and Demolition Waste Management of India

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**ABSTRACT**

**In the world, around 30% of the total solid waste is construction and demolition waste. In India, as per the building material promotion council, 150 million tonnes of C&D waste is generated every year. In the total C&D waste, only one percent which is 6500 tonnes per day is recycled, mentioned in the report released by the Centre for science and environment, New Delhi. There is a rising gap between increasing demand and limited sources in the construction sector of India. It leads to market instability and environmental harm. Linear business model is most commonly used in present times. It is one of the main reasons for the increase of C&D wastes. This linear approach (source-commodity-waste) encourages the one-use of products. It leads to excessive dumping of C&D wastes in landfills, which is not a sustainable practice. Circular business models leads to closed-loop approach (source-commodity-waste-new source). The adoption of circular business models in C&D waste management is the possible solution for the decreasing resources. This study aims to discuss the implementation of various approaches including conceptual models, methods, and tools of circular business models in the C&D waste management in India, which leads to the circular economy and sustainable development. Through the study of recent literature sources, various data related to circular business models, circular economy are collected. Data analysis will be done using the literature review. This research will highlight the socio-economic, environmental benefits, improvements, and the applicability of circular business models in the C&D waste management of India. This paper is concluded that framing strict circular economy policies for India would encourage the implementation of CBM in C&D waste management which reduces the need for fresh resources and ensures sustainable development.**

***Keywords—*** C&D Waste Management, Circular Business Models, Circular Economy, Indian Construction Sector, Sustainable Development

## I. INTRODUCTION

Present linear business models, also known as "take-make-waste" methods, leads the world to produce more wastes and result in resource scarcity[1]. These practices are straight opposite to nature, which produces no waste and uses all the things as a source of energy for other processes. Due to the rapid urbanisation and rising population, enormous resources are needed. On the other side, essential supplies like water and some other sources are depleting. Therefore, drastic changes are needed to change the present economy. Circular business models

(CBM) have been formed to enable organizations to minimise their wastes by reusing, recycling, and retaining materials. While the idea of circular business models has been around for a long time, it is only recently that the term has been used in educational research[1]. The benefits of CBM adoption have become apparent to both professionals and academicians, and they are not confined only to environmental effects.

The transition from the present linear economic model to a circular model would not only save money but also it would have a huge positive influence on the environment. As a result, the circular economy (CE) has gained momentum as one of the most effective and recent approaches to sustainability. Materials and commodity design, innovative business models, world reverse networks, and enabling conditions are the four basic building blocks of the circular economy[2]. The transition of an economy to a circular model is based on the policies and decisions on the one side, and on the other side, it is based on the business organisations integrating circularity into their business models.

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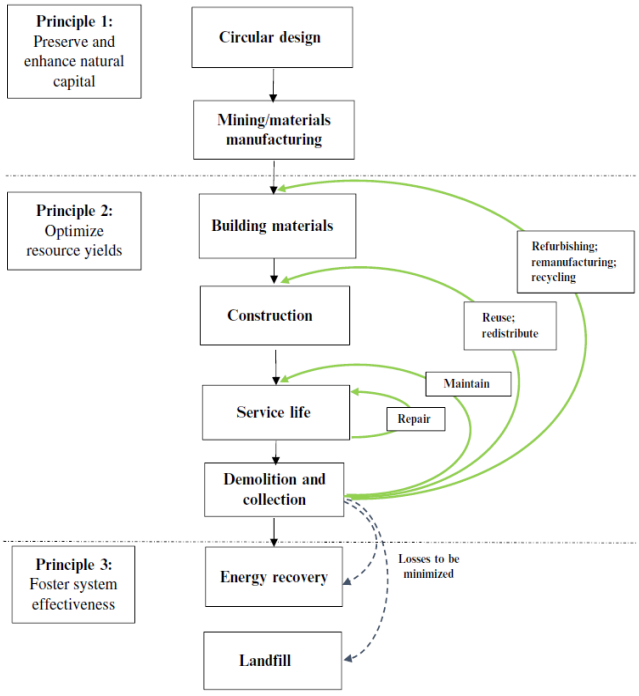


**Figure 1:** Basic concepts for handling the CE adoption in the operational cycle of construction value chain[3]

## II. OBJECTIVES

- To document and analyse the various techniques in circular business models which are being applied in the C&D waste management of India, that contribute to the circular economy and sustainable growth.
- To study the circular business models and it's benefits, applications in the construction and demolition waste management.
- To analyse the applicability of various approaches of circular business models in the C&D waste management of the Indian construction sector.

## III. METHODOLOGY

Data on the circular economy, circular business models and the integration of CBM in the C&D waste management are collected from various literature sources. This study is a compiled literature review that gathered data from a variety of literature sources to arrive at conclusions about the implementation of circular business models in the C&D waste management of India. The data is gathered from approximately 20 research papers related to circular economy, CBM and the integration of CBM in C&D waste management. In the discussions, the collected data is analysed and described. Conclusions and recommendations for improvements that will be needed in the near future are drawn from the literature data analysis.


**Figure 2:** Methodology flow diagram

## IV. LITERATURE REVIEW

### *A. Circular Economy*

The circular economy concept has deep roots and can't be identified back to a single date or creator. The word circular economy is thought to have first surfaced in the late 1970s, when it was debated by a small group of scientists, innovators, and business people[4]. Over the years, the idea of closing the cycles has been researched and further explored in actual business situations. Different schools of thought, such as cradle-to-cradle, production economy, biomimetics, environmental sustainability, and regenerative design, have refined and expanded the generic idea of the circular economy. In today's world of limited resources, a modern economy that generates new values, links responsibilities for people, earth and the economy, is a self-evident reality. In recent years, the circular economy has caught the interest of business leaders all over the world. In fact, circular economy is a basic alternative to the prevailing linear economic model, which follows the 'taking-making-consuming-throw away' trend.

### *B. Difference between Linear Economy and Circular Economy*

The linear model is based on a large amount of low-cost, readily available materials and energy. Resources are collected, formed into items, sold, and ultimately disposed of in a 'grave' of some kind, typically a landfill or incinerator, according to the linear model[4]. This model depletes our world's resources and pollutes the ecosystem. It also contributes to a scarcity of raw materials, which drives up prices. In contrast to the linear economy, circular economy aims to follow the ecological benefits by increasing the recyclable and renewable sources which lower raw materials consumption. As a result, emissions and resource depletion can be minimised.


**Figure 3:** Difference between linear economy and circular economy[4]

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### *C. Circular Business Models*

The concept provided by [5] is the most widely used definition of CBM: "A circular business model is a rationale of how an organization creates, delivers and captures value with and within closed material loops". Conventionally, a corporate plan aimed to provide better value to consumers and gain a larger share of that value than competitors. In CBMs, the business should be done in a sustainable manner that offers measurable environmental and/or social benefits, in addition to financial benefits. As a consequence, the outcomes of CBMs can be divided into three categories: economic, social, and environmental. Customers and the company will save money by reusing, recycling, and using fewer materials/components/products. Sharing and reusing resources among members of society, especially among businesses, are examples of social factors that improve interactions. Environmental impacts are reduced by minimising waste production and resource use. Some authors draw attention to the connection between circular and sustainable business models. This is consistent with the authors' previous research, which found that some, but not all, conceptualizations of circular business models emphasise sustainability. Circular business models can be described as business models that cycle, expand, intensify, and/or dematerialize material and energy loops to minimise resource inputs into and waste and emission leakage out of an organisational system. This includes steps such as recycling (cycling), expanding the usage process (extending), intensifying the use phase (intensifying), and replacing goods with service and software solutions (dematerialising)[6], which is illustrated in Figure 4.

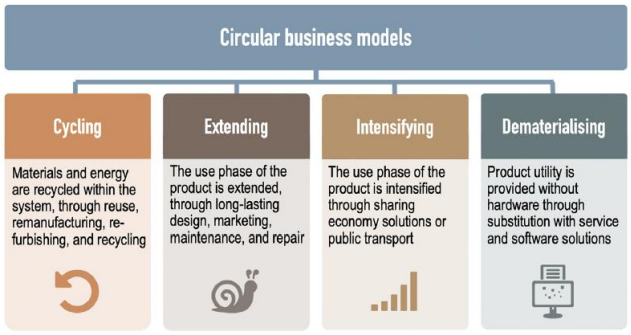


**Figure 4:** Circular business model strategies[6]

### *D. Effect of Circular Business Models in C&D Waste Management*

Raw materials are not taken out of their cycles in a circular economy; instead, they are used efficiently and intelligently to stay in the economy for as long as possible. By maximising their re-use or recycling, their importance is also retained. The circular economy, therefore, entails far more than just recycling; it necessitates a fundamental rethinking of supply chains and business models, as well as product design and the overall economic processes through which they are implemented, to achieve the lowest possible environmental effect. This means that structures and construction elements are planned to be adaptable, dismantle able, and rarely demolished in the built world. Building materials or building components can be retrieved rapidly and effectively, resulting in high-quality materials being recovered to the maximum extent possible in a closed loop and virtually no material ending up as waste[7]. Asbestos and tar, for example, will be eliminated from the material cycle.

To accomplish this, a new pragmatic approach involving all players in the supply chain, as well as collaboration between different sectors, is needed. In a circular economy, C&D waste management is not treated as a separate market, but rather as part of a larger structure, with interference analysis taking into account all parts of the system. Actions influenced by the circular economy taken early in the lifecycle of the building can have a significant impact on waste management. The use of long-lasting, high-quality construction materials will extend the life of a structure and help to reduce waste.

To create a truly circular economy, additional steps must be taken, such as focusing on the entire lifecycle of building materials in a way that conserves energy and closes the loop. [8] compiled a list of typical examples of key actions in applying circular economy concepts through a building's lifecycle, divided into various stages, from literature, and the following list was expanded with a focus on waste.

At every stage of the construction process, actions must be taken to adopt the circular business models or economy in C&D waste management. The various actions are:

***Phase 1 - Material Production***

- The building materials are recyclable.
- Low environmental impact production processes.
- The construction industry uses large quantities of materials, the materials have a high recycled content. This recycled content can also come from industrial symbiosis, in which waste or other products from one industry become a source for another.
- The materials are extremely durable and therefore it's lifespan is long.

***Phase 2 - Design***

Good design is important for fostering recycling and aiding in the repair and durability of buildings and construction products, thereby conserving valuable resources[7]. Actions included in this phase:

- Structures that are robust, versatile, upgradable, repairable, and adaptable have a longer lifespan.
- Buildings that are modular and simple to disassemble.

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- By avoiding over-specifying and using higher-strength materials, we can cut down the number of materials used.

***Phase 3 - Construction***

- By the use of custom-made building materials, can eliminate the material surplus.
- Adoption of additive manufacturing like 3D printing.
- Building information modelling (BIM) aids in the creation and maintenance of value over the lifecycle of a structure and its components.
- Give back the building materials that are no longer required from the construction.

***Phase 4 - Utility Period***

- Contracts for the built environment are dependent on results.
- Increase the building usage intensity by providing versatile functionality for multiple users at different times of the day by sharing the spaces.
- Maintenance of building and its facilities.
- Extending the life of buildings by advanced restoration, strengthening and refurbishing.

***Phase 5 - End of life***

- Material auditing and waste management preparation should be done before the demolition.
- Source segregation of materials.
- Adoption of selective demolition.
- Preparation of building materials for reuse and recycle.

The appropriate business models, like product-service combinations and policy support tools, are required to enable these strategies. Pilot and prototype projects aid in putting these innovations into effect and bringing them to market faster.

### *E. Benefits of Circular Business Models*

- As a result of adopting circular economy business models, the emphasis would turn to sustainable procurement, sustaining resource productivity over the lifecycle of developments, and reducing non-renewable material losses. There will be financial, social, and ecological benefits as a result of this.
- The circular economy market is expanding, and it is predicted that over the next ten years, it will raise economic growth by up to 4% [9].
- In accordance with the EU Waste Framework Directive, the circular economy would assist companies in reducing raw material costs as well as waste management costs. Given the UK's increasing landfill tax rates, reducing the amount of waste sent to landfills will provide significant financial benefits to companies.
- There will be little or no waste to landfills, and biological nutrients will be reintroduced into the biosphere by composting and bio-digesters, enriching the ecosystem [10].
- Due to closed loops of technological components and an increase in sustainable renewable resources, growth would be decoupled from resource extraction. Lesser energy will be extracted, lowering the climate effect.

### *F. Enabling Factors of Circular Business Models*

Several enabling factors will be needed to maximise the benefit of circular economy. These are divided into three categories: design, information, and collaboration [9]. As a result, the operation would generate additional value, with benefits for asset value and waste output as illustrated in figure 5.

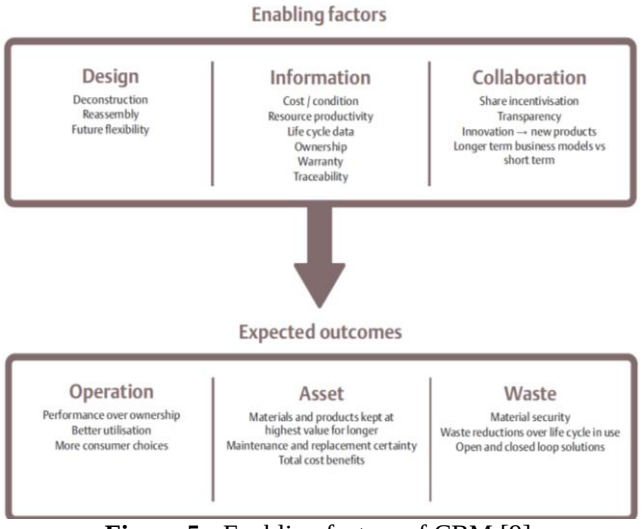


**Figure 5:** Enabling factors of CBM [9]

### *G. Scope of CBM in C&D Waste Management of India*

Governance and policymaking would be critical in moving global markets towards circularity, particularly because the concept of circularity is not well-known within managerial circles and among citizens [11]. The concepts and practices around the circular economy earned a lot of acceptance in the research field in recent years, as demonstrated by the Scopus survey data, which revealed that the search term 'circular economy' yielded the most results and became a search hit [12]. To understand research efforts dedicated to this topic at national scale, the keywords established and quick emerging economies from US, Europe, and South Asia were integrated with the keyword CE. China came up first in the search results, followed by Germany. This is also evident in practice, with China enacting the Circular Economy Promotion Law (2009) and the Circular Economy Growth Strategy and Immediate Plan of Action (2013) to integrate clean technology strategies into the country's economic growth.

Due to schemes like the PMAY (Housing for All), India's construction and demolition industry is expected to expand [12]. This industry, which contributes to the country's GDP has the capacity to support Circular business model values. Achieving circularity by reuse and recycling of materials which influencing India's GDP and this sector would not only promote circular economy growth but also reduce the country's dependence on imports. The construction value chain would achieve resource recycling at the material manufacturing, design planning, and end-of-life phases. Furthermore, India is the second-largest producer of C&D waste [13], integrated wet recycling provides a viable option for C&D waste management, of over 95% source reduction and minimal environmental effects [14].

The construction and demolition waste management industry contributes 13,76,293 crore towards the national gross value added in the year of 2018-2019 [12]. It includes various type of wastes like building materials, stone, timber, glass, masonry waste, etc., The potential of C&D waste recycling is, using the model of LINGO-11.0, a revenue return of 6,22,624 rupees was calculated from C&D waste of 5 types following the demolition of a housing project [15]. The opportunities for moving towards circularity in C&D waste management are Portland cement, blended cement, demolition products, asphalt walkway, Fly ash bricks, plastic waste adapted bitumen for laying of roads. The conversion process of these materials involves the use of waste compactors, grinders, balers, and crushers to reuse materials from demolition, deconstruction, and restoration projects, as well as to recover recyclable materials.

Some central policy initiatives in India that are linked to circular economy concepts have some notable characteristics. India implemented a policy framework called ‘Construction and demolition waste management rules’ in 2016 which was implemented by the Ministry of environment forests and climate change. In the framework, some basic features related to the circular business model are exist. Waste generators who generate more than 20 tons of waste in a single day must apply a waste management plan and separate their waste into various sources such as steel, soil, concrete, timber, and plastic, as well as bricks and masonry blocks. Construction and demolition waste can be used for a number of purposes by local governments, including non-structural concrete, paving stones, walkways, and country roads. Construction and demolition waste processing facilities should be approved by the state pollution control boards.

## V. DISCUSSIONS

Governance, laws, and business models would all be important in assisting the transition from a linear to a circular economy. More specifically, Circular business models would allow an asset to be held at its maximum value over the years while still promoting natural capital growth. At different stages of an asset's lifecycle, different CBMs may be needed, and they can operate separately or in conjunction. Through exchanging products, systems, energy, knowledge, and services, developers, manufacturers, service providers, contractors, and end-of-life organizations would be able to successfully adopt these business models. Adoption of new business models would allow, maximum control of source networks in the supply chain, allowing for the identification and capture of added value. New entities can be created by supply chain innovation, such as waste management, redevelopment, and reverse logistics. Both players in the supply chain are working together more closely and the product development that collects valuable goods and resources.

The various forms of circular business models would almost certainly need to communicate and collaborate in order for a circular economy to operate. The challenges and opportunities in different types of CBM are as follows:

***1) Circular Design - Planning Phase***

Products, processes, and whole building structures are engineered to have a higher residual value and last longer. In comparison to conventional models, they would be easier to manage, fix, update, renovate, remanufacture, or recycle. New materials, especially bio-based materials, can also be produced and sourced that are less costly or completely recyclable. New processes are being built in the same context to increase the recyclability and reuse capacity of building and manufacturing materials, by-products, and wastes. Designers have the ability to engage with prospective partners who may be involved in the development (or parts of the development) after primary use. This could be connected to the CBMs for "usage" and "recovery" to ensure that the design's gain is understood.

There are threats in terms of technology, industry, and operations. These involve a lack of information on product results and a degree of ambiguity about the asset's operating costs. Customer adoption of reusable/ recycled goods is linked to the economic threats. Customers want the latest model in a limited amount of time, so product extinction is always built-in. To move away from business models based on this theory, a shift in attitude is needed. In comparison to conventional linear models, a greater upfront investment would be required to minimise the need for raw materials, boost product efficiency, and maximize residual money at the end of the life of products.

***2) Circular Use - Operational Phase***

These models are designed to maintain leverage over a product while still preserving its value. Product-to-service models allow businesses to move from manufacturing goods to a range of new services, such as renting and sharing. They also provide services that

promote the identification, promotion, and trading of secondary raw materials, as well as extending the service life of goods and materials. This provides new opportunities for businesses to grow their clients through customer satisfaction while also increasing long-term sales through extra services including repair, fix, maintenance, and component replacement.

Products should be treated with a heavy emphasis on operational expenses rather than capital expenses, which would have clear effects on working capital as well as possible tax implications. Circular usage models will enable businesses to operate with low cash flows due to a longer time to get back from the initial cost, as compared to a higher ROI, which is correlated with consumers' willingness to pay more for a product that performs better. As a result, either borrowers or financiers would need to be able to take on higher-risk loans. Financial institutions, on the other hand, have historically lacked the good tools needed to properly price risk, which leads to a high rate of interest or even refusal of loans. The risks increase as there are misconceptions about the product's potential residual value as a result of raw material market price volatility, as well as complexities about consumer demand and the lack of appropriate legal frameworks.

***3) Circular Recovery - End of Life Phase***

Established goods are transformed into new ones, adding value, lowering prices, and waste reduction, both of which generate revenue. In this situation, the development of a forum to improve reverse logistics is critical.

Material recycle/ reuse is more cost/ time efficient than processing raw material in these models. Recaptured goods are often not reused due to the high cost and difficulty of reverse logistics. While these models have fewer budget restrictions, the regulatory structure in construction can be a barrier. Recapturing materials is hindered by legislation regulating waste management, product efficiency, and safety & health. The role of regulators will be critical in the production of these circular business models.

## VI. CONCLUSION

Two concepts gained so much of research interest in recent days. They are circular economy and circular business models. This study focused on both the concepts and explored more about the circular business models and their applicability in the C&D waste management of India. There are not many studies conducted on this particular topic in the specified context.

The usage-driven cradle to grave concept leads to exploitation of resources to produce new goods and also discarding the used products in an unstructured way to landfills which is an unsustainable practice. The circular business models' core concept is cradle to cradle solution. The drawbacks in the linear business models are the promotional factors for the transition towards CBM.

In countries like India, C&D waste management is largely an unorganized sector. The concerned ministry in association with state pollution control boards, local authorities, and corporations has enacted many laws and frameworks for governing this sector. But there are lot of issues in implementing these policies and also it lacks of talking about circular economy and business models. There are issues such as insufficient recycling, lack of infrastructure, under focused business capabilities which limits the circular economy understanding, adoption, and development. The ecosystem for acceptance of integrated technologies for processing, segregation of C&D wastes is missing. There is also a negative social perspective among people, to remove this perception, government action is needed to regulate the industry.

The complexity in understanding the CBM among people works as a benefit for the linear business models. There are some challenges and contradictions in the adoption of CBM. To surpass these challenges and contradictions, the supply chain has to modify as per the following points into consideration: a) Looking in the long run, b) Business model innovation, c) Co-operation and collaboration, d) Durability, e) Use of latest models in making and usage of materials, and f) Deconstruction-friendly design.

Therefore, framing a strict Circular economy policy for India would encourage the implementation of circular business models in C&D waste management which leads to sustainable development and also reduce the need for fresh resources.

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