



2. The Circular Economy is a Compulsory Choice for a Sustainable World

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ABSTRACT

The **linear economy** is frequently characterised by the presence of **structural waste**: instances where components, products or materials reach their end-of-use/life prematurely, or where their capacity for value creation is underutilised. To address this, the **circular economy (CE)** concept proposes a range of efficiency and productivity enhancing activities collectively known as circular strategies, such as reduce, reuse, repair, recycle, restore, cascading, etc. In this sense, CE is an umbrella concept: it groups a range of sub-concepts and imbues them with a new meaning by highlighting a shared feature of the sub-concepts. This new meaning revolves around the notion that through the application of circular strategies both more value can be created as well as value loss and destruction reduced. For CE this means that there is currently a focus on developing CE transition methodology. This is taking place in a number of aspects relevant for Circular Oriented Innovation, such as in business models, metrics and assessment, product design and the creation of organisational capabilities such as experimentation, value chain innovation and other

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*human factors. The circular economy aims at **sustainable production**, consumption and resource use by minimizing pollution, turning waste products into productive assets, extending product lifecycles and sharing of products and services. It strives for a competitive economy that creates green and decent jobs and keeps resource use within planetary boundaries.*

In recent years, the circular economy has become part of key national and international policies. Partnerships and collaboration among national and sub-national entities, business and public sector actors as well as consumers and local communities are needed for the circular economy transition. Regions and municipalities have a major role to play in circular economy strategies and roadmaps, and as a laboratory for experimentation with new ideas, based on bottom-up approaches with strong buy-in from citizens, consumers and business, as showcased by leading examples, such as the city of Glasgow.

*This economic model moves away from the traditional "**take-make-waste**" culture of a linear economy and attempts to uplift the economy from a social, economic and environmental standpoint. A circular economy is vital to tackle the looming issues of **climate change**, dwindling finite resources, pollution, waste, and the need for sustainable energy.*

We cannot achieve a circular economy overnight with the cooperation of one sector alone. It requires help and collaboration from all industries, as well as governments. Some industries are trying to implement circularity in their production processes to make their products more sustainable while reducing waste and energy consumption. In 2015, the United Nations established 17 Sustainable Development Goals (SDGs) that were adopted by world leaders, with the aim of achieving them by 2030.

The objective of this writing is to uncover the available evidence on innovation in relation to the circular economy and to determine those aspects that remain unexplored or should be studied in more depth in order to be able to continue to make progress in this field.

01. Introduction:

In 2015, the United Nations established 17 Sustainable Development Goals (SDGs) that were adopted by world leaders, with the aim of achieving them by 2030. Despite the fact that each one focusses on a different aspect and, therefore, each objective has different purposes, a common idea underlies all of them: the implementation of the circular economy as the sustainable solution as opposed to the current model of production and resource management, whose effects have a negative impact on the economic, social, and environmental dimensions.

In particular, SDG 9: ‘Industry, Innovation and Infrastructure’ is important because economic growth, social progress, and action to combat climate change depend largely on investment in infrastructure, sustainable industrial development, and technological progress. Thus, the justification for this work lies in the need to research new and innovative forms of industrial production within the framework of the circular economy that will enable the achievement of the SDG, especially number 9.

The objective of this article is to uncover the available evidence on innovation in relation to the circular economy and to determine those aspects that remain unexplored or should be studied in more depth in order to be able to continue to make progress in this field. Currently, there exists a range of frameworks that could potentially be drawn from to support CE visioning. These take the form of circular strategies frameworks.

Importantly, these frameworks can be seen as the visual representations of a vision for how to operate in a CE, since they select, name and organise circular strategies seen as relevant, such that their relationship becomes apparent.

Blomsma (2018) observed that such circular strategies frameworks can identify or emphasise different circular strategies, which can be linked to addressing different types of structural waste. As such, there is a risk that they do not include circular strategies with transformative potential for a particular context. For these reasons, there is scope to further develop these frameworks to support visioning in COI, therefore call for the development of such frameworks within academia.

We develop a circular strategies framework for manufacturing companies.¹ Manufacturing companies were chosen as the focus as they are important users of materials and energy, produce significant amounts of byproducts traditionally regarded as waste, and form an important employment sector² and contributor to GDP. In addition, manufacturing companies play an important role in the creation of value to their customers and therefore have great potential to decouple this value provision from linear resource consumption.

After clarifying the research gap and exploring the shortfalls of current circular strategies frameworks to support COI (Circular Oriented Innovation) within manufacturing, we continue with setting out the methodology to be applied.

02. Concept of Circular Economy:

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concept proposes a range of efficiency and productivity enhancing activities collectively known as circular strategies, such as reduce, reuse, repair, recycle, restore, cascading, etc . In this sense, CE is an umbrella concept: it groups a range of sub-concepts and imbues them with a new meaning by highlighting a shared feature of the sub-concepts. This new meaning revolves around the notion that through the application of circular strategies both more value can be created as well as value loss and destruction reduced.

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Specifically, in COI a high-level conceptual understanding of CE needs to be translated into a vision that is useful and meaningful on the level of decision making. The importance of a shared vision in innovation projects has long since been acknowledged and it has been posited to be relevant for both inter and intra organisational COI efforts. Circular economy ideas are taking off around the world, with solutions tackling waste and promoting sustainability in every aspect of our daily lives. Organizations and businesses need inspiration to take part in the circular transition. In recent years, the circular economy has become part of key national and international policies.

The Ellen MacArthur Foundation highlights a tendency to think that we face a simple choice between going linear and circular. Yet, existing models, incentives, and structures are primarily designed for linear production and must be re-thought for a successful transition to the circular economy. A systematic approach is needed to open up circular economy opportunities, to drive supply and demand and establish the landscape for innovation and the circular economy to flourish.

Simply promoting innovation is not enough. To support a circular economy, innovation needs to be pursued with that objective in mind. Regions and municipalities have a major role to play in circular economy strategies and roadmaps.

Once their purpose is fulfilled, raw materials are given numerous lives through recycling, repurposing and reusing, rather than disposing of. This economic model moves away from the previous linear model, forming loops and closing the circuit. "Reduce, reuse and recycle" are the cornerstones of this model.

This economic model moves away from the traditional "take-make-waste" culture of a linear economy and attempts to uplift the economy from a social, economic and environmental standpoint. A circular economy is vital to tackle the looming issues of climate change, dwindling finite resources, pollution, waste, and the need for sustainable energy.

We cannot achieve a circular economy overnight with the cooperation of one sector alone. It requires help and collaboration from all industries, as well as governments. The general shift towards more sustainability in production and consumption is undoubtedly helpful to establish and promote circular economies.

"Instead of focusing on just profit, entrepreneurs are now thinking about a triple bottom line: people, planet and profit."

Top 8 Circular Economy Trends & Innovations in 2022:

The global population is increasing at a steep rate, far outpacing available resources in the traditional "take-make-waste" approach of the linear economy. This is why there is a shift towards a circular economy. Solutions that aim to reduce waste and the use of new raw materials enable establishing a closed-loop economy. Thus, circular economy solutions turn waste into resources and extend the life of products and materials. For this, startups and smart cities are turning to technologies like Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain, making them integral aspects of circular economy trends.

1. **Waste-to-Resource:** The world generates tonnes of waste annually, most of which end up in landfills. The circular economy retains the value of products or resources by putting them back into the product cycle after use. Besides mechanical recycling, one of the biggest circular economy trends is to upcycle this waste to energy by incineration, gasification, anaerobic digestion, and pyrolysis.
2. **Reuse:** Reusing products extends their lifecycle while reducing waste and the use of new raw materials, thus, making it one of the top circular economy trends. To tackle this issue, various types of sharing platforms are on the rise. Reusable packaging is also gaining traction in the manufacturing, automotive, and consumer goods industries.
3. **Internet of Waste:** start-ups are developing IoT-based smart waste management solutions to reduce the inefficiencies in trash collection. Such solutions leverage sensors, IoT platforms, and mobile applications.
4. **Artificial Intelligence:** AI-powered sensors differentiate among items made from different materials as well as nuances among the ones of the same materials. It also detects chemical contamination in the items. This is why the use of AI in waste management is one of the emerging circular economy trends. Moreover, AI-driven machines sort recyclables much faster than humans using computer vision and deep learning algorithms. AI enables waste management companies to reduce the need for manual labour, thus, cutting costs and maximizing efficiency.
5. **Bio-Based Materials:** companies are producing new bio-based materials obtained from renewable resources, making it an important circular economy trend. Bio-based materials are generally compostable and easier to recycle, allowing companies and consumers to reduce their carbon footprints. For the packaging industry, startups are developing sustainable packaging solutions such as compostable packaging and edible cutlery.
6. **Remanufacture:** recycling implies breaking down a product to convert it into raw materials that are used for making new products. But remanufacturing involves rebuilding a product to its original condition with reused, repaired, and some new parts, making it as good as new.
7. **Blockchain:** Blockchain secures its position as a top emerging trend by enabling two important functions in the circular economy — providing transparency and traceability, and incentivizing circular behavior. Startups use blockchain's immutability to verify the origin of products, assuring that they meet their sustainability claims.
8. **Repair:** Repair solutions address this, extending the life of products. Repair solutions hold the potential to bring much of it back to the cycle. This is why repair solutions are an important circular economy trend and companies are adopting them to reduce their carbon footprint and save costs on raw materials.

03. Ecological Innovation (EI):

Eco-innovations, defined as innovations that reduce the environmental impact of production and consumption activities, play a very important role in the search for more sustainable societies because they transfer individual technologies. EIs require more cooperation than other innovations, as they are characterised by new technologies that require more external sources of knowledge and information than innovation in general. The study carried out by Demirel and Danisman (2019) identifies two main EI pathways: cleaner production and eco-design of products. They also establish that the positive impact of innovations on companies is conditioned by their structure, characteristics, specific innovation strategies, and the industry context.

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The following are several in-depth EIs through which progress can be made in achieving the circular objectives.

The first is the system of products and services, an innovative business model. With the CE paradigm, probably the most difficult sustainability challenge in the capitalist economy is separating economic growth from consumption.

To address this, two main types of innovative models are used.

- First, the user-oriented business model, where the company owner provides a product under rental or lease contracts but retains ownership.
- Second, the results-oriented business model, where the lead company provides the customer with a predefined outcome.

These are encompassed within the so-called system of products and services by which a change in the business model is proposed, moving from offering a manufactured product where the profit depends on the number of units sold to offering a combination of products and services that meet the needs of the consumer, where the profit also depends on the service units delivered. Spring and Araujo (2017) also studied this innovative idea in their article from the perspective of servicing (service-based growth).

In the second place, there are the dynamic capabilities in order to achieve sustainable competitive advantage. Several authors analyse this concept, implying a sustainable competitive advantage. These include capacities for detecting needs, taking advantage of opportunities, and reconfiguring the system based on the idea of micro-foundations made up of different skills, processes, and business activities. They are also envisaged in remanufacturing, which is a form of sustainable manufacturing by reusing the remaining value in old products instead of disposing of them in landfills. In this case, they are called dynamic remanufacturing capabilities (DRC).

The study shows that dynamic capabilities make it easier for the company to integrate, create, and reconfigure resources for sustainability in this dynamic business environment. The article by Scarpellini et al. (2020) identified a positive relationship between the circular scope of companies and their environmental capabilities,

In the third place, 3D printing is considered an emerging disruptive technology capable of enabling and facilitating the transition to CE by adding new capabilities and changing the underlying economy of several manufacturing sectors.

It facilitates recycling through a product design that allows for longer product life and establishes a local supply chain, taking advantage of economies of scope rather than economies of scale, resulting in significant cost reductions.

In the fourth place, connectivity between objects is studied through the product's biography and mechanisms. The implementation of CE requires technological changes and institutional innovation to enable products to be accessible and shared or sold. This introduces product biography to study the relationships of products with services and other

objects and in the different processes throughout their lifespan. This approach suggests seeing them as a set of trajectories with changing qualifications rather than a stable and productive conceptualisation of the object. Products are repaired, reconditioned, improved, manipulated, dismantled, reassembled, and discarded .

Finally, a fifth innovation tries to implement the CE in software, that is, far beyond the hardware components. In the electronics industry, circular practices must be established not only for hardware components but also for software products. The owner of a device does not have the same rights and freedoms about a tangible good because, for the use of software, a licence for use is acquired only for the period of its ownership. This is a limitation for the reuse or repair of the device and its software. The developers of these programs must configure digital rights management in such a way that it does not affect certain consumer behaviour after the purchase of the product and that it does not restrict the use of an old version of the device, thus extending the life of the software.

IE will be the means through which the implementation of CE will be possible in the industries. Specifically, the system of products and services, dynamic capabilities, 3D printing, the biography of the product and the software recycling seem to be the main EI for which the CE will be supported.

04. Strategies Management is a Circular Economy:

Circular development is a model of economic, social and environmental production and consumption that aims to build an autonomous and sustainable society in tune with the issue of environmental resources. The circular economy aims to transform our economy into one that is regenerative. An economy that innovates to reduce waste and the ecological and environmental impact of industries prior to happening rather than waiting to address the consequences of these issues. This is done by designing new processes and solutions for the optimization of resources, decoupling reliance on finite resources.

The circular economy is a framework of three principles, driven by design: eliminate waste and pollution, keeping products and materials in use and regenerate natural systems. It is based increasingly on renewable energy and materials, and it is accelerated by digital innovation. It is a resilient, distributed, diverse, and inclusive economic model. The circular economy is an economic concept often linked to sustainable development, provision of the Sustainable Development Goals and an extension of a green economy.

Circular development is directly linked to the circular economy and aims to build a sustainable society based on recyclable and renewable resources, to protect society from waste and to be able to form a model that is no longer considering resources as infinite. This new model of economic development focuses on the production of goods and services taking into account environmental and social costs.

Circular development, therefore, supports the circular economy to create new societies in line with new waste management and sustainability objectives that meet the needs of citizens. It is about enabling economies and societies, in general, to become more sustainable.

The CE does not aim at changing the profit maximization paradigm of businesses. Rather, it suggests an alternative way of thinking how to attain a sustained competitive advantage, while concurrently addressing the environmental and socio-economic concerns of the 21st century. Indeed, stepping away from linear forms of production most often leads to the development of new core competencies along the value chain and ultimately superior performance that cuts costs, improves efficiency, meets advanced government regulations and the expectations of green consumers. CE decision-making remains a highly complex exercise with no one-size-fits-all solution. The intricacy and fuzziness of the topic is still felt by most companies especially SMEs, which perceive circular strategies as something not applicable to them or too costly and risky to implement. This concern is today confirmed by the results of ongoing monitoring studies like the Circular Readiness Assessment.

Strategic management is the field of management that comes to the rescue allowing companies to carefully evaluate CE-inspired ideas, but also to take a firm apart and investigate if/how/where seeds of circularity can be found or implanted. The book *Strategic Management and the Circular Economy* defined for the first time a CE strategic decision-making process, covering the phases of analysis, formulation, and planning.

Most countries that are in the lead in the field of circular economy are European countries, meaning that Europe in general is in the lead group at the moment. The reasons behind this are numerous. First of all, circular economy is a field that is, at the moment mostly advanced in the developed countries, thanks to, between others, technology.

05. Conclusion:

In conclusion, CE is presented as the solution to the environmental problem that has been facing humanity for several years now. Although it is still at a very early stage of implementation, its benefits and drivers have already been investigated, and its challenges and barriers to implementation. Proof of this is that the European Union has already started to adopt sustainable growth policies that promote CE.

There is some criticism of the idea of the circular economy. A key tenet of a scatolic approach to waste is to consider waste as unavoidable and worthy of interest. Whereas total quality sees in waste a sign of failure, a scatolic understanding sees a sign of life. Likewise, whereas the Circular Economy analogy of a circle evokes endless perfection, the analogy of scats evokes disorienting messiness. A scatolic approach features waste as a lively matter open for interpretation, within organizations as well as across organizational species.

Korhonen, Nuur, Feldmann, and Birkie (2018) argued that "the basic assumptions concerning the values, societal structures, cultures, underlying world-views and the paradigmatic potential of CE remain largely unexplored" The EI (Ecological Innovation) is necessary to leave behind the current linear economic model, committing to new business models and new ways of operating in the supply chains that allow the circle to be closed and all the waste to be taken advantage of. All the proposals that have been studied, i.e. the system of products and services, dynamic capabilities, 3D printing, the biography of the product and the software recycling, have already been put into practice to a greater or lesser extent, largely because companies and consumers are increasingly aware of the importance of being part of the fight against climate change.

In this sense, future research work may try to analyse the impact of this strategy in different industrial sectors, at a firm level and at a country-level, and the environmental and economic consequences of their implementation. It would also be interesting to study the impact of the required changes in production processes and environmental policies.

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