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The Circular Economy as a trajectory to Sustainable Economic well-being

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Abstract:

Circular Economy is a sustainable development strategy where in economic benefits are increased while reducing the burden on natural resources. The technology and alternative practices that allow shifting of focus from non-renewable natural resources to recovery of resources from the waste thereby generating economic, social, and environmental benefits is the basic idea behind the Circular Economy origin.

The aim of this paper is to Understand the Relationship between Industry 4.0 Revolution, the fundamental shifts brought by Circular Economy, and the efforts towards sustainable development. To perform a literature review in order to identify the nature of sustainable development addressed by the combination of industry 4.0 and Circular Economy. this article discusses How do both the circular economy and industry 4.0 contribute to achieving sustainable development? The study is primarily based upon the secondary data. For this extant literature related to the topic from different databases, websites and other available sources were collected. I searched relevant literature in Scopus, science direct, and Google Scholar using specific keywords, e.g., “Circular Economy,” “industry 4.0,” “sustainable development,” “economic growth”. A systematic review of collected literature was done in detail.

Keywords: **circular economy; sustainable development; economic growth; industry 4.0.**

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I. INTRODUCTION:

According to Silvestre and Tirsa (2019), sustainable performance cannot be achieved without innovation. Technological progress and innovation are driving transformations from the individual sphere to all supply chains and communities. In this context, advanced technologies that are integrated in the context of Industry 4.0 (I4.0) can drive development to achieve the goals of the SDGs, especially in the industrial sector (Hidayatno et al., 2019). Likewise, the new possibilities opened up by I4.0 technologies can use the circular economy (CE) and contribute to the achievement of several SDGs (Schroeder et al., 2019).

The term I4.0 refers to a radical disruption towards an intelligent industry with autonomous and interconnected manufacturing technologies (Bai et al., 2020). According to Drath and Horch (2014) the purpose of I4.0 is to connect the industry to the internet, turning factories more economical, smart, and efficient. It is believed that this new technological scenario will revolutionize the current industrial modus operandi (Ramakrishna et al., 2020), and possibly will affect all sectors by transforming the design, operations and transportation of products and materials (Hofmann and Rüsch, 2017). I4.0 describes the use of integrative and interconnected technologies for production optimization (Wan et al., 2016), for example: Cyber-physical Systems (CPS), Internet of Things (IoT), Big Data (BD), Additive Manufacturing (AM), and Internet of Services (IoS) (Ramakrishna et al., 2020). Other advanced technologies encompassed by I4.0 are Cloud Computing (CC), Augmented Reality (AR), Systems Integration, Simulation, Cybersecurity, and Autonomous Robots (Zhong et al., 2017).

There is an urgent need to move to more sustainable socio-technical systems (Markard et al., 2012). Environmental problems such as loss of biodiversity, pollution of water, air and soil, depletion of resources and overexploitation of land increasingly threaten the planet's survival systems. (WWF, 2014). Society's expectations are not being met due to issues such as high unemployment, poor working conditions, social vulnerability, the poverty trap, equality between and within generations and increasing inequalities (Prahalad, 2004). Economic challenges such as supply risk, problematic ownership structures, deregulated markets and flawed incentive structures lead to increasingly frequent financial and economic instabilities for individual businesses and entire economies (Sachs, 2015). To address these and other sustainability issues, the concept of the circular economy, while not entirely new, has recently gained prominence on the agendas of policy makers (Brennan et al., 2015) . This can be seen, for example, in the comprehensive European

package on the parcel economy and in the Chinese law aimed at promoting the circular economy (Lieder and Rashid, 2016). The circular economy has also become an important area of academic research, as the number of articles and journals devoted to this topic has increased significantly over the past decade. Companies are also increasingly aware of the opportunities that the circular economy promises and have started to recognize its potential value for themselves and their stakeholders.

1. Statement of problem:

Despite the concept's importance for academia, policymakers, and companies, the conceptual relationship between the Circular Economy and sustainability is not clear. This has potential detrimental implications for the advancement of sustainability science and the diffusion of practices based on these concepts and from this perspective, the research problem can be formulated as follows:

- How do both the circular economy and industry 4.0 contribute to achieving sustainable development?

2. Research questions:

This article focuses to answer the following questions:

- What is the reality of industry 4.0, technological development and economic growth?
- What is the meaning of circular economy?
- What are the benefits of circular economy?
- what are the relationship types between circular economy and sustainable development?

3. Research hypothesis:

- Sustainable development has an indirectly affected by the combination of CE and I4.0 conclusion

4. Research objectives:

This paper focus to:

- perform a literature review in order to identify the nature of sustainable development addressed by the combination of industry 4.0 and Circular Economy.
- Understand the Relationship between Industry 4.0 Revolution, the fundamental shifts brought by Circular Economy, and the efforts towards sustainable development.

5. Methodology:

The study is primarily based upon the secondary data. For this extant literature related to the topic from different databases, websites and other available sources were collected. A systematic review of the collected literature was done in detail.

6. Previous studies of circular economy:

Several scholars have analyzed the rapidly evolving field of research on the circular economy. However, these studies exhibit varying focuses:

Homrich et al. (2018), who conducted a general bibliometric analysis of CE research, also dedicated a section to the CE-SD relationship. However, they only focused on 39 CE and supply chain-related publications, and then assigned these to the three dimensions of sustainability.

Ruiz-Real et al. (2018) highlighted three main trends in CE research, namely eco-innovation, eco-design, and waste management, and mentioned assessment-related topics, as well as sustainable development, as an upcoming connection to CE.

D'Amato et al. (2017) compared the literature on the circular, green and bioeconomy, as all three of these concepts imply a change in the current economic system towards a more sustainable one. According to the authors, the three concepts mainly evolved around relative decoupling within economic growth. Additionally, the idea of a green economy also merges into green growth, and the literature on the bioeconomy is mixed in with concepts covering green growth and business as usual scenarios.

Cui and Zhang (2018) compared the scientific literature on a circular economy and related the topics to Chinese public policy, and found clear interactive feedback. They call for a more spatial approach towards CE, including urban and regional metabolisms.

Türkeli et al. (2018) analyzed CE development in China and in the European Union and the potential for research cooperation between these two leading regions. They confirm that there is a high potential for international cooperation within the automotive, construction, and demolition sectors, as well as in developing suitable business models and resource security.

Finally, Nobre and Tavares (2017) find that although the IoT and big data applications can be seen as crucial enablers for CE approaches, their inclusion in the literature remains relatively scarce (70 publications), thus indicating a gap in the research.

II. LITERATURE REVIEW:

1. The Linear Economy and waste: An unsustainable practice:

In times of prosperity and abundance, such as the 1920s and mid-1950s, planned obsolescence encouraged and empowered the linear economy, the pattern of use where products become waste. at the end of life. In "developed" countries, the wealthiest members of society simply dispose of unwanted products, while the less wealthy repair and reuse the products. Manufacturing and repair (reuse and repair) and salvage (recycling) practices were common in society during and immediately after World War II, as resources were rationed and many were only available for the so-called war effort. After the rationing ended, the products were disposed of at the end of their useful life. The linear model was further sustained in the 1960s when significant changes in world markets made bailing out metals, paper, glass, and textiles less economically attractive than buying new products. ;; Therefore, as described above, the products were not designed to be disassembled. The linear model has benefited creative, manufacturing and retail industries, utilities, and producers of raw materials (such as mining and oil). However, conversely, the environment was damaged as large amounts of waste were sent to landfill and incinerated as waste. Like consumption, waste is a function of wealth and, while it is impossible to quantify the amount of commercial and / or municipal waste that has been generated so far in the linear economy, it is expected to increase. Simultaneously with population growth by increasing incomes and behavior related to urbanization. Urbanization is projected to account for 70% of the world's population by 2050, and urban dwellers generate twice as much waste as their rural counterparts. Currently, the world population produces around 1.3 billion tons of municipal waste per year, but this could reach 2.2 billion tons per year by 2025 (World Bank, 2012). End-of-life disposal has never been a

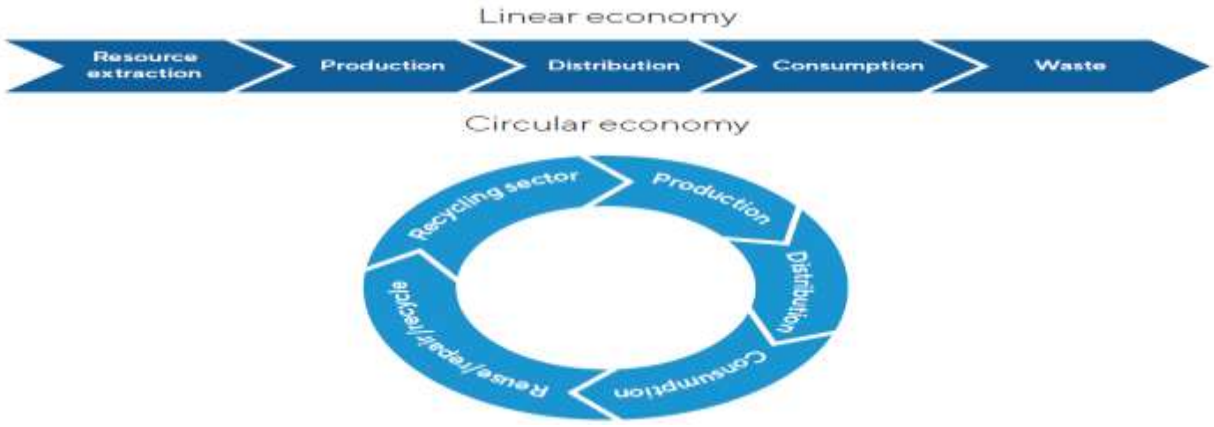
sustainable practice, but several factors make it less and less sustainable. These are now briefly discussed and underscore the need for an alternative to the linear economy (Andrews, 2015).

1.1 The limits of linear consumption:

In the course of its development and diversification, our industrial economy has barely surpassed a fundamental characteristic established in the early days of industrialization: a linear pattern of resource consumption that follows a levy pattern. Companies harvest and extract materials, make a product out of it, and sell it to a consumer who then throws it away when it no longer serves its purpose. This is truer today than ever. In terms of volume, around 65 billion tons of raw materials entered the economic system in 2010, and this number is expected to reach 82 billion tones by 2020 (Ellen MacArthur Foundation, 2014).

Recently, many companies have also found that this linear system increases risk, especially rising commodity prices and supply disruptions. More and more companies are feeling stuck between rising and less predictable prices in commodity markets on the one hand and strong competition and stagnant demand for certain sectors on the other. The turn of the millennium was when real prices for natural resources began to rise, essentially erasing the real price declines of a century.

Figure01. the linear and circular economy



Source: (Ellen MacArthur Foundation,2014)

At the same time, the price volatility of metals, food and agricultural non-food production was greater in the first decade of the 21st century than in any other

decade of the 20th century. Uncontrolled, high prices and volatility are likely to persist if growth is robust, population is growing and urbanizing, and the cost of extracting raw materials continues to rise. Given that three billion new medium-sized consumers are expected to enter the market by 2030, price signals may not be strong or broad enough to change course fast enough to meet these growth needs.

Other trends indicate that the power of the linear model is reaching its limits (Ellen MacArthur Foundation,2014):

• There are still opportunities to increase the efficiency of modern manufacturing processes, but the gains are largely incremental and insufficient to create any real competitive advantage or differentiation.

• An unintended consequence of eco-efficiency has been the acceleration of energy consumption and the scarcity of resources due to the rebound effect, which is negative when improvements in energy and resource efficiency increase. the actual amounts of materials and energy used.

• Agricultural productivity is growing more slowly than ever, and soil fertility and even the nutritional value of food are declining.

• The security of supply risk associated with long and carefully optimized global supply chains appears to be increasing.

• Many manufacturing sites with excessive demand for pristine resources (water, land or atmosphere) find it difficult to renew their operating licenses when competing in sensitive local resource markets (Ellen MacArthur Foundation, 2014).

2. Technological Development, Industrial Revolution and Economic Growth:

In 1776 the economist Adam Smith stated that, in addition to agriculture, gold and silver, the ‘wealth of nations’ was grounded in ‘national production’, i.e. manufacture (Smith, 2012). The quantity, variety and speed of production increased concurrently throughout the first and second Industrial Revolutions, which were due in part to mechanization, the development of new energy systems and materials and to the division of labor. Production processes were further accelerated during the 1950s following the invention of industrial robots and CAD CAM (Computer Aided Design and Computer Aided Manufacturing), since when utilization has become widespread. Digital manufacture has further evolved and is now facilitating emergence of the Third Industrial Revolution

that includes additive manufacturing (3D printing) and a shift from centralized to decentralized local and domestic manufacture. 'National production' was critical to and developed as a result of the demand– supply–income cycle (Goossens et al., 2007), and, as predicted by Smith national and personal wealth increased.

2.1 The Concept of Industry 4.0:

The development of new cutting-edge technologies proposed by I4.0 offers new possibilities to close production cycles, to maximize the use of already used resources and thus to minimize the extraction of raw materials (Pham et al., 2019). Examining the points of convergence between these two topics from a sustainability perspective therefore shows great relevance not only for the academic community, but also for political decision-makers and decision-makers. The convergence and combination between I4.0 and circular systems, hereinafter referred to as CE-I4.0-Nexus, is a topic that is currently emerging in the scientific literature (Pham et al., 2019). Dev et al. (2020) analyzed the potential of implementing I4.0 tools to increase the performance of the reverse supply chain. Belaud et al. (2019) discussed the benefits of implementing DB in agricultural supply chains.

Figure02. The industry 4.0



Source : (Dantas et al,2020)

Jabbour et al. (2020) and Pham et al. (2019) analyzed how I4.0 can further promote the resource sharing within the technological cycles. Ramakrishna et al. (2020) performed a study linking these two main topics in a university environment. The work of Hatzivasilis et al. (2018) described the potential of

IoT as a facilitator for CE. Hence, it is clear that the CE-I4.0 nexus is a promising research topic that links groundbreaking technologies to systemwide shifts in our economic and industrial models (Dantas et al,2020).

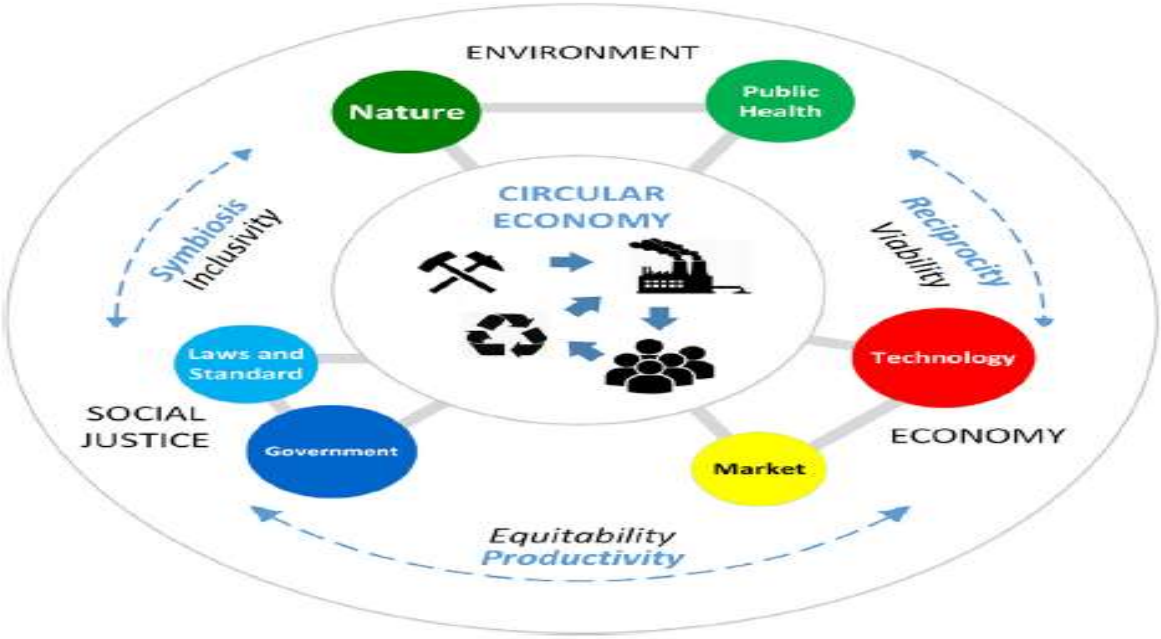
3. Circular Economy:

The concept of CE was first introduced by Pearce and Turner in "Economics of Natural Resources and the Environment." Subsequently, since 2010, the Ellen MacArthur Foundation has contributed significantly to the development of CE practices in various sectors, such as: B. Waste management, sustainable design and construction, food production and indicator development. The EC is a sustainable development strategy that increases economic benefits while reducing the burden on natural resources. The alternative / technology / practice that allows changing the focus from non-renewable natural resources to the recovery of residual resources and thus achieving economic, social and environmental benefits is the basic idea of the CE concept. CE is a kind of rethinking, a way to recycle valuable materials from a product at the end of its life and reuse the same material for the manufacture of another product in order to preserve the ecology and remain useful beyond the useful life of individual products. In this way, the assets of today can become the resources of tomorrow. The concept of CE is based on the principles of waste management in terms of reduction, reuse, recycling and recovery (Kakwani and Kalbar, 2020).

3.1 The Benefits of a Circular Economy:

Linear consumption is reaching its limits. A circular economy has benefits that are operational as well as strategic, on both a micro and macroeconomic level. This is a trillion-dollar opportunity, with huge potential for innovation, job creation and economic growth.

Figure03.circular Economy environnement



Source: (Ellen MacArthur Foundation,2014)

The last 150 years of industrial development have been characterized by a linear or one-sided production and consumption model in which goods are made from raw materials, sold, used and then disposed of as waste or incinerated. In view of the sharp increase in the volatility of the world economy and the increasing signs of resource scarcity, the demand for a new economic model is growing. The search for a substantial improvement in resource performance across the economy has led companies to seek ways to reuse products or their components and recreate more of their precious materials, energy and manpower. Work (Ellen MacArthur Foundation, 2014).

A circular economy is an industrial system that is restored or regenerated by intent and design. It is estimated that the economic benefit of moving to this new business model equates to more than $ 1 trillion in material savings.

3.2 Barriers to Adopting Circular Economy Business Practices:

Numerous barriers can hamper the implementation of ‘circular’ and ‘green’ economy practices by SMEs that can originate, for example, from the SME enabling environment, such as culture and policy-making, from the market chain in which the SME operates, such as behavior of suppliers, and from lack

of technical skills and finance. These barriers are further analyzed below on the basis of a literature review (Rizos et al,2015):

1 Environmental culture
2 Financial barriers
3 Lack of government support and effective legislation
4 Lack of information
5 Administrative burden
6 Lack of technical skills
7 Lack of support from the supply and demand network.

4. Sustainability:

Sustainability concerns are increasingly being incorporated into the agendas of decision makers and corporate strategies. The term sustainability itself has its origins in the French verb support, "to maintain or to support", and its modern conception has its origins in forestry. It is based on the silvicultural principle that the amount of wood harvested should not exceed the renewable volume. This conceptualization was already written in "Sylvicultural Economic" in the early 18th century, and there appear to be even older sources that follow the underlying principles for addressing timber scarcity and managing cooperative systems. Later it was moved to the context of ecology as the principle of respect for the regenerative capacity of nature, so the modern definition of "can be maintained at a certain speed or level". He estimated that there are around 300 definitions of sustainability. To name a few, sustainability can be defined as a situation in which human activities are carried out in such a way that the functions of the earth's ecosystems are preserved, a transformation of the human way of life that increases the likelihood that living conditions improve safety, well-being. and continuously promote health, in particular by maintaining the supply of irreplaceable goods and services or by maintaining indefinitely all forms of life (Geissdoerfer et al., 2017).

The concept's uptake can be traced back to the increasing evidence on global-scale environmental risks, such as ozone depletion, climate change, biodiversity loss or the alteration of the nitrogen cycle. These risks have been systematically investigated since the 1960s, raising questions about whether present prosperity trends can be maintained in the future and, consequently, revealing many sources of tensions.

The emergence of such tensions has sparked a number of international debates about the complex and dynamically interconnected nature of the environment, society and the economy. These discussions challenged oversimplified development frameworks and their assumptions about economic growth. The 1972 Stockholm Conference and the Limits to Growth report had far-reaching implications by interpreting "development" and "environment" as contradicting elements of an intrinsic compromise. "However, the concept of sustainable development implies limits, not absolute limits, but limits imposed by the current state of the art and social organization of environmental resources and by the ability of the biosphere to absorb the impacts of human activities". (Geissdoerfer et al., 2017).

On this basis and with a view to maintaining the holistic, adaptable and flexible character of sustainability, the term sustainability is formulated in this article as a balanced and systemic integration of economic performance within and between generations.

Despite the divergence between the perceived strengths and weaknesses of the term and the associated reactions, sustainability has become institutionalized in the agendas of political decision-makers and the strategies of large organizations and cumulatively more firmly anchored in the rules that structure interventions. Social and fitness behavior (Geissdoerfer et al. 2017).

4.1 Sustainable Development and Sustainable Economic Welfare:

Before examining how to set values for economic services and poor environmental services, we must briefly consider the implications of sustainable development requirements when choosing the economic approach. The United Nations World Commission defines sustainable development as a way for future generations to enjoy the same well-being as current living generations. The implication of this approach from an economic point of view is a requirement of constant consumption or, to put it more abstractly, constant use. In order to keep annual performance at a constant level, it will be necessary, in the absence of technological advances, to keep the stock of environmental resources constant.

Environmental resources must be managed in such a way that future performance does not deteriorate and future generations are not harmed. In this way, environmental resources can be seen as a bank account in which the

capital (amount deposited) remains constant to generate a constant flow of interest for living.

The demand for a constant return and a constant stock of natural capital is restrictive. It has become common to distinguish between strong and weak versions of sustainability. In the weak form of sustainability, the substitution of natural capital and other types of capital is permissible, so the depletion of natural capital must be offset by savings in other types of capital such as human capital. or physical capital. While this is often seen as a relaxation of sustainability criteria, even this lower definition of sustainability would be challenging for many countries that do not have systems to determine whether or not fossil fuel extraction is being offset. reinvesting in education (human capital) or infrastructure (physical capital). The strong version of sustainable development that does not allow for substitution tends to become less rigid, so the emphasis is on the non-substitutability of certain types of critical capital.

The definition of economic sustainability is generally tied to the Hartwick austerity rule, which states that rents from the extraction of raw materials must be reinvested in other types of capital and that the government must ensure this by introducing an extraction tax. of natural resources. to ensure savings. In the case of fossil fuels, Hartwick's savings rule implies that fossil fuel tax revenues will be reinvested in other types of capital and that these would generate a similar annual income in the future. current fossil fuel production (Andersen, 2007).

5. The Circular Economy as a Pathway to Product Sustainability:

The circular economy (CE), also known as the "closed loop" economy, is an evolving industrial and social concept that pursues holistic sustainability goals through a culture without waste. It arises from the ideologies that were introduced in 1862 with Simmonds' "Waste Products", "The Economics of the Spaceship Earth to Come", "Industrial Ecology", "Cradle to Cradle", "Performance Economics", "Biomimicry"., among other. In a CE, the end-of-life phase of products and materials must be replaced by restoration. The EC also considers industries that use renewable energy, eliminate toxic chemicals and waste, while maximizing competitive advantage through superior design of materials, products, systems and business models. (Ellen MacArthur Foundation, 2014).

Companies subscribed to a CE would mainly benefit from material savings, a reduction in supply risk, improved customer loyalty and the development of new sources of income. The EC has also alerted governments, researchers and NGOs to a plausible path to sustainable social growth by closing the loop and renewing biological and technical material (De los Rios & Charnley, 2017).

figure04.circular & sustainable business



Source: (Ellen MacArthur Foundation, 2014)

De los Rios and Charnley (2017) summarizes four principles of the CE as points of action to eradicate careless resource depletion and revitalize existing material value in industry:

1. Optimize the use of resources and energy throughout lifecycles.
2. Maintain products and components in use for longer.
3. Materials cycle through the system as many times as possible through cascaded uses.
4. Utilize pure materials for improving quality of post-life use.

Different kinds of product cycles take place within a circular economy. Some loops involve companies maintaining economic value of material assets during their entire lifecycles, avoiding products to end up in landfill for as long as possible; some others involve the adoption of resources that can be reintegrated into nature, or fed into another supply chain (Ellen MacArthur Foundation, 2014).

5.1. Relationship types between Circular Economy and Sustainable Development:

Similarly, Geissdoerfer et al. (2017) describes a circular economy as an important element of sustainable development.

Webster (2015) assumes a much stronger conditional relationship. Perhaps even more pronounced, at least with regard to the environmental dimension, are Bakker et al. (2014), who consider circularity to be absolutely necessary in order to support economic production. A similar approach is also supported by the United Nations Environment Program (2006), which presents the circular economy as a necessary condition for sustaining economic growth, but not other ways of creating this condition. You are not excluded. A third type of conditional relationship is identified by Nakajima (2000), who describes circularity and service-based systems as a necessary but not sufficient condition for a sustainable system. Other conditions, such as a change in lifestyle, must be accompanied by a closed system in order to achieve long-term sustainability. The European Commission (2014) shares a similar point of view and presents circular economies as beneficial to various dimensions of sustainability, such as resource productivity, job creation and GDP growth, but does not state whether this is a necessary or sufficient condition or how it relates to other concepts that can promote sustainability.

The OECD (2009) takes a hierarchical view and regards closed-loop manufacturing systems as more sustainable than most other manufacturing concepts, as they contain more goals and mechanisms for eco-innovations. The only exception to this prioritization is the industrial-ecological framework, which is considered to be even more sustainable.

Geissdoerfer et al. (2017) argue that although circularity has a positive effect on some aspects of sustainability, it does not integrate other dimensions, especially the social dimension. These missing dimensions could complement the concept of circular economy.

an overview of the different types of relationships between sustainability and the circular economy identified in the study. These categories are intended to highlight the most obvious differences found in our sample. It is important to emphasize, however, that this table is not intended to be exhaustive as any type of relationship could be further sub-categorized and therefore explored in depth (Geissdoerfer et al., 2017).

5.2 Circular Economy for Sustainable Development: Toward a New Scientific Definition:

The concept of CE is loosely based on a fragmented collection of ideas drawn from specific areas of science, including emerging and semi-scientific concepts. These sources include, for example, industrial ecology, industrial ecosystems and industrial symbioses, cleaner production, including reviews of the circular material flows of manufacturing systems and developments for this purpose, systems of products and services. , Eco-efficiency, cradle-to-cradle design, biomimicry. , the resilience of socio-ecological systems, performance economics, natural capitalism, the concept of zero emissions and others (Korhonen et al., 2018).

While some of these approaches have made important contributions to sustainability science, the relationship with EA's current popular concept is obscure and difficult to understand. Scientific studies on this connection are practically non-existent. Green economics is an established scientific field and has a long tradition in recycling and the problems associated with it. The ecological economy seems to be the right place to start basic scientific work on CE. Perhaps the most influential core concepts in the EC were the cradle-to-cradle concept, developed by the "eco-efficiency" actors, and the industrial ecology concept, which includes a view of the industrial ecosystem "intersystem ecology". For example, in these highly idealized visions. Eco-efficiency, economic systems and natural systems are positively linked in a single system that is 100% renewable energy and that recycles all materials. This ideal of a single ring system, while desirable, is not realistic. Around 75% of the world's energy generation is based on non-renewable sources that are obtained from the burned lithosphere. Combustion releases emissions into the biosphere in forms and concentrations that nature cannot tolerate or absorb. This is the most obvious example of linearity across the economy and the best example of the limits of current EC views (Korhonen et al., 2018).

5.3 Sustainable Development Goals Indirectly Affected by The Combination of Ce and I4.0:

Although the aim of this research was to highlight how the application of I4.0 technologies to circular systems can directly contribute to the successes of sustainable development, the systematic review carried out also provides additional results. Linking CE concepts and practices with new technologies developed under the aegis of I4.0 indirectly benefits alternative sustainable

development. Because of these secondary relationships, the effects of the CE-I4.0 relationship according to the specific indirectly affected sustainability goals were not analyzed in detail in this study (Dantas et al., 2020).

The effects on these ecosystems can be reduced through more environmentally friendly production, consumption and behavior. Smart waste management, waste minimization, and natural systems restoration recommended by CE are practices and solutions that can contribute to this problem. As mentioned in this article, I4.0 can improve EC strategies and methodologies by extending their positive impacts and in this case contributing to sustainable development related to the biosphere. This analysis is supported by the studies of Rodríguez-Anton et al. (2019). In terms of the social and economic sector, the CE-I4.0 link can improve the current global contexts to which sustainable development relates. The reasons for this are the controversial revolution that CE and I4.0 could impose on the labor market (Hahn, 2020). In the event that these drastic changes, due to the need for new technology and sufficient business models, encourage job creation and redistribution around the world, the jobs created could mean a reduction in inequality and poverty in the United States. The work area focused on sustainability while addressing hunger problems. In addition, CE is presented as a valuable solution for food safety. If I4.0 is fed, the food shortage can also be addressed by fully implementing CE principles and practices. Finally, we argue that even if the above indirect links may seem fragile due to the many links between the Sustainable Development Goals set out in the 2030 Agenda, several authors emphasize that the Sustainable Development Goals are an interconnected strategy for sustainable development (Dantas et al., 2020).

III. CONCLUSION

The circular economy is an economy built from social production and consumption systems that maximizes the services that arise from the linear flow of materials and energy between nature, society and nature. This is done using cyclical material flows, renewable energy sources and cascading energy flows1. A successful circular economy contributes to all three dimensions of sustainable development. The circular economy limits the flow to levels that nature tolerates and uses the cycles of ecosystems in business cycles, taking into account their natural rates of reproduction. The EC should use the cycles of nature to conserve materials, energy and nutrients for economic purposes. Material flows that get into nature from business must have a form that

enables nature to use them in its own functions. There are many individual examples of how this demonstrated goal can be achieved in practice, for example. in the cradle-to-cradle studies mentioned above (Braungart et al., 2007) or in applications of industrial ecology in intersystem ecology. Not only bioenergy, pulp, paper, wood, food and biomaterials can be part of the economy-nature-economy cycles of nature etc., but also other wastes produced by society. these common renewable cycles. This type of activity is strongly advocated in recent cradle-to-cradle commercial visions in which so-called "biological nutrients" in the biomass-using industry are released into the biosphere where they contribute to the growth and development of biomass. Conservation of biodiversity, i.e. work and support of the source base for savings in nature (Korhonen et al., 2018).

In summary, in our definition of CE for sustainable development, the environmental objective of the CE is to reduce the system of production consumption of virgin materials and energy inputs, as well as waste and emissions (physical flow) through the application of material cycles and waterfalls more renewable Energies. . The economic goal of the EC is to further reduce the costs of raw materials and energy of the economic production and consumption system, the costs of waste management and emissions control, risks related to (environmental) legislation / taxes and the public image of innovative new product designs and business market opportunities. The social goal is the collaborative economy, increasing employment, participatory democratic decision-making and the most efficient use of the existing physical material capacity by a cooperative and communal user (user groups that use value, service and function). as opposed to a consumer (people who consume physical products) (Korhonen et al., 2018).

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