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CIRCULAR ECONOMY: CONCEPTS AND PRINCIPLES

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Abstract. The 21st century is largely determined by the current phenomenon of globalization. It is gaining more powerful valences, has caused environmental issues that require a global sustainable solution. Limited natural resources, rapid deterioration of air, water, and soil quality, global warming, deterioration of the ozone layer, glacier melting, the loss of biodiversity - are just some of them. Looking beyond the current „take-make-waste" model, humanity continues to consume more resources and contribute more to environmental degradation. The linear economy, which relies exclusively on resource extraction, is no longer a viable option. Circular economic model is the solution to do things differently, in a sustainable manner. It is an economic system aimed at eliminating waste and ensure continual use of resources through repairing, refurbishing, recycling and reusing existing materials and products. This paper aims at improving the understanding of the circular economy concept based on an extensive literature review, as well as its various dimensions, concepts and principles.

Key words: *circular economy, sustainability, recycling, reuse, circular principles.*

Rezumat. Secolul XXI este determinat în mare parte de fenomenul actual al globalizării. Acesta câștigă valențe tot mai puternice, provocând probleme de mediu care necesită o soluție durabilă globală. Resursele naturale limitate, deteriorarea rapidă a calității aerului, apei și solului, încălzirea globală, deteriorarea stratului de ozon, topirea ghețarilor, pierderea biodiversității sunt doar câteva dintre acestea. Privind dincolo de modelul actual de „ia-fă-consumă-aruncă", umanitatea continuă să consume tot mai multe resurse și să contribuie tot mai mult la degradarea mediului. Economia liniară, care se bazează exclusiv pe extragerea resurselor, nu mai este o opțiune viabilă. Modelul circular este soluția de a face lucrurile diferit, într-o manieră durabilă. Este un sistem economic menit să elimine deșeurile și să asigure utilizarea continuă a resurselor prin repararea, renovarea, reciclarea și reutilizarea materialelor și produselor existente. Acest articol are drept scop îmbunătățirea înțelegerii conceptului de economie circulară bazat pe o analiză extinsă a literaturii de specialitate, precum și a diverselor dimensiuni, concepte și principii.

Cuvinte-cheie: *economie circulară, durabilitate, reciclare, reutilizare, principii circulare.*

Introduction

The 21st century is a century of great changes in the behavioural models and rules affecting the economic, social and environmental ecosystem. It is largely determined by the current phenomenon of globalization that is gaining more impact and delivering stronger consequences. The direct consequences of this phenomenon raise issues of such proportion that require a global solution. Given the considerable decline in natural resources that are already scarce, the rapid deterioration of air, water, soil quality, the intensification of the urbanization process, and the damage driven to natural ecosystems, the transition to a circular economy becomes inevitable. Moreover, current resource consumption is so large that it jeopardizes the chances of future generations - and of the developing countries - to gain access to their fair share of limited resources. Currently, approximately 16 tonnes of resources per capita are used annually in the EU, of which 10 tonnes go into material stocks (infrastructure, housing, durable goods) and 6 tonnes leave the economic circuit as waste [1].

According to UN forecasts, if current trends will continue to grow, the humanity would need the resources of two Earths by 2030 and three Earths by 2050 to function properly [2]. Therefore, the circular economy becomes a complex and indispensable subject for the future socio-economic evolution. Being a regenerative system, which is based on the use of renewable energy, on the capitalization of waste through the design of new materials, products, systems, the circular economy is the solution for the future.

The basic objective of this scientific approach is focused on outlining the theoretical and conceptual framework of the circular economy, its principles and highlighting the importance of the process of transition to the circular business model.

I. The concept of circular economy

The concept of circular economy cannot be accurately dated or attributed to a particular researcher. However, numerous scientific studies consider the American scientist Kenneth E. Boulding as the initiator of circularity, [3, 4, 5] who, in his paper „The economics of the coming Spaceship Earth", states that „the earth has become a single spaceship, without unlimited reservoirs of anything [...], therefore, man must find his place in a cyclical ecological system which is capable of continuous reproduction of material" [6].

A little later, in the 1970s, the idea of a circular economy was also discussed by environmental researchers, J.T. Lyle and Walter Stahel, who argued that traditional (linear) production processes, in which most by-products are eventually discarded after use, are not sustainable [7]. Although the idea of circulating, reusing, reproducing resources is found in many scientific researches of that period, it is considered that in fact the Conference on the Environment held in Stockholm in 1972, for the first time seriously raised the issue of environment deterioration and sustainability as an essential feature of the circular economy, gathering a record number of over 6000 people, delegations from 113 countries, over 1500 journalists, 700 observers from over 400 non-governmental organizations [8].

That massive involvement, that large-scale event, shows that concerns about human activities on the environment and the need for reform have been acknowledged since then on a global scale. Moreover, two years later, in 1974, Lester R. Brown, founder and current president of the Earth Policy Institute, created the „Worldwatch Institute" - a global organization designed to accelerate the transition to a sustainable world, having as principles the 4Rs **reduce - repair - reuse – recycle**.

Later the research report „The Potential for Substituting Manpower for Energy" from 1976 presented to the European Commission in Brussels by researchers Walter Stahel and Genevieve Reday outlined the idea of circularity, respectively closing the „**economy in loops**" (or circular economy) and defining its impact on job creation, economic competitiveness and the importance of rational use of resources and waste processing [9].

A closer approach to practice of the idea of „circularity" in economics is proposed by Maria Popescu in her paper „A possible answer to the dilemmas of development - active circular process", defining it as „method of design and multidimensional organization of multi-purpose production processes" [10].

Another interpretation, similar in purpose, is found in the authors of the book „Economics of natural resources and the environment" by David Pearce and Kerry Turner, published in 1990, which explains the importance of the transition from the linear to the circular economic model. In fact, David Pearce and Kerry Turner are considered to be the first who have used the notion of circular economy in their research. With the publication of this book in the academic community, and not only, the interest in the circular economy is becoming more and more accentuated.

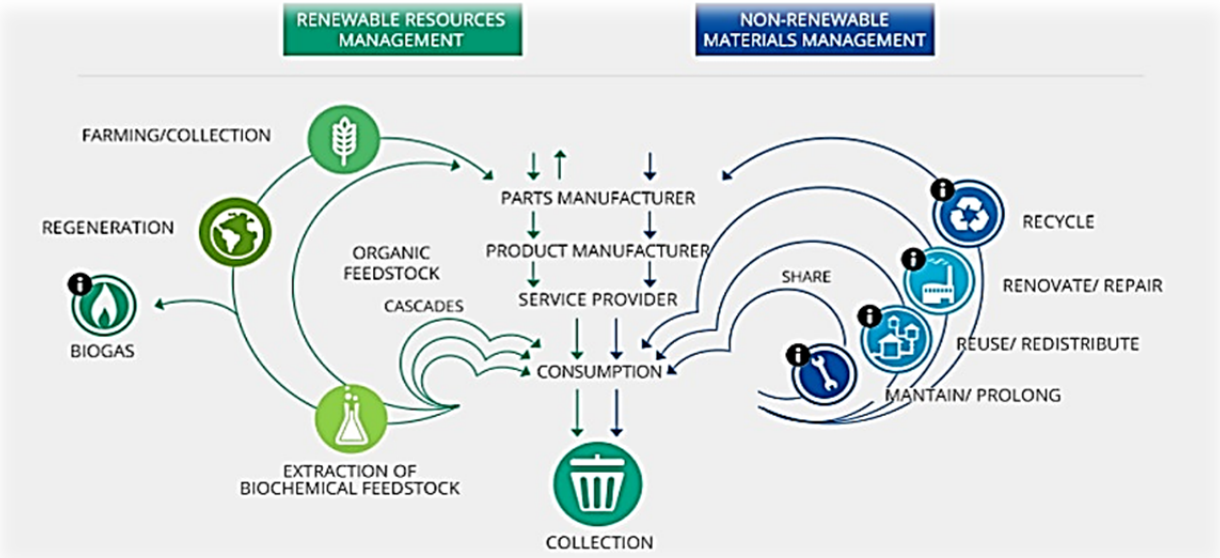
As a result, the literature is gradually enriching this sense, there are a lot of papers that enjoy increased attention, including: (1992) "Saving the Planet: How to Shape an Environmentally Sustainable Global Economy" by Lester Brown; (1993) "World Without End: Economics, Environment, and Sustainable Development" by David Pearce and Warford Jeremy; (1995) "Merging strategic safety, health and environment into total quality management", by M.Rahimi; (1997) "Implementing nature's lesson: the industrial recycling network enhancing regional development" by Schwarz, E.J.; (1998). Sustainability and Sustainable Development: Historical and Conceptual Review" by Mebratu, Desta; (2002) "Cradle to Cradle: Remaking the Way we make Things" by McDonough, William, and Braungart, Michael; (2004) " Reflections on Circular Economy Theory and Policy" by Xie, Zhenhua; (2006) "An introductory note on the environmental economics of the circular economy" by Anderson, Mikael Skou; (2009) "Prosperity without Growth: Economic for a Finite Planet" by Jackson Tim; (2010) "The Performance Economy" and "The business angel of a circular economy - higher competitiveness, higher resource security and material efficiency" by Stahel, Walter R.

Parallel to the scientific research in the academic field with regard to circularity, there were global initiatives, events, numerous debates within the various organizations (e.g. UNIDO, UNEP, OECD, UNFCCC) in the direction of promoting the circular economy. It could be highlighted the Report of the World Commission on Environment and Development in 1987, the Conference Declaration on Environment and Development in 1992, the Conference on the Greenhouse Effect in Berlin in 1995, the Conference on the Greenhouse Effect in Kyoto, in 1997, in Buenos Aires in 1998, in Bonn in 1999, the Summit of the United Nations for Sustainable Development in Johannesburg in 2002, the Conference in Bali in 2007, the Conference on Climate Change in Cancun (COP 16).

The circular economy gained applicable consistency only in 2010, when the Ellen MacArthur Foundation was founded in the United Kingdom having its mission to accelerate the process of transition to the circular economy [11]. The Foundation has had a huge, successful influence in spreading the concept of the circular economy among world leaders, multinational corporations and academia. In this context, the annual reports „Towards the circular economy" have been written and published in three volumes.

The first volume "Economic and business rationale for an accelerated transition" was published in January 2012, the second one, entitled "Opportunities for the consumer goods sector", was published in 2013, and the third one, "Accelerating the scale-up across global supply chains", was launched in 2014. According to these publications, the circular economy acquires a more comprehensive description, being considered a new industrial model, as opposed to the linear production model "take-make-dispose".

The circular economy is defined by the members of the Ellen MacArthur Foundation, in their first report as: "***an industrial system that is restorative by intention and design, which aims to use renewable energy, eliminates the use of toxic chemicals and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models***" [12]. The definition was later supplemented „... an economy that offers multiple value-generating mechanisms, which are decoupled from the consumption of finite resources" [13]. For a better visualization and perception of the term of circular economy, it's suitable to illustrate the butterfly diagram, proposed by the members of the Ellen MacArthur Foundation.



Source: *Ellen Macarthur Foundation, Circular Economy Diagram.*

At the level of governments, one of the most quoted definitions of the circular economy is the one set out by the European Commission, which reads as follows: "In a circular economy, the value of products and materials is maintained for as long as possible. Waste and resource use are minimised, and when a product reaches the end of its life, it is used again to create further value. This can bring major economic benefits, contributing to innovation, growth and job creation" [14].

The circular economy concept starts from the premise that in the future there will be no more waste, and the products will be designed to enter a cycle of disassembly and use, so that a used product (physically or morally) serves as a raw material for another product, the energy used in this process being obtained from renewable sources [15]. Making a generalization of the terminology, one can notice that there are different ways in which the circular economy is described. These results from different understandings, perceptions of the issue by different researchers. The concept of circular economy cannot be accurately dated or attributed to a particular researcher, but rather to a few schools of thought. In fact, the concept of circular economy has been derived from other concepts such as: sustainable

development, performance economy, eco-industrial development or industrial ecology, ecological design, biomimicry, etc.

Table 1 summarizes the schools of thought with regard to circularity, according to members of the Ellen MacArthur Foundation.

Table 1

Schools of thought on the concept of circular economy

Performance economy	Performance economy W. Stahel, G. Reday „The Potential for Substituting Manpower for Energy" 1981	The authors describe the principles of an economy in loops (or a circular economy) and its impact on waste prevention, rational use of limited resources, creating new jobs, and economic growth.
Eco-industrial development	R. Frosch and N. Gallopoulos, "Strategies for Manufacturing", 1989	Eco-industrial development involves a closed-loop production cycle in order to minimize environmental problems, such as soil and water pollution, desertification, energy management, by-product synergy, resource efficiency, air quality. The main objective of eco-industrial development is to significantly improve both business and environmental performance.
Regenerative design	John T. Lyle, The theory of regenerative design for sustainable development, 1994	The term „regeneration" refers to processes that restore, renew or revitalize the energy and materials needed for production, creating conditions for the establishment of sustainable economic systems.
Biomimicry	Janine Benuys, the book „Biomimicry", 1997	The author defines biomimicry as „a new discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems". Studying a leaf in details to invent a better solar cell is an eloquent example of this concept. J. Benuys defines this discovery as „innovation inspired by nature". Biomimicry relies on three key principles: - Nature as model to solve human problems. Nature as measurement measure. - Nature as mentor: nature research is not based on what we can „extract" from it, but what we can learn from it.
Cradle to Cradle	M. Braungart and B.Macdonough, "Cradle to Cradle: Remaking the Way We Make Things", 2002	The Cradle to Cradle concept was developed in 2002 by Michael Braungart and William McDonough. If the products are designed based on the "Cradle to Cradle" concept, there will be no more waste, which will be recycled. The materials used in this process since the extraction of the raw material are therefore in a closed circuit, without loss of natural resources.

Continuation Table 1

Blue Economy	Gunter Pauli ”The blue economy: 10 years,100 innovations, 100 million jobs”, 2010	The concept of Blue Economy was first mentioned in the book „The Blue Economy 10 Years - 100 Innovations - 100 Million Jobs”, written by Gunter Pauli. In his research, Pauli presents multiple innovations in the field of energy; water; construction or food industry. The basic idea of this economic model is the efficient use of natural resources through innovation and entrepreneurship.

Source: *adapted from Ellen MacArthur*

From the above it can be mentioned that the concept was initially related to environmental issues and the crisis of natural resources. However, despite differences, schools of thought largely revolve around the same basic principles and have the same starting point: the current industrial economic system is unsustainable, needs restructuring by identifying innovative solutions that would use limited natural resources more efficiently, and it would not harm the environment.

At the same time, it could be notice that these schools have designed the concept of circular economy from different points of view, depending on the area of interest. While the Performance Economy (Stahel) and the Blue Economy (Pauli) focus more on establishing an economically advantageous sustainable business model, others analyse this issue predominantly from an ecological point of view (Biomimicry, Janine Benuys). Thus, the concept of circular economy emerged as a reaction to the aspiration for sustainable growth, in the context of the growing pressure that production and consumption exert on resources, the environment and the planet.

II. The principles of the circular economy

According to the explanatory dictionary of the Romanian language, the principle represents a fundamental element, idea, law on which a scientific theory, a system, a norm of conduct is based. The principles of the circular economy in different scientific research are formulated differently depending on the area of interest. However, the basic idea they convey is similar. Many researchers such as Boulding (1966), Park et al. (2010), Andersen (2007), Preston (2012), Hollander et al. (2017) identify 3 fundamental principles of the circular economy, while others such as Pearce and Turner (1990), Stahel (2013), Ellen MacArthur Foundation (2013), Hopkinson and Spicer (2013), Webster (2015) attribute to the circular economy 4 or more principles.

According to Boulding (1966) the principles of the circular economy are related to economic performance, rational behaviour with the environment and waste reduction. Huamao and Fengqi (2007) and Yuan and colleagues (2006) summarized the principles of the circular economy in the „3Rs”, which means Reduce-Reuse-Recycle [16]. In Walter R. Stahel's paper “The business angle of a circular economy - higher competitiveness, higher resource security and material efficiency” of 2012, we find the following 5 principles [17]:

Principle 1: The smaller the loop (activity-wise and geographically) the more profitable and resource efficient it is.

Principle 2: Loops have no beginning and no end.

Principle 3: The speed of the circular flows is crucial: the efficiency of managing stock in the circular economy increases with a decreasing flow speed.

Principle 4: Continued ownership is cost efficient: re-use, repair and remanufacture without a change of ownership save double transaction costs.

Principle 5: A circular economy needs functioning markets.

Making an in-depth analysis of various scientific papers on circular economy [13, 17, 2, 18, 19, 20], it can be concluded that in fact most authors agree with the following fundamental principles:

1. Sustainability of resources

The use of renewable energy and renewable, recyclable and biodegradable materials in successive life cycles.

2. There is no waste, the waste is turned into raw materials

The circular economy model proposes the total disappearance of waste and the rethinking of products so that they can be recycled and reused to obtain other consumer products.

3. Optimizing resource yields by circulating products, components and materials with the highest usage and priority

4. Promoting the efficiency of the system by denouncing and combating the harmful effects of the current industrial economic system, referred to in some sources as: system-level thinking

5. Diversity means power

The diversity and high degree of adaptation of products are a priority for the circular economy, trying to create sustainable products over time, which can be transformed into other products so that there is a recycling cycle, without waste. Wastes processed into raw materials. The circular economy model proposes the total disappearance of waste and the rethinking of products so that they can be recycled and reused to obtain other consumer products.

Conclusions

The circular economy is a hotly debated topic both in the academic community and at the level of government institutions, NGOs. The transition from the linear economic model is inevitable, as this business model is no longer sustainable. It leads, on the one hand, to massive waste and, on the other hand, to the waste of natural resources.

In terms of sustainability as a successful strategy for the long lasting of the enterprise, it can be drawn a parallel with Darwin's law for the living world: „*The species that will survive is neither the strongest nor the most intelligent, but the one that is most receptive to change*." The transposition of this law into business requires companies to reconsider their current business model, based on the „take-make-waste" criterion and to move to the circular business model. In the literature, abundant in this sense, the circular economy is seen as a new form of economy, restorative and sustainable. Even though its foundations were conceptually laid in the 1990s, the circular economy is gaining visibility, consistency and applicability with the creation of the Ellen MaccArthur Foundation in 2010. Since then, a number of circular economic missions have been carried out: high-level political and business meetings in third countries to communicate and promote sustainable and resource-efficient policies. Global natural resources are exhaustible and scarce, so optimizing the use of resources by circulating products, components and materials in the technical and biological cycles of the economy, becomes a viable solution.

According to the Executive Director of the European Environment Agency, Hans Bruyninckx "The concept of a circular economy has recently gained traction in European policymaking as a positive, solutions-based perspective for achieving economic development within increasing environmental constraints". In this context, it is noted the importance of the transition to a circular economy, a waste-free economy. The transition to a circular economy requires changes in value chains, from product design to the identification of new business and market models, from new ways of turning waste into a resource, to rational ways of consumer behaviour. This transition involves systemic change and innovation processes in technology, organizations, society, new funding methods and new policies.

In conclusion, it can be said that the circular economy, being a regenerative system based on the use of renewable energy, on the capitalization of waste by designing new materials, products, systems, is the solution for the future. **Now, more than ever, it is time to rethink and redesign the way we do things!**

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