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Circular Economy: The future in sustainable cities

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ABSTRACT
Cities are like living organisms that, to function, need resources and goods such as energy, raw materials, water, and food. After being used, the surplus of these resources is discarded, being directly responsible for most of the environmental impacts caused by human actions on the planet and not only in the territory where urban agglomerations are concentrated. Circular Economy arises to meet the need to reverse and contain the current scenario of exhaustion of natural resources and loss of biodiversity, introducing sustainable production and consumption. Its concept has been explored by different segments of society such as industries, academia, NGOs, government entities, among others, with multiple approaches and applications. Thus, this article, from a theoretical framework, explores the origins of the Circular Economy concept, providing a review of the main schools of thought that preceded it, and analyzes the common point of view on the Circular Economy concept. The article also identifies some scenarios in Brazil and in the world, whose countries and regions have stood out for their representativeness in the global context. It concludes with an insight on the current "status", the future, and transition to Circular Economy.

KEYWORDS: Circular Economy. Circular Cities. Sustainable Consumption.

1 INTRODUCTION

According to the United Nations report entitled World Urbanization Prospects*, ca.* 55.3% of the world's population has lived in metropolitan regions. It is expected that in 2030 urban areas will shelter 60% of this population, considering that one out of three people will live in cities with at least half a million inhabitants (WEF, 2018).

The combined effects of urbanization, industrialization, and globalization have deeply influenced the development of the cities around the world. The fact that most of the world's population live in cities leads to an increasing degradation of life conditions. It is estimated that more than two thirds of the world's energy is consumed in the cities, which responds for more than 70% of the global CO_2 emissions. Besides, it is in the cities that the greatest quantities of waste are generated (WEF, 2018).

The Brazilian Association of Public Cleaning Companies and Special Waste (*Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais* – ABRELPE, 2020) points out that waste generation in Brazil exceeds population growth rates as a function of the growth of production and consumption activities. Human growth and enrichment take place at the expense of climate imbalance – an increase of 70% in waste generation is estimated to occur until 2025. Not distantly, in 2020, due to the lockdown imposed by Covid-19, it is possible to affirm that we are already facing this reality.

The ABRELPE report also estimates that due to quarantine and social distancing measures, a relevant increase in the amount of household solid waste has occurred, varying from 15 to 25%. Regarding medical waste in health care units, the number has increased considerably, from 10 to 20 times (ABRELPE, 2020). It is therefore necessary and urgent to change the habits hitherto maintained in relation to how waste also energy production and consumption are dealt with.

According to the Ellen MacArthur Foundation (2017), the objective of Circular Economy is to maintain products, components, and materials at their highest level of usefulness and value as much as possible, by distinguishing cycles of technical and biological materials. This concept has gained impulse both among scholars and professionals. Therefore, Circular Economy does not emerge with the purpose of solving linear economy problems, founded on the unsustainable model of extraction, production, consumption, and disposal, but recreates the production model, in order to avoid such problems. Characterized as the starting point for a new alternative, as opposed to the linear model, Circular Economy is innovating and regenerative.

In this sense, the objective of this study is to present the origin, the concepts, and the main contributions that Circular Economy can offer to make cities sustainable, by means of practices implemented in Brazil and in the world. The analysis and the information presented in this study aim to contribute to a clearer understanding of the Circular Economy concept. The presentation of some current Brazilian and international scenarios may stimulate thinking about and envisage possibilities of different strategies for the implementation of Circular Economy. Thanks to the increasing interest in the business opportunities thus created, Circular Economy has gained impulse among companies and governments, and it is therefore fundamental to understand its concept for its successful implementation in cities.

2 THEORETICAL FRAMEWORK

The Circular Economy concept is based on more specific approaches that surround a group of basic principles (ELLEN MACARTHUR FOUNDATION, 2017). It is presented under several perspectives, including those of companies, Non-Governmental Organizations (NGOs), cities, and sustainability. According to Van Buren et al. (2016), the notion of circularity in the economic processes related to production and consumption was launched in the last decade as the last stage in the evolutionary debate on sustainability.

Since the end of the 1970's, Circular Economy practical applications to modern economic systems and industrial processes have gained impulse, thanks to the increasing environmental pressure and the increase and volatility of resources prices (WAUTELET, 2018). Therefore, the Circular Economy concept and practice have almost exclusively been developed and led by professionals, that is, policies formulators, companies, business consultants, business associations, and business foundations, among others. According to the International Reference Centre for the Life Cycle of Products, Processes and Services (CIRAIG), this concept emphasizes the redesign of processes and material recycling, which can contribute to more sustainable business models (CIRAIG, 2015).

From 1976, the Circular Economy concept was widely explored by an increasing number of NGOs, such as the Ellen MacArthur Foundation, the Circle Economy, and the *Institut de l'économie circulaire*, whose main focus has gradually expanded from strict waste recycling to guided control aiming at efficiency inside closed-circuit material flows in all phases of the supply chain – production, distribution, and consumption (WAUTELET, 2018).

Recognizing that the implementation of a vision for a Circular Economy in cities can lead to vast economic, social, and environmental benefits and considering the cities as a focal point in the transition to a Circular Economy, the Ellen MacArthur Foundation launched a guide entitled "Circular Economy in Cities" in 2019, which contained a suite of resources for urban policymakers and change-makers. This document presents a global framework and opportunities to support the major priorities of city administrations regarding housing – such as buildings designed to be flexible and modular, maximizing space and raw materials –; mobility – with clean and shared systems, maximizing efficiency and reducing energy costs – and economic development, by which local resources are valued, processes are optimized, generating profitability and expansion and diversification of the economic basis, building more engaged and collaborative communities (ELLEN MACARTHUR FOUNDATION, 2019).

According to Williams (2021), these concepts, mostly extracted from the literature, have concentrated on a vision of improved efficiency resources in supply chains and production

processes to maximize the economy. Nonetheless, social practices and life styles of the people who live in the cities have been neglected.

Prendeville, Cherim, and Bocken (2018) define Circular City as the city that "practices Circular Economy principles to close resource loops, in partnership with the city's stakeholders (citizens, community, business and knowledge stakeholders), to realize its vision of a future-proof city".

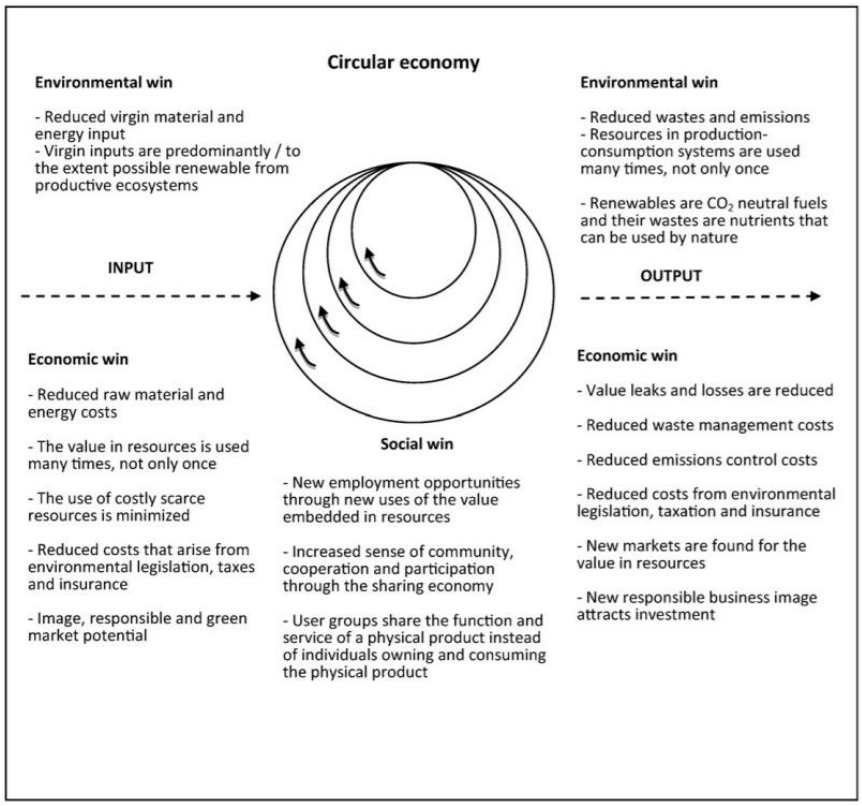
Another approach for the Circular Economy concept is the perspective of sustainable development of the World Commission on Environment and Development (WCED) and the sustainability science, which encompasses the three – economic, environmental, and social – sustainability dimensions. Kirchherr, Reik, and Hekkert (2017), after reviewing 114 Circular Economy definitions analyzed in 17 dimensions, indicate that many of the researched concepts present few explicit linkages of the Circular Economy concept to sustainable development. In this sense, the authors present the following definition:

> A circular economy describes an economic system that is based on business models that replace the 'end-of-life' concept by reducing, alternatively reusing, recycling, and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity, and social equity, to the benefit of current and future generations (Kirchherr et al., 2017).

In turn, Murray, Skene, and Haynes (2017) present the following definition: "Circular Economy is an economic model wherein planning, resourcing, procurement, production, and reprocessing are designed and managed as both process and output, to maximize ecosystem functioning and human well-being". The circularity is recognized by the relationships among three elements: human beings, their activities and environment, involved in entire production networks, with a diffusion of responsibility in all these networks.

Circular Economy must be adapted to natural ecosystem cycles and use them in economic cycles, respecting reproduction rates (KORHONEN; HONKASALO; SEPPALA, 2018). Figure 1 presents the Circular Economy win potential in the three sustainable development dimension.

Figure 1 – Circular Economy



Source: Korhonen, Honkasalo, Seppala (2018, p. 40)

Korhonen, Honkasalo, and Seppala (2018) also suggest that a successful Circular Economy model contributes to the three sustainable development dimensions. Economy is built from production-consumption systems and maximizes the service produced from materials, energy, and nature via cyclical materials flows, renewable energy sources, and using nature's cycles that are respected in order to preserve materials, energy, and nutrients for economic use.

3 METHODOLOGY

The present study is of exploratory and descriptive character and is based on a theoretical review of the literature. The objective of this research is to present the origin, concepts, and main contributions that Circular Economy can offer to make cities sustainable, by means of practices implemented in Brazil and in the world. According to Tranfield, Denyer, and Smart (2003), literature review is an important part of any research, aiding the researcher to map and assess the relevant intellectual territory, in order to specify a research question that will develop even more the knowledge base.

Thus, this research progressed by means of the consultation of databases, such as "Google Academic", "Scientific Electronic Library Online (SciELO)", "Web of Science", and "Scopus", using the keywords "Circular Economy" and "circular cities", both in Portuguese and English. The time frame begins in 2017. From selected texts, reading and mapping of other articles and books cited in them helped conceptually clarify the terms under analysis.

4 RESULTS

4.1 Origins of Circular Economy

Despite the Circular Economy concept has been discussed since the 1970's, causing the change of the present economic model from linear to circular, the term Circular Economy has appeared in the literature in different areas of knowledge. The first president of the Royal Society of Chemistry, August Wilhelm von Hofman, stated back in 1848: "[...] in an ideal chemical factory there is, strictly speaking, no waste but only products. The better a real factory makes use of its waste, the closer it gets to its ideal, the bigger is the profit" (MURRAY; SKENE; HAYNES, 2017).

Chart 1 presents a summary of the main concepts that preceded Circular Economy.

Chart 1 – Concepts preceding Circular Economy

Year	Denomination	Authors of the concept	Concept	Reference
1969	Life Cycle Assessment	N/A	Tool used to quantify the environmental impacts of a product or process along its life cycle – from acquisition, manufacturing, transport, assembly, and use and disposal of raw materials.	Korhonen, Honkasalo, Seppala (2018); Sehnem and Pereira (2019).
1861-1865	Reverse Logistics	US Army at the End of the American Civil War	Physical flow of products, packaging, and other materials, from the consumption point to the origin.	Korhonen, Honkasalo, Seppala (2018); Sehnem and Pereira (2019).
1970	Performance Economy Closed-loop	Walter Stahel	Growth and prosperity are decoupled from natural resources, consumption and degradation of the ecosystem by refraining from discarding used products, components, and materials, and opting to redistribute them, in order to generate value in other production chains. Therefore, the proposal is to create a society with a healthy economy, inspired in the balance with nature.	Sehnem and Pereira (2019).
1976	Performance Economy Double-loop	Argyris	To close the loop or change objectives or decision-making rules, in the light of experience.	Sehnem and Pereira (2019).
1989	Industrial Ecology	Frosch and Gallopoulos	Aiming at optimizing energy and materials, and reducing pollution and waste by the economically viable transformation of industrial sub-products or waste in input, so as to make industrial systems that imitate natural ecosystems available.	CIRAIG (2015); Korhonen, Honkasalo, Seppala (2018); Sehnem and Pereira (2019); Weetman (2019).
1990	Cradle to Cradle (C2C)	Michael Braungart and William McDonough	Safe and potentially infinite use of materials in loops.	Esquivel (2019); Korhonen, Honkasalo, Seppala (2018); Sehnem and Pereira (2019).
1994	Performance Economy Upcycle	Reine Pilz	Process of transforming waste or useless and disposable products in new materials	Esquivel (2019); Sehnem and Pereira (2019).

			or more valuable, useful or better-quality products.	
1997	Biomimetics	N/A	Discipline that studies the best ideas from nature and then imitates the most relevant nature's inventions to adapt them, in order to supply the society with innovative and sustainable solutions.	Esquivel (2019); Wautelet (2018); Weetman (2019).
2009	Blue Economy	Janine Benyus	Open-code movement that gathers concrete study cases that aim at inspiring entrepreneurs to change the rules of the game and implement new and innovating business models, responding to the basic necessities of all with what is locally available.	Wautelet (2018); Weetman (2019).
2016	Industrial Symbiosis	Chertow and Park	Cooperation and sharing of resources, such as water, energy, and subproducts – *e.g.*, materials waste – in all organizations, for both environmental and economic benefits.	Korhonen, Honkasalo, Seppala (2018); Sehnem and Pereira (2019).
N/A	Spiral Economy	N/A	To learn with the natural world (natural ecosystem) and apply this knowledge to organizations and economy. The subproducts of an organization or industry not only form a component of another industry, but become a platform that engenders opportunities for infinite unfolding at different scales.	Sehnem and Pereira (2019).
N/A	Green Economy	N/A	It proposes economical solutions, mainly to environmental problems, by means of a broad and multi-party policy. The proposals come from the United Nations and permeate national governments and NGOs.	CIRAIG (2015); Korhonen, Honkasalo, Seppala (2018).
N/A	Shared Value	Michael Porter and Mark Kramer	It is a management approach developed by strategy researches, in order to reconcile capitalism and social needs. The scenario calls for companies to create value, meeting social needs by means of new products and markets, redefined value chains, and creation of clusters for community development.	CIRAIG (2015); Esquivel (2019); Korhonen, Honkasalo, Seppala (2018).
N/A	Extended Producer Responsibility (EPR)	N/A	Condition of the "polluter pays" principle, by which the environment of a product is changed and the responsibility along the whole life cycle goes back towards the producer – and away from the municipalities. Even though EPR has the potential to drive change over the full life cycle, it has mostly enabled postconsumer end-of-life management.	CIRAIG (2015).
N/A	Ecodesign	N/A	Based on the integration of environmental aspects in product development, ecodesign can be used as a tool to implement Life Cycle Analysis results, or can be a guideline, a checklist, or an analytical tool that supports a product based on the eco-efficiency of the development process.	CIRAIG (2015); Esquivel (2019).

Legend:
N/A – Not Available.
Source: Elaborated by the authors (2021)

4.2 National and International Scenario

In the last decade, the Circular Economy concept has spread out in the five continents in such a way that it has influenced the development of public policies, actions and programs developed by private companies, especially transnational and multinational (ABDALLA; SAMPAIO, 2018). This idea has become even more important, not only in the academic, but also in the political, economic, business, and social fields (CERDÁ; KHALILOVA, 2016), being possible to observe a world movement that leads to the implementation of transition strategies to the Circular Economy model (CNI, 2018).

Cities are the key to Circular Economy, with opportunities to introduce new practices in urban systems, including reverse logistics facilitation, waste processing, conservation of energy and natural resources, new business models and services, and product design that incorporates circular thinking to housing and mobility solutions, among others, focusing on complex linear economy challenges, becoming ideal test fields for Circular Economy models (WEF, 2018).

4.2.1 Europe

In March 2020, the European Commission adopted a new Action Plan for Circular Economy, which became one of main pillars of the European Ecological Pact – the Regulation of the European Parliament and the European Council (2018/1999), which establishes the scenario to reach climatic neutrality. This new European guide for sustainable growth has proposed measures to be applied along the whole life cycle of products. The new action plan intends that the economy be well prepared for a green future, competitiveness be strengthened – maintaining environment protection –, and new rights be granted to consumers. Based on works carried out since 2015, the new plan is centered in Circular Economy conception and production phases, so as to ensure that the used resources be kept in the European Union economy as long as possible. The plan and the initiatives predicted in it will be developed with the close participation of business communities and stakeholders (EUROPEAN COMMISSION, 2020).

Approved by the Council of Ministers, Resolution 190-A/2017 dated 23rd November 2019 is the Action Plan for Circular Economy in Portugal, which defines a strategic model of growth and investment in Circular Economy, by means of a series of transversal actions and sectoral and regional agendas. The main objective of the *Iniciativa Nacional Cidades Circulares* (National Initiative for Circular Cities – InC2), promoted by the General Directorate of Territories and developed by the *Divisão de Desenvolvimento Territorial e Política de Cidades* (Division of Territorial Development and Cities Policy – DDTPC) and starting in 2019, is to accredit municipalities and their communities to the Circular Economy transition (ESQUIVEL, 2019).

Recently, the Prefecture of Porto, which is the second largest city in Portugal, developed a Circular Economy action, aiming at transforming Porto in a circular city until 2030, following the national action plan and encouraged by other European actions (ELLEN MACARTHUR FOUNDATION, 2019).

According to the Ellen MacArthur Foundation (2019), this action plan is supported by four axes:

1) Promotion of sustainable production and consumption;
2) Guaranteed availability of natural resources and environmental balance;

3) Creation and maintenance of shared infrastructures, renovation of buildings, and creation of circularity guidelines for new works;
4) Development of innovative solutions to transform waste in resources.

Actions related to the food system are included in axis 1. Porto intends to act in three areas, as described in the Cities and Food Circular Economy report, prepared together with the Ellen MacArthur Foundation. The actions include: (1) procurement of food produced by regenerative – and when possible, local – agriculture; (2) avoid as much as possible food waste; and (3) develop and commercialize healthier food (ELLEN MACARTHUR FOUNDATION, 2019).

4.2.2 China

The People's Republic of China has already implemented some Circular Economy projects, aiming the reduction of greenhouse gas emissions, waste recycling, remanufacturing, reconditioning, among other goals. China took the lead position in the Circular Economy transition (LANTAU 2020), from decisions taken since 1973, when the first National Conference on Environmental Protection formulated environmental protection policies and guidelines. In 2002, the National Congress of the Chinese Communist Party established an ambitious development plan – involving economic aspects such as growth, social equality, and environmental protection –, known as a "Circular Economy". The term was defined by the Chinese legislation as a means to reduce, reuse, and carry out recycling activities in production, circulation, and consumption processes. Later in 2010, the term was included in the 12th National Five-Year Development Plan – designed for the 2011-2015 period – and approved by the National Committee of the Chinese People's Political Conference, during the 12th China-ASEAN Business and Investment Summit. Economic and tax incentive measures were defined in this event, so as to establish priorities for the national economy and to encourage planned districts to reuse waste (WEF, 2018).

An example of Circular Economy initiative in China is the new Suzhou District, created as a pilot program in 2008. In 2014, Suzhou hosted more than 16 thousand companies and almost four thousand manufacturing companies, many in the areas of information technology, electronics, biotechnology, and manufacturing of medical devices. The program identified recycling and recirculation of metal resources, such as gold and copper, as a gap in the PCB (Printed Circuit Board) supply chain, and established an advanced metal recycling business in Suzhou. The waste generated by copper lamination and PCB manufacturing is treated and returned to other Suzhou companies, thus recovering copper and water from the slime produced by PCB processing (MATHEWS; TAN, 2016).

4.2.3 India

India is one of the most populated countries in the world, with 17% of the world's population. Together with China, it has become a manufacturing center, experiencing accelerated growth, urbanization, and industrialization, as well as negative environmental impacts associated with these transformations (ELLEN MACARTHUR FOUNDATION, 2017).

Statistically, India produces 62 million tons of solid waste daily, which equals three million truck loads per day. It is predicted that this volume will reach the number of 436 million tons per day in 2050. Only 20% of this total is treated, and the remaining waste is disposed in sanitary landfills (MALLAPUR, 2014).

Waste management in India is controlled by legislation established by the Ministry for the Environment, Forests and Climate Changes, in association with statal councils for pollution control, statal and municipal governments, despite in an unstructured and disorganized way. An increasing number of companies started to make the conscious decision of focusing on the value chain oriented to the Circular Economy manufacturing, as well as delivering environmentally correct products and services, in order to be kept competitive and sustainable in the future (GOYAL; ESPOSITO; KAPOOR, 2018).

The Haathi Chaap company is an example of the significant impact of the reduction paradigm, designing and implementing an exclusive business model for paper manufacturing and related products, using elephant dung as raw material. The company created a market niche and is distinguished from other paper manufacturing companies by such brand of paper, changing the dynamics of this type of raw material and manufacturing processes, involving less material, when compared to the traditional process – and using wastewater from elephant dung washing as organic fertilizer for farms (GOYAL; ESPOSITO; KAPOOR, 2018).

The business required little technological know-how, providing a significant employment opportunity for small-town inhabitants. It was boosted by the large raw material availability, ranking Haathi Chaap as a green – ecologic –, sustainable and circular enterprise. Characterized as rural manufacturing, the company worked with nomads, tribes, and elephant owners, in order to obtain raw material and collaboration from local people for the paper production, in accordance with NGOs. The objective was to create awareness and acceptance so as to involve people in the business (GOYAL; ESPOSITO; KAPOOR, 2018).

Banyan Nation is another example in India, a startup for waste recycling. The company won the Circulars Awards at the World Economic Forum in 2018, having created an innovative technology to remove paint and decontaminate discarded plastics. The technology, tested and certified by Tata Motors and L'Oréal, was directed to the use in conventional products, such as bumpers, shampoo bottles, among others. Besides, it contributed to the development of a data intelligence platform to integrate the plastic waste chain, which was totally informal. The platform was extended to cities, in order to aid a more efficient waste management (GOYAL; ESPOSITO; KAPOOR, 2018).

4.2.4 Brazil

According to the National Confederation of Industry *(Confederação Nacional da Indústria* – CNI), there is not, at the moment, a national strategy for the implementation of a Circular Economy model in Brazil; however, some policies, programs, and plans exist that somehow seek for sustainability, by means of circular practices, and deal with related themes. An example is the National Policy for Solid Wastes (*Política Nacional dos Resíduos Sólidos* – PNRS), approved by Law 12305 dated 2010 and enacted in August the same year, which is considered a milestone in the Brazilian legislation (CNI, 2019).

The Ministry for Science, Technology and Innovation (*Ministério de Ciência, Tecnologia e Inovação* – MCTI), in partnership with the United Nations Climate Technology Center & Network, launched a Circular Economy roadmap in July 2021, where several joint initiatives with the Renato Archer Technology and Innovation Center, Mineral Technology Center (*Centro de Tecnologia Mineral* – CETEM), and the Brazilian Institute for Information in Science and Technology (*Instituto Brasileiro de Informação em Ciência e Tecnologia* – IBICT) were presented,

receiving the collaboration of the Financing Agency for Studies and Projects (*Financiadora de Estudos e Projetos* – FINEP), regarding the investment in innovation to promote Circular Economy in Brazil. The roadmap has placed Circular Economy in Brazil, taking into account the analysis of life cycle, renewable energy, new technologies of industry 4.0, or how industrial waste is dealt with, so that visions and systems can be established in common (MCTI, 2021).

The strategic areas of intervention related to Circular Economy identified in Brazil were: Bioeconomy; urban infrastructure, productive inclusion and regional sustainable development; circular manufacturing and value chains; Life Cycle assessment and inventory; research, development, and innovation for low-carbon industry and agriculture, and Bioenergy. The aim of the project was to identify and develop a map of the main stakeholders, public and private initiatives, analysis of opportunities, and strong points of the Circular Economy sector in Brazil (CTCN, 2020).

Specifically in the State of São Paulo, the capital of São Paulo sanctioned Law 16817 on 2nd February 2018, institutionalizing the adoption of the UN Agenda 2030 for Sustainable Development as a guideline of public policies in the municipalities, by means of a program for its implementation (SÃO PAULO, 2018). The law was regulated by Decree 59020 dated 21st October 2019, creating the Municipal Commission for Sustainable Development – Agenda 2030 –, which shows commitment to the established actions (SÃO PAULO, 2019a).

The Prefecture of São Paulo Municipality signed on 13th November 2018 a Memorandum of Understanding with the United Nations, which renews for other four years the cooperation between the parties in priority areas, such as health, education, security, economic development, public administration, social assistance and development, innovation, transparency, culture, and sustainability, besides productive inclusion, sustainable urban development, food security, and integration of migrants and refugees (SÃO PAULO, 2019b).

As part of its actions, the Prefecture of São Paulo Municipality and the Ellen MacArthur Foundation signed an agreement in 2019 for the formulation of Circular Economy projects and public policies that potentialize the promotion of economic development and generation of employment and income. As in the city of Porto in Portugal, São Paulo city developed Circular Economy actions in partnership with the Ellen MacArthur Foundation, starting from a program named Municipal Program to Combat Food Waste and Loss (*Programa Municipal de Combate ao Desperdício e à Perda de Alimentos*). Developed in the ambit of the Circular Economy concept, the program was created in 2017 by the Municipal Secretariat for Economic Development and Labor (*Secretaria Municipal do Desenvolvimento Econômico e Trabalho* – SMDET). It envisages the collection of food in street and municipal markets with the objective to donate food to more than 300 assistance entities registered in the Food Bank Program (SÃO PAULO, 2019b).

Another initiative of the Prefecture of São Paulo Municipality is *Ligue os Pontos* (Connect the Dots), which aims to promote sustainable development in the rural area. It was presented to the Ellen MacArthur Foundation in 2018, via the C40 Food Systems Network – a network that connects the major cities of the world to support the creation and implementation of integrated food policies, in order to reduce greenhouse gas emissions, increase resilience, and promote results in health (SÃO PAULO, 2019b). This project stood out in a study developed by the Foundation and complementary to the "Cities and Circular Economy for Food" global report. It won the Mayors Challenge prize in 2016, promoted by the Bloomberg Philanthropies. It is worth mentioning that, besides São Paulo, other cities in focus were Brussels (Belgium), Guelph (Canada), and Porto (Portugal) (SÃO PAULO, 2019b).

5 CONCLUSIONS

The Covid-19 crisis evidenced vulnerabilities in the current global economic system, making paramount to rethink the way humans produce, consume, and discard goods and services. Proof of this is what Casero-Ripollés (2020) attests, when mentioning that Covid-19 is impinging important and profound effects on various spheres of society, causing social, economic and cultural changes.

The pandemic has caused a change in consumers' behavior, regarding the location of consumption goods, the distance from these to those who search for them, and the technologies coming from habits inherent to social distancing. This consumption change caused a search for alternative goods – as the circular –, once consumers are more aware of the systems' vulnerability and more worried with the climate transformations on Earth. Under this perspective, Circular Economy emerges as a more resilient, circular, and low-carbon economic model. It is an even more popular model, adopted by a variety of companies that have invested in this route, while governmental institutions and agencies present legislative proposals to allow the transition (BORSCHIVER; FURTADO; TAVARES, 2020).

The CNI report (2019) states that the Circular Economy transition represents a systemic change that builds long-term resilience. The consequence of producing aiming at minimum discard opens new opportunities for industry, encompassing the whole economy. New challenges emerge, such as: to innovate the design of products to a better circularity; to diminish the dependence on virgin raw materials; to reduce the losses in the production processes; to more efficiently distribute and widen product maintenance, and recover services and build the channels for reverse logistics and recycling.

According to Van Buren et al. (2016), the building of a Circular Economy will demand a coherent change in consumer's behavior, on behalf of the government – its policies – and business practices. This transition is complex and requires simultaneous changes in several – such as the energy, logistic and financial – subsystems. The Circular Economy implementation also needs to be evident regarding guiding and monitoring, because the circular systems are not necessarily "better" than the linear ones under all circumstances – on the contrary, inefficient circular systems can create many social, economic, and environmental problems.

Thus the change to a value-creation Circular Economy will lead to new business models, value chains, and product-service delivery models. One can say that it affects the design process, production, use, and discard, as well as the collection of products and materials for reuse. Besides, Circular Economy also adds new processes to facilitate, maintain, share, repair, update, and remanufacture products (CNI, 2019).

In this sense, there are many public policy instruments that have been adopted in the world, such as: regulatory instruments; tax actions; measures to support research, education and information; collaborative platforms; financial support; investments in infrastructure; and business subsidies. On the other hand, Circular Economy in the Brazilian public policy is still very incipient: despite the concepts are present in the legislation, plans, programs, and projects, they are decentralized. It is important to create a national strategic plan that envisages concrete measures to encourage research, technologies, and business models that can promote Circular Economy development, in a manner compatible with the necessity of economic development (CNI, 2019).

It is worth pointing out that a sustainable future for the human race will demand system-based thinking that involves, in equal measure, society, environment, and economy. The alignment of these pillars of sustainability shall take place, provided that the humans' objective is to rediscover an existence in balance with the biosphere. Of the three pillars of sustainability – social, economic, and environmental – the social pillar is the least expanded in the majority of the Circular Economy conceptualizations and applications. Besides, it is necessary to give emphasis to the intra- and intergenerational equity supported by ethical concepts, just as much as the environmental, in relation to the moral imperative for business to thereby sustain the natural environment (MURRAY; SKENE; HAYNES, 2017).

Despite the several concepts presented in this study, it is evident that the process of Circular Economy implementation cannot lose its integrative vision of engagement of all the actors involved in the process for coordinated and multisectoral actions, who must actively interact to encourage public policies for the Circular Economy progress. Many are the cities that have already faced challenges of different – economic, environmental, and social – natures. While the challenges of economic nature involve competitiveness and employment, those related to the environment include air, water, and soil pollution and waste management. In turn, the challenges of social nature involve marginalization, inequalities and disintegration of the social fabric. When treated individually, these intertwined issues seem to be complex, and for this reason Circular Economy demands a systemic approach, linked to the vision of the city that is intended to be achieved.

We hope that this outlook on the origin, concepts, and main contributions of Circular Economy can offer the possibility to cities to become circular and sustainable. Should some of the challenges mentioned in the study – and that need to be faced to achieve sustainable development – serve as contribution to further, more in-depth, research.

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