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A Review of Circular Economy Concept : Findings, Challenges and Future Scope

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Balancing industrial development, economic growth, human health and environmental preservation are the current challenges faced today and in response to these efforts have been put on low-carbon development mechanisms and limited resource usage. To address such complex issues on a global scale the initiatives like circular Economy (CE) have come forward where its core idea is to recognize the value of resources in a closed-loop system. This process allows to reduce emissions, reduction in waste production and economic growth. This paper firstly examines the existing literature based on aims, methodology and analyzes the major findings and secondly, tries to identify the research gaps to pave the way for future advancement. The findings are of utmost importance for the organizations,

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stakeholders, and researchers who are keen on gaining information on CE and explore the potential opportunities in this field.

[**Keywords :** Circular Economy, Enablers, Inhibitors, Manufacturing sector, Re-cycle, Re-use]

1. Introduction

The apportionment of scarce resources in relation to competing uses is something that continuously bothers economists. The environment can be defined as some surrounding that has an impact on development and growth. In any economy there are quintessentially three sectors : Agriculture, Industry and Services. These sectors have an interplay with the environment in three main ways:

- Using it as a source for natural resources,
- Getting amenity goods and
- Using it as waste sink.

Economists have always recognized and shown interest in the impact of economics activities on the natural surroundings such as considering natural resources usage and reducing waste accumulation. The important questions have been finding the institutional and economic reasons for environmental problems, valuing the degradation of the environment and to inculcating the economic incentives to greet the environmental issues. It was in 2015 that the Sustainable development goals (SDGs) came into being. Various approaches such as Industrial Ecology, Green economy, blue economy, Performance Economics, Biomimicry and Circular Economy have been developed to achieve these goals. All these are budding topics that promotes sustainability.

SDGs (6, 7, 8, 12 and 15) are the ones that cater to Circular Economy. It offers a tool chest for recycling e-wate, wastewater, household waste, contributing to sustainable development. The concept of circularity emphasizes keeping resources within a circular loop rather than following the linear "take-make-use-dispose" model of consumption, which has been in place since the Industrial Revolution. The increasing gap in the demand for bounded resources and its availability is highlighted by demand-supply globally. The origins of the circular economy can be traced back to a departure from the linear economic model that characterized past centuries. Emphasizing circularity and sustainability becomes crucial in managing resources and achieving sustainable economic development.

1·1 Concept of Circular Economy

The first ever formal usage of the term circular economy was done by Pearce & Turner (1990) in an Economic Model. It works on the fact that output of one operation/process can be input of other. It's important to understand that circular economy as a whole i.e., both in production and consumption needs a paradigm. The enthusiasts of circular economy claim it to be a new paradigm for the industry as it is aimed towards bettering the economic, ecological and social value of the environment. The need for circularity can be attributed to the following reasons : The expected increase in world population in the next 50 years and economic growth has raised serious concerns about the capacity of natural ecosystem (Herrmann, 2012). The energy requirement by industrial sector accounts for half of the world's total energy demand (Kant & Sangwan, 2014). It is expected that by 2030 the energy requirement will increase by 40% from 175 quadrillion British thermal unit (BTU) in 2006 to 246 quadrillion BTU (2020), out of which 85% is still generated by non-renewable energy sources like coal, petroleum, and natural gas (Fang et al., 2011). It's not just recycling that is crucial in circularity but also a restorative industrial process is required that will eventually see waste as an input for new things. Circularity concept is not just about recycling, it is basically a system which is restorative in the industrial processes which treats the waste as a resource. It implies that once a in the product life cycle the product's life ends, attempts should be made to utilize them by creating a value of it (Ellen Mc Arthur, 2015).

1·2 Definitions of Circular Economy

- Production and consumption of goods through closed loop material flows that internalize environmental externalities linked to virgin resource extraction and generation of waste (including pollution) (Suave et al., 2015).
- The core of the circular economy refers to three activities: reuse at the product level (such as repair or refurbishment); reuse at the component level (e.g., re-manufacturing); and reuse at the material level ('recycling') (Zink and Geyer, 2017).

The studies focusing and addressing role of manufacturers in the success of Circular Economy has accelerated. Reviews with

interplay from the circular economy largely focuses on aspects from the circular economy which are centered on issues outside the manufacturing process. (Ghisellini, Cialani and Ulgiati, 2018) for instance reviews literature concerned with the ecology of circular economy and its implementation at different levels : micro, meso and macro. Circular Economy is a booming field providing opportunities and profitable business.

There is a dire need, particularly in emerging and developing countries, to improve manufacturing performance, resulting in less pollution, less wastage, and less material and energy consumption (Sangwan & Mittal, 2015). This will lead not only to environmental and social benefits but also economic benefits.

Also, Given the current uprise of the global movement towards sustainability manufacturing firms feel societal pressure to minimize their ecological impact (Haigh, 2019; Sengupta, 2019). Circular Manufacturing means maximizing the process in manufacturing and yielding towards accomplishing efficiency in manufacturing on hand and limiting unnecessary waste polluting the environment. In manufacturing commodities, wastages are produced at different levels, requiring attention while disposing of them. Therefore, one can emphasize enough on the need to implement the Circular Manufacturing system before pollution reaches an extreme level.

2. Methodology

It was after 2008 that Circular Economy became highly discussed though it first appeared in 2004. It was China that laid greater emphasis in publication in this field starting from 2005 and until 2013. Between the linear economy and circular economy, the perspective on sustainability is different. The research paper was searched using the keyword Circular Economy AND (Manufacturing) OR (Industry)) and almost eighty research papers were short-listed based on the abstract that suited the aim of this research and further ten paper were short-listed based on the full paper and analyzed further to identify the methodology, findings and the research gaps.

3. Results and Analysis

Table-1 elaborates the ten short-listed papers on next page.

Table-1 : The Major Findings and gaps in Short-listed Papers

S. No.	Author (Year)	Title	Aim & Methodology
1.	Wang et al. (2021)	Analysis of the impact of foreign direct investment on urbanization in China from the perspective of 'circular economy	1. To assess the level of circular economy development in China provinces. 2. Data of 30 provinces (2004-2016) Using the Super-Efficiency SBM model to measure the eco-efficiency value used to measure CE .

Findings	Gaps	Country
1. A Complex non-linear relationship between the development of urbanization and CE. 2. FDI under Environment regulations is beneficial to promote China's urbanization. 3. Promotes policies to promote CE and reinforce FDI screening	1. Can be extended to find the eco-effectiveness. 2. Should incorporate economic, environmental pollution, and resource consumption at all levels of evaluation.	China

S. No.	Author	Title	Aim & Methodology
2.	Antonioli et al. (2022)	The economic returns of circular economy practices	1. To offer new empirical data regarding economic benefits and to find the factors affecting the choices of greener production different from traditional technologies. 2. 3000 Italian manufacturing firms' data to establish a relationship between innovations and Circular Economy and economic outcome.

Findings	Gaps	Country
1. Circular Economy related innovations tend to be barely related to revenues and to production costs. 2. Circular Economy process is positively related to revenues and potential influence to increase, production costs as due to innovation cost of production increases.	1. Economic returns is little talked about when it comes to CE and its associated technologies. 2. No information on sales and employment increase due to CE and its broader potential. 3. Can be further extended to environment and social aspect	Romania

S. No.	Author	Title	Aim & Methodology
3.	Singh et al. (2018)	Developing an extended theory of planned behaviour model to explore circular economy readiness in manufacturing MSMEs, India	1. The theory of planned theory (TPB) (Ajzen, 1991), is a most strong theory in psychology to assess the intrinsic and external factors that impact circular economy in manufacturing. 2. Data collected from industries listed red and green in CPCB (Firms are Dairy, food etc)

Findings	Gaps	Country
1. This study contrasts the TPB and extended TPB (ETPB) model and opined that ETPB model has a finer illustrative power in predicting CE readiness among MSMEs in India. 2. The findings signify that attitude and social norms play a positive role in promoting Circular Economy and perceived control behaviour is impediment in Circular Economy.	1. Can be analyzed for the manufacturing sector as a whole except for MSME. 2. Also, the Cultural aspect is not touched. 3. The dependency on consumers' willingness to accept a circular product not added as a construct.	India

S. No.	Author	Title	Aim & Methodology
4.	Rizos et al. (2015)	The Circular Economy: Barriers and Opportunities for SMEs	1. The aim is to identify key barriers and enablers to adopting circular economy business practices. 2. Done by analyzing the Literature on the Topic

Findings	Gaps	Country
1. Finance has been identified as a barrier, lack of knowledge about the benefits of CE , raising consumer awareness about CE and its products	1. This is all based on a literature review analysis. 2. No empirical evaluation was done such as meta-analysis to find the in-depth impact of these barriers and enablers	Europe

S. No.	Author	Title	Aim & Methodology
5.	Zhu et al. (2017)	Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector : A literature review	1. Investment is the key. 2. Varied barriers (political, economic, legislative, managerial and informative).

Findings	Gaps	Country
1. Findings are that both the Rs i.e, reuse/recycling at the end-of-life of a building and production process provide sustainable and economic benefits. 2. Nevertheless, several factors as the type of material, logistics, building elements, economic and political context play an important role	1. Different frameworks can be used. 2. Only a few studies assessed the design phase in the life - cycle of traditional buildings within a cradle to cradle which calls for increased efforts to better understand and further improvement.	China

S. No.	Author	Title	Aim & Methodology
6.	Chimwal, Madhukar et al. (2021)	Challenges in the implementation of circular economy in manufacturing industry	1. 30 factors of CE are identified from the literature. 2. Using TOPSIS, SIMOS approach, the rating and impact of decision makers (DMs) for each factor were collected

Findings	Gaps	Country
1. Management of waste is one of the major challenges faced by many developing countries. 2. Develops a circular economy (CE) model to reduce the generation of residual wastes in municipalities.	1. Limited to only waste management sector only. Other sectors can be touched on, and a similar CE framework can be developed. 2. Nothing is said about the cost, attitude. And other challenges that are faced by the stakeholders.	India

S. No.	Author	Title	Aim & Methodology
7.	Zhu et al. (2017)	A Comparison of Regulatory Awareness and Green Supply Chain Management Practices Among Chinese and Japanese Manufacturers	1. To understand CE and GSCM, survey was conducted among small & medium-sized Japanese manufacturers, leading Chinese manufacturers and traditional Chinese manufacturers. 2. Shenyang is an industrial zone for the survey. Kawasaki Eco- Town for projects in Japan, and many small and medium-sized manu- facturers are located there. Thus, Kawasaki was chosen as a case study area in Japan.

Findings	Gaps	Country
1. The highest awareness of both international and domestic rules/ polices and apply GSCM practices at the priority level among the Chinese manufacturers. 2. Traditional Chinese manufacturers have scares acknowledgement of global environmental regulations/policies	1. How to disperse the events in these priority manufacturers to other manufacturers needs further studies. 2. Second, customer interactions and cooperation with environmental concerns and investment recovery. Such driving measures can be more sustainable. 3. Awareness on social, economic and cultural aspect not studied.	Japan and China

S. No.	Author	Title	Aim & Methodology
8.	Namita Kapoor (2021)	Circular Economy in India: emerging business models and its effects	1. The study aims to be beneficial for a broad understanding of the Circular Economy with respect to Indian Economy. 2. The study provides empirical evidence to the Consumer's willingness to participate in circular economy. It also provides a data base for further research in the related field. 3. An attempt has been made to examine the consumption pattern and willingness of individuals in participating in the Circular Economy.

Findings	Gaps	Country
1. An approach involving the partnership of consumers, retailers and investors jointly is required. 2. One pattern of consumption is very responsible. Consumers do want to access products- retain them but they want to buy and exchange them back to the system. 3. The other type of consumption pattern shows that consumers can afford and access products (used/ refurbished products) as the companies are offering them.	1. To understand the holistic view more case studies should be done. 2. No empirical work has been done to gauge and measure the impact of circular economy. Future studies focus on the quantitative aspects of these impacts. 3. Quantitative analysis of the benefits (Environmental, economic, social) are not that common. Aspects like gender race, and equality of social opportunities are not considered in the circular economy concept.	India

S. No.	Author	Title	Aim & Methodology
9.	Clube & Tennant, 2022)	Social inclusion and the circular economy: The case of a fashion textiles manufacturer in Vietnam	1. Fashion textiles and its social concerns as laborer rights, safety, minimum wages remain valid. 2. Uses H-SD framework

Findings	Gaps	Country
1. Exposed communities and resources that are sustainable have been highlighted. 2. Offering stable jobs to people with disability while revalidating wastage problems in the fashion industry.	1. Interaction between human resources, management, and Circular Economy is rarely studied. 2 If CE practitioners can showcase the intensification of human needs, then this will help provide a more compelling narrative for the social benefits of transitioning to circularity	Vietnam

S. No.	Author	Title	Aim & Methodology
10.	Liakos et al. (2019)	Understanding circular economy awareness and practices in manufacturing firms	1. To see the realization levels and practices of CE in manufacturing firms and empirically validate it. 2. A quantitative survey questionnaire-based approach. 3. More than 500 people were contacted. The sampling process took 40 days using a database (FAME), LinkedIn and personal contact. Descriptive statistics were used to validate the CE model, a correlation analysis was also conducted.

Findings	Gaps	Country
1. The research findings show that with the growing emphasis on CE globally. 2. The analysis also shows the insights on the three pillars (environmental, economic benefits and resource scarcity) of CE. 3. Out of the three pillars it was environment that was in more developed state mostly, in a research state.	1. In the future to generalize the results larger responses should be analyzed. This can also be extended to other sectors to get an idea of the benefits and issues of CE . 2. The opinion of the experts can be taken to shed some more light CE and its practices Along with it the use of more robust statistical analysis techniques can further add to the credibility of the findings.	U. K.

Source : Compiled by author.

The sustainability concept within a linear economy focuses on eco-efficiency. Though it shows that Industry has room for improvement and potential for resource conservation and thus application of Circularity. Sustainability is said to increase the eco-effectiveness within a circular economy. We need to reinforce the ecological, societal and economic systems so that this effectiveness creates an overall positive impact. Despite unsustainable economic development, China was one of the first countries to plan an economy based on closed loops, in order to maintain strong economic growth while pursuing environmental sustainability (Zink and Geyer, 2017).

4. Discussion

Based on the above analysis, it can be said that CE studies follow three main lines of action :

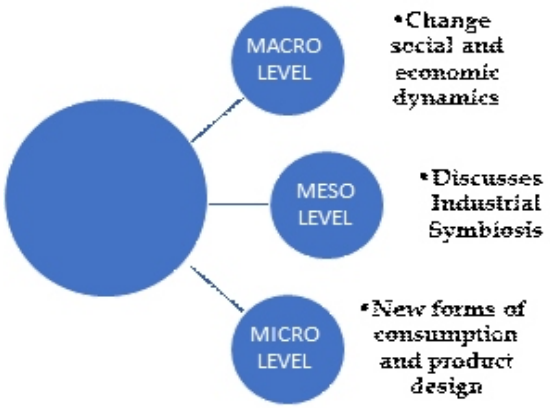

Figure-1 : CE main action lines

After going through the available literature this section consists of the following findings :

4·1 Micro-Level

Out of the papers found the least focus was at the micro-level. It was only recently after 2018 that the focus has been shifted to micro level. Articles based on reuse, recycle, circular business models, corporate practices involving circularity have been increasing recently. The concept distribution has been at the market level on supply and demand side. By taking steps to change the traditional linear corporate procedures (operation and production), the firm level is taken as the first factor which contributes to closing, narrowing, and reducing the materials loop. It also creates the right environment for new entrepreneurs to take advantage of business

opportunities. Several operational models have been proposed to help businesses reuse and reduce resources and use renewable energy sources. In relation to the circular economy, numerous corporate practices have been proposed that offer useful tools for enhancing organizational practices, organizational culture, and human resource management (Pham et al., 2019). On the consumer side very few papers are there that have analyzed the willingness of consumers to pay for products produced based on CE and on the behaviour of consumers towards circular economy products (Camacho-Otero et al., 2018)

4·2 Meso-Level

According to the logic of industrial ecology, industrial symbiosis, industrial metabolism, and eco-clusters, this denotes a collaboration between businesses in their efforts to exchange waste materials. The final selection of publications for this study, however, concentrated on the fundamental goal of looking at industrial ecology in relation to CE during the previous decades. Over the past few years, there has been a sharp rise in articles discussing the interaction between CE and industrial symbiosis. This implies that a firm's waste materials could be reused as raw material for other firms. The idea that is being emphasized is that the nexus between the concept of CE and industrial ecology can reinforce the social acceptance of industrial parks.

4·3 Macro-Level

Most of the studies done on CE is done at the macro level. It focuses on regional, urban and national level measurement of CE. Also, the policies could be of critical importance in promoting CE in the extant economies. They also mentioned several issues with these tools, such as the absence of CE education programs for the general public and the lack of waste treatment technology, both of which are crucial for promoting CE practices. In order to transition businesses from linear to CE behaviour, another section of the pertinent literature focuses on conceptual models to bring CE criteria into public procurement (Alhola et al., 2019).

Significant amount of importance has been given to articles on engineering, environmental, and natural sciences. Not many papers are on the economic aspects of CE. The closer link between CE and the idea of sustainability is a crucial subject for research. Even though

there have been numerous initiatives to link CE with sustainability and the SDGs, a stronger connection between CE and sustainability is still required. In fact, the idea of strong sustainability offers a solid foundation for developing effective solutions for the preservation of environmental resources, the growth of the economy, and the bolstering of social cohesion. Strong sustainability assumes that the three capital kinds (economic, environmental, and social, for example) might replace one another in a constant quantity with the main goal of preserving a crucial capital suited to preserve and renew the various capital types. Future research in this field might be particularly interesting if it focuses on greater sustainability in circular business models, in corporate social responsibility, in clean technologies and on consumer behaviour supporting strong sustainable consumption. The eco-efficiency of resources and the positive impacts of CE on sustainability is another crucial academic area that should be examined by researchers in the context of CE.

By protecting natural resources for future generations and generating new employment possibilities for the current generation, CE is a good weapon to advance social and human rights problems. To investigate the social aspect of CE and how these might be incorporated in more comprehensive approaches to the notion, scholars must conduct more research. The papers reviewed majorly catered to industry, business or manufacturing sector as the majority of work for development takes place in this sector. But CE has much scope in the agriculture and services sector too. In fact interrelated study or comparison analyses in these sectors can be done. CE enablers and inhibitors are listed and talked about and adopted by many papers but to see their impact on CE is still limited.

5. Conclusion

This essay presents some fundamental concepts that establish the background for the CE and Sustainability initiative. Our study summarizes the current state of the CE literature with a focus on identifying needs and prospects in this area. A triple-level perspective was used to assess the literature, with an emphasis on the micro, meso, and macro levels. This paper reveals that work has been increasing gradually in the field of CE during the previous ten years (from 2011 to 2021), especially with an increased focus on analyzing the papers based on the level of implementation (micro-meso- macro). The niche of studies conducted is mainly on production side therefore consumer

side, demand and application of Ce in different sectors is unknown especially in developing countries. This paper thus identified such gaps and future scope for CE. It was also discovered that the academic subjects of engineering and the natural sciences are covered by the majority of the CE articles. For future investigation, certain productive research avenues are identified. The relationships between the three levels of analysis (micro, meso, and macro), the relationship between CE and its social dimension, and the necessity of strengthening the connection between different fields are all included in a suggested research agenda (inter- disciplinary approach).

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