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THE IMPORTANCE OF OPEN INNOVATION FOR THE DEVELOPMENT OF CIRCULAR ECONOMY

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Purpose: The importance of OI for the development of CE is a relatively new field of research. The purpose of the study is to present the possibilities of supporting the circular economy through the adoption of the Open Innovation concept in the enterprise.
Design/methodology/approach: A thesis was formulated assuming that the adoption of the Open Innovation paradigm is conducive to the implementation of the principles of the circular economy in the enterprise. The author's considerations are based on literature studies and a review of the results of selected secondary research. The basic research method is *desk research* (analysis of existing data).
Findings: The author presented the possibilities for supporting the circular economy through Open Innovation activities, with an emphasis on cooperation between stakeholders and co-creation. The analysis of the results of selected existing studies allowed the author to confirm the thesis.
Research limitations/ implications: A limitation of the study of the importance of OI for the development of CE is the concentration of considerations at the level of enterprises.
Practical implications: The study promotes managers' focus on OI processes for the purpose of accelerating the transition to CE, indicating the preferred options for activities.
Social implications: The inclusion of recommendations by leaders/managers should have a positive impact on the development of the circular economy.
Originality/value: The results of the analysis have cognitive value in the context of drawing attention to the possible synergy between OI and CE. Managers were offered recommendations for a strategic approach to the utilization of OI for the development of CE.
Keywords: Open Innovation, Circular Economy, cooperation, co-creation.
Category of paper: general review; research paper.

1. Introduction

The 5th Congress of Management Sciences of TNOiK - The Scientific Society for Organization and Management (Warsaw, 22-23 May 2025), organized in the year of the 100th anniversary of the founding of this organization, prompted the author to reflect once again on

the achievements of Karol Adamiecki (1866-1933), a professor of the Warsaw University of Technology and the first director of the institution, formerly known as the Institute of Scientific Organization (Instytut Naukowej Organizacji). This outstanding pioneer of management sciences promoted the principles of scientific organization, emphasizing, among others, the importance of their implementation in order to counteract "waste of capacities and resources within manufacturing plants" (Adamiecki, 1932, p. 34).

One of the most important contemporary concepts promoting and developing the care for efficient resource management is the so-called **Circular Economy** (CE), the principles of which are implemented not only at the level of enterprises, but also cities, regions, and the national economy. Circular Economy is an alternative model that can help reduce environmental impacts and build a more sustainable future (Geissdoerfer et al., 2023). The development of circular economy has become a strategic priority of the EU on the path towards achieving the Sustainable Development Goals (UN, 2015), and in particular goal 12: responsible consumption and production. It is therefore advisable to support activities conducive to transformation towards a circular economy at all the above-mentioned levels. These activities are associated with efforts to eliminate barriers and activate innovative processes leading to innovation in the area of circular economy.

The concept of **Open Innovation** (OI) promotes two-way interactions and inter-organizational cooperation, thereby encouraging the acceleration of internal innovation processes. Open Innovation has been the subject of broad interest of theorists and researchers for over twenty years, but it is presented less frequently in conjunction with the concept of circular economy.

The research problem, narrowed down in the study to the level of enterprises, focuses on the question of whether the adoption of the Open Innovation concept has an impact on the transformation towards a circular economy. A thesis was formulated which assumes that the adoption of the Open Innovation paradigm is conducive to the implementation of the principles of the circular economy in the enterprise.

The **purpose of the study** was to determine the possibilities of supporting the circular economy through the implementation of the Open Innovation concept in the enterprise.

On the path to achieving this purpose the author presented the essence and aspects of the circular economy, the barriers to the transition to CE, as well as the assumptions and the framework of the Open Innovation concept. The author's considerations are based on literature studies and a review of the results of selected secondary research. The basic research method used in the study is *desk research* – analysis of selected existing scientific reviews and bibliometric analyses. In the conclusion of the study the author presents her own approach to the examined problem, leading to recommendations for managers interested in the circular economy in light of the ongoing ecological transformation. Recommendations for further research and analyses are also included.

2. The concept of the circular economy

Circular Economy is the subject of interest of theoreticians and scientific researchers, as well as business practitioners. For firms, CE implies the transforming production, supply chains and linear models to circular ones, transforming waste and excess resources into new materials and products (Blomsma, Brennan, 2017). Unlike the linear economy model where products "single-use" means a "take-make-dispose" pattern, CE ensures products circularity in a value chain (Bonsu, 2020), promoting the utilization of waste as useful inputs in the production process. This allows for avoiding waste and extending the lifecycle of resources.

Examples of definitions of the circular economy (Table 1) focus on sustainability and resource efficiency.

Table 1.
Selected definitions of the Circular Economy

Author	Definition of the Circular Economy
Ellen MacArthur Foundation (2013, p. 25)	The term 'circular economy' denotes an industrial economy that is restorative by intention and design. In addition to meeting current demand/consumption needs, a circular economy also actively invests in improving resource systems and increasing their resilience to ensure their continuing availability in the future.
Pichlak, Kruczek (2017, p. 22)	Circular economy is "an economic system characterized by the principle of **sustainable development** and less dependent on depleting natural resources than traditional economies, through the mechanism of recycling of waste constituting an output of the system".
Korhonen et al. (2018, p. 547)	CE is a **sustainable development** initiative with the objective of reducing the societal production-consumption systems' linear material and energy throughput flows by applying materials cycles, renewable and cascade-type energy flows to the linear system. CE promotes high value material cycles alongside more traditional recycling and develops systems approaches to the cooperation of producers, consumers and other societal actors in **sustainable development** work.
Alhawari et al. (2021 p. 13)	CE is the set of organizational planning processes for creating, delivering products, components, and materials at their highest utility for customers and society through effective and efficient utilization of ecosystem, economic, and product cycles by closing loops for all the related resource flows.
Kirchherr et al. (2023, p. 7)	The circular economy is a regenerative economic system which necessitates a paradigm shift to replace the 'end of life' concept with reducing, alternatively reusing, recycling, and recovering materials throughout the supply chain, with the aim to promote value maintenance and **sustainable development**, creating environmental quality, economic development, and social equity, to the benefit of current and future generations. It is enabled by an alliance of **stakeholders** (industry, consumers, policymakers, academia) and their technological innovations and capabilities.

Source: own compilation.

As far as the pursuit of a uniform definition of CE is concerned, it can be determined – based on an analysis of 221 definitions of Circular Economy - that contemporary researchers see sustainability as the main objective of CE. According to researchers, the transformation towards a circular economy is based on **a broad alliance of stakeholders**, including producers, consumers, decision-makers and scientists (Kirchherr et al., 2023). The cited researchers formulated the definition of CE (Table 1) adopted for the purposes of the study.

The successful implementation of this closed-loop system requires fundamental changes in the firm product design and manufacturing processes as well as in management practices (Ferasso et al., 2020). Enterprises transitioning from a linear economy to a circular economy are transforming their business models, taking into account the principles of CE.

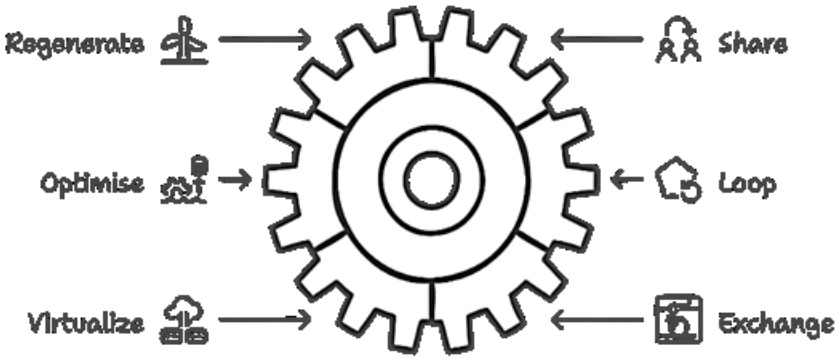

Figure 1. ReSOLVE framework.

Source: own compilation on the basis of: Kyrö (2020), with the use of the Napkin AI application.

Numerous models of activity paths within the Circular Economy, also referred to as CE business models, have been presented in the literature of the subject. In essence they refer to the principles and processes of value creation, which covers the foundations of a business model. The ReSOLVE framework, developed by the Elle McArthur Foundation (2015), covering six key actions (Figure 1) is the most commonly used CE model according to the researchers (Kyrö, 2020). The elements of the ReSOLVE framework are shown in Table 2.

Table 2.
Selected elements of the ReSOLVE framework

ReSOLVE FRAMEWORK
Regenerate signifies the shift to renewable energy and materials. It is related to returning recovered biological resources to the biosphere.
Share actions aim at maximizing utilization of products by sharing them among users. It may be realized through peer-to-peer sharing of private products or public sharing of a pool of products; sharing means also reusing products as long as they are technically acceptable to use (e.g., second-hand), and prolonging their life through maintenance, repair, and design enhancing durability.
Optimise actions are focused on increasing the performance/efficiency of a product and removing waste in the production process and in the supply chain; they may also be related to leveraging big data, automation, remote sensing, and steering; what is important is that optimization does not require changing the product or the technology.
Loop actions aim at keeping components and materials in closed loops; higher priority is given to inner loops.
Virtualize actions assume to deliver particular utility virtually instead of materially.
Exchange actions are focused on replacing old materials with advanced non-renewable materials and/or with applying new technologies (e.g., 3D printing).

Source: Lewandowski, 2016.

The implementation of principles of CE in an enterprise requires the transformation of processes from a linear approach to a circular approach, which often requires innovations in products and business processes, as well as incurring certain expenses. The benefits for the enterprise and the environment, such as improved environmental, market and social efficiency, especially in the longer term (Castro-Lopez et al., 2025), justify counteracting the barriers

encountered in the transition to CE. External barriers are mainly related to supply chain management and institutional complexity, while internal barriers relate to enterprise-specific constraints. The following barriers for Circular Economy are mentioned (Dorrego-Viera, Urbinati, Lazzarotti, 2025):

- **contextual** - referring to the structural and cultural environment in which enterprises operate; one challenge in the external environment are complex supply chains, in which production and consumption take place in many countries; one internal barrier is structural rigidity wherein organizational hierarchies and constraints suppress flexibility and innovation, which are crucial for the adoption of CE; market and cultural resistance as well as risk aversion hinder progress towards CE (Jaeger, Upadhyay, 2020);
- **economic -** relating to financial challenges associated with the implementation of CE (Kirchherr et al., 2018); high initial costs are a significant barrier, including investments in reconstruction, relocation of infrastructure, construction of new infrastructure and retraining of personnel (Salvador et al., 2022; Kirchherr et al., 2018);
- **technical** - resulting from the lack of skills, knowledge and technologies required for the transition to CE: the lack of information on the design and production of products hinders the development of CE-compliant products; one significant barrier is the quality compromise, as enterprises are concerned that prioritizing environmental issues over efficiency may reduce product quality.

According to researchers, technological limitations are among the most important challenges faced by enterprises transitioning to CE (Dorrego-Viera, Urbinati, Lazzarotti, 2025; García-Quevedo, Llopis, Martínez-Ros, 2020). The above challenges indicate the need for systemic changes outside of organizations in order to create a supportive environment for CE, including, but not limited to, innovative financing models, grants and support for enterprises, research and training.

Among ways of overcoming barriers in the implementation of CE, researchers recommend expanding organizational boundaries, cooperating with external entities and accelerating the commercialization of innovation through shared knowledge and complementary resources (Jesus, Jugend, 2021). These recommendations are expressed in the Open Innovation paradigm, which refers to innovative processes implemented in the enterprise and leading to the implementation of innovation.

3. Open Innovation

According to the Oslo Manual 2018, a business innovation is a new or improved product (product or service) or business process (or combination thereof) that differs significantly from previous products or business processes and that has been placed on the market or brought into use by an enterprise (OECD/Eurostat, 2018).

In contrast to so-called closed innovation, in this mode the boundaries of the organization become more flexible, thus enabling the combination of external sources of knowledge with internal ones in a cooperation ecosystem (Gao et al., 2020). Open innovation was defined by the creator of the concept as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation (Chesbrough, 2006), and then as a distributed innovation process based on purposefully managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model (Chesbrough, Bogers, 2014).

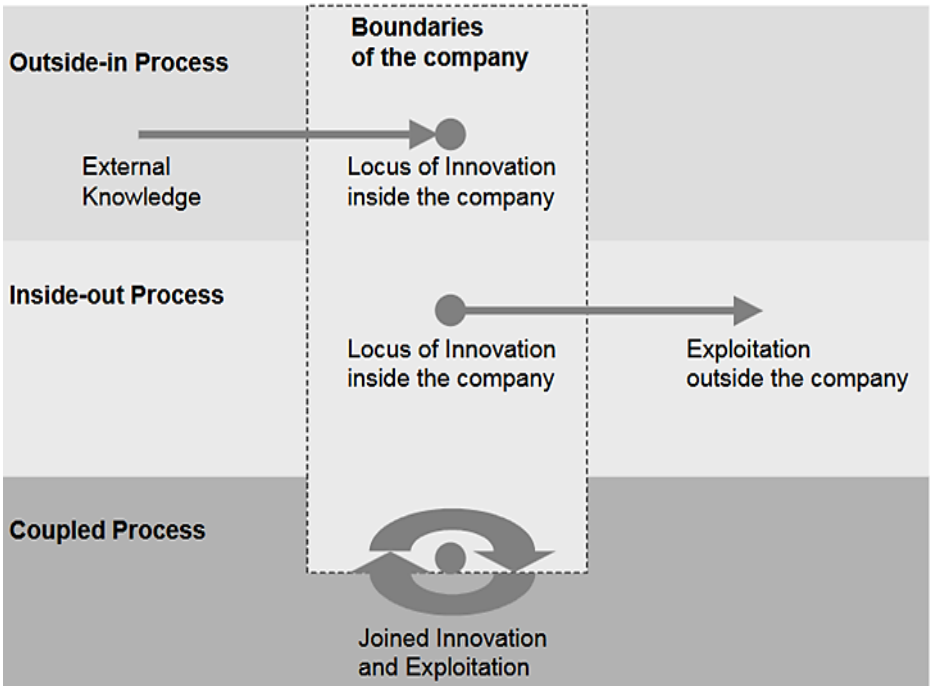

Figure 2. The Open Innovation framework according to O. Gassmann and E. Enkel.
Source: own compilation based on Gassmann, Enkel (2004, p. 6).

The open innovation model describes the directions of knowledge flow across the boundaries of the enterprise, taking into account three basic open innovation processes: centripetal process (outside-in process), centrifugal process (inside-out process) and coupled process (Figure 2). The enterprise unlocks its access boundaries and opens itself to the use of external ideas and solutions (outside-in, or centripetal stream). The inside-out or centrifugal process (stream) leads outside from inside the enterprise, if it decides to make its solutions

available to other organizations, thus unlocking access to its own resources. The coupled process is based on the enterprise's cooperation – both internal and inter-organizational, combining centripetal and centrifugal processes (Bigliardi, Galati, 2016) on the path to co-creating value. Cooperation with external and internal actors, supporting the transfer of knowledge, information, resources and technology, is aimed at the joint creation of innovative solutions and their commercialization. According to researchers, companies seem to be mainly interested in exploiting open innovation in order to reduce the costs of product development or to identify new market opportunities (Strazullo et al., 2025).

Other researchers point to the challenges: factors limiting cooperation between enterprises and institutional partners. These include, among others, the costs of technology transfer, institutional partners' concerns resulting from the lack of experience in the area of technology transfer, rigid procedures (Tartari, Salter, D'Este, 2012) or the management of intellectual property rights. Openness can result in resources being made available for others to exploit, with intellectual property being difficult to protect and benefits from innovation difficult to appropriate (Dahlander, Gann, 2010). According to researchers, "porous firm boundaries result in less proprietary control and increased coordination costs, requiring a joint analysis of open innovation and intellectual property" (Bican et al., 2017, p. 1386). Due to the asymmetry of partners, selecting the right partner for cooperation requires finding the desired matches between the partners' resources, goals and strategies (Arsanti et al., 2022).

OI has the ability to drive the transition to CE, reducing technological barriers to its adoption, such as the lack of knowledge, availability of technical solutions and modifications required for product designs and manufacturing processes. The opening of the company's boundaries, proposed by the IO, may enable the flow of knowledge conducive to the development of CE. The use of the concept of OI in enterprise management should therefore be conducive to reducing barriers in the process of transformation towards a circular economy. For enterprises, the transition to a circular economy is essentially innovation-driven, with a particular focus on product innovation (Chirumalla et al., 2024).

4. Methods

In recent years, the research effort has been directed at the relationship between Open Innovation and Circular Economy in business practice. Research publications devoted to this issue started appearing and the number of publications has significantly increased since 2016, which confirmed growing interest in the topic (Jesus, Jugend, 2021).

The purpose of the study was to determine the possibilities of supporting the circular economy through the implementation of the Open Innovation concept in the enterprise. A thesis was formulated which assumes that the adoption of the Open Innovation paradigm is conducive to the implementation of the principles of the circular economy in the enterprise.

The study was aimed at confirming the thesis. The considerations were based on literature studies and a review of the results of selected secondary research. The basic research method chosen for the purposes of the study is desk research - analysis of existing data. The strengths of this research method are: easy availability of data, cost effectiveness, lack of influence of the researcher on the subject of the study. The weakness is often the inability to verify the reliability of data (Bednarowska, 2015).

For the purposes of the study, an electronic search was conducted using the Google Scholar database, focusing on scientific articles published between 2021 and 2025. The search strategy employed the keywords "Open Innovation" in combination with "Circular Economy" to identify relevant publications.

5. Open Innovation and Circular Economy: Results of a desk research study

The chapter presents interesting results of existing research, presented in scientific publications selected by the author.

Research by G.K.M. Jesus and D. Jugend (2021)

The research by G.K.M. Jesus and D. Jugend aimed to investigate how OI can contribute to the adoption of CE (2021). The researchers conducted a systematic literature review and qualitative analysis of selected articles. A total of 433 items from the Scopus database and 284 items from the Web of Science database were used. Only articles published in journals, in the English language, were considered. Articles from scientific meetings and book chapters were excluded. As a result, the research sample included 24 scientific articles published in the years 2016-2021.

The researchers found that acquisition of knowledge and technologies resulting from the co-creation approach, combined with stakeholder cooperation, can reduce barriers and facilitate the transition to CE (Jesus, Jugend, 2021). The result of the study confirmed the possibility of correlation between OI and CE, and in particular it was found that (Jesus, Jugend, 2021):

- **stakeholder collaboration** can be used to align stakeholders' goals in a joint effort to address environmental issues at three CE levels,
- an approach that promotes **co-creation** can be adopted as a strategy to encourage consumers to participate in the development of environmentally sustainable products, which can foster the transition to CE.

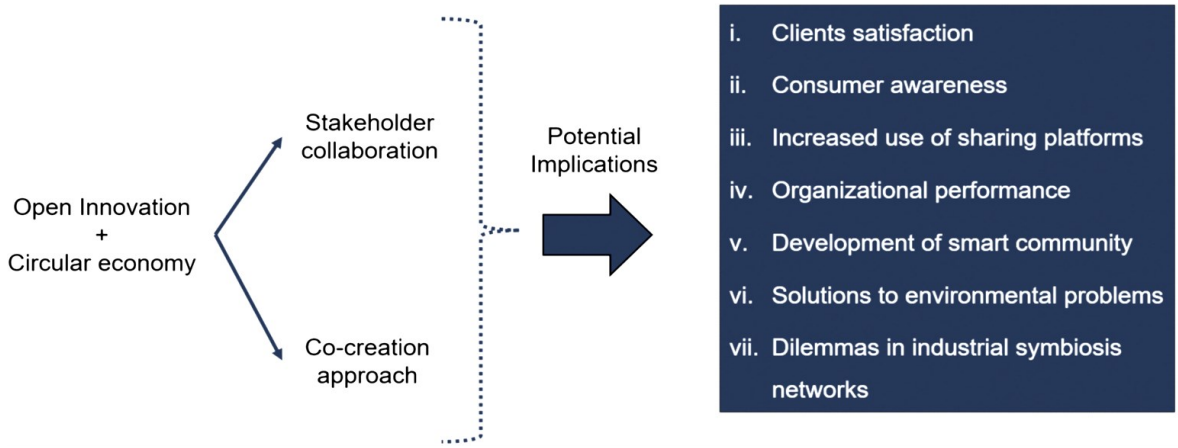

Figure 3. Potential implications for the open innovation-driven CE.

Source: Jesus, Jugend (2021, p. 78).

The set of implications, created by the authors of the discussed existing study on the basis of analyses, is presented in Figure 3 and Table 3.

Table 3.
Potential implications for the open innovation-driven CE

Client satisfaction:	The co-creation approach tends to facilitate the development of solutions for CE as it has the potential to accelerate the development cycle of product designs and business processes while also improving user satisfaction.
Consumer awareness of CE:	The approach based on co-creation and participatory design facilitates interaction and communication between the enterprise and consumers, raising awareness of the importance of sustainable consumption. Enterprises' interaction with consumers can also enable joint development of scenarios for the future and planning of the life cycle of an environmentally sustainable product.
Increased use of sharing platforms:	The co-creation process at the design stage can stimulate the development of online platforms, improve relations with stakeholders. Platforms can also be useful for gathering information about customer needs in CE projects.
Organizational performance improvement:	The co-creation approach, when applied to CE, has the potential to improve the operational efficiency of enterprises, and can lead to increased production and improved financial performance.
Development of smart community:	Co-creation used in a smart community generally means that members of the community participate more actively in decision-making, which results in knowledge exchange between scientific communities, citizens, companies and local administrations.
Solutions to environmental problems:	A co-creation approach can strengthen integrated collaboration between enterprises and communities in order to address local issues. Collaboration between different stakeholders (such as scientists, public authorities, companies, community leaders and citizens) can result in solutions to waste-related problems.
Dilemmas in industrial symbiosis networks:	Greater coordination and sharing of information between network actors can streamline activities such as identification of the value of residues and waste materials and conversion of one company's waste into another company's raw material.

Source: own compilation based on Jesus, Jugend (2021, pp. 78-79).

The results of the discussed existing study, based on an analysis of selected publications from the years 2016-2021, allow for the confirmation of the previously formulated thesis. Activities based on the Open Innovation paradigm can support the development of the Circular Economy. Researchers emphasize the importance of stakeholder cooperation and co-creation, which points to the dominant role of coupled and centripetal (outside-in) processes proposed in the Open Innovation model. Appropriate orientation of these processes may contribute to the implementation of the circular economy concept in the enterprise.

Other studies

The relationships between OI and CE continue to constitute an interesting field of study. Latest research explores and emphasizes the importance of cooperation with stakeholders and co-creation, as elements connecting OI and CE.

For example, contemporary researchers dealing with this topic - in relation to the construction industry - argue that the transition to a circular economy requires establishing cooperation between various entities involved in order to gain access to external competences and to engage in a new way in the entire value chain. OI enables access to these external competences and fosters collaboration throughout the whole value chain (Sgambaro, Chiaroni, Urbinati, 2025).

Other researchers, pursuing research objectives on the basis of case studies and interviews - despite the limitations of this type of study - have presented key insights into barriers to CE and practices within OI (Dorrego-Viera, Urbinati, Lazzarotti, 2025):

- technical barriers, such as skills shortages, knowledge gaps and material quality concerns, have been identified as the most important factors hindering the development of circular economy products,
- OI practices such as publicly funded research and development consortia, consumer **co-creation**, and university collaboration, have been shown to be particularly effective in addressing these barriers.

An interesting result of the above-mentioned research is also the disclosure of significant regional disparities in the ways in which enterprises utilize OI practices to overcome barriers to CE when developing their products: in highly industrialized regions, enterprises focus on advanced technologies and stakeholder engagement, meanwhile in less developed regions they face challenges through bottom-up cooperation and capacity-building efforts (Dorrego-Viera, Urbinati, Lazzarotti, 2025).

According to the researchers, disparities in the ways in which companies utilize OI practices to overcome CE barriers do not depend only on these regional factors. The degree of overlap of the two concepts OI and CI differs according to the type of industry, the size of the organization (start-ups, SMEs, multinational corporations) as well as the degree of openness of each stakeholder (Runiewicz-Wardyn, 2023).

It is worth recalling the results of the study carried out by M. Portuguez-Castro, based on the systematic literature review (SLR) method, and covering 53 scientific articles from the Scopus and Web of Science databases. The objective of the study was to examine the potential of open innovation for **co-creation** in entrepreneurship. The results of this study revealed, among others, that co-creation and open innovation activities enable entrepreneurs to expand their knowledge base through cooperation with various stakeholders (Portuguez-Castro, 2023). Despite the recognition of the importance of this cooperation, the researcher points to existing challenges such as the scarcity of resources and cooperation skills.

By synthesizing the findings of several empirical and literature-based studies, it can be concluded that Open Innovation (OI) — particularly through external and coupled innovation models — can significantly mitigate the technical, economic, and contextual barriers to the transition towards a circular economy. The considerations lead to the confirmation of the thesis that the adoption of the Open Innovation paradigm promotes the development of a circular economy.

6. Discussion

The considerations presented in the study regarding the concepts of Open Innovation and Circular Economy point to the complexity and multidimensionality of each of them. On the other hand, they also show the possibilities for combining seemingly divergent paradigms. The research problem taken up in the study, narrowed down to the level of enterprises, focused on the question of whether the adoption of the Open Innovation concept has an impact on the transformation towards a circular economy.

The results of the existing research used provide valuable insights into the importance of Open Innovation for the development of the circular economy. Actions based on the Open Innovation (OI) paradigm can support the development of the Circular Economy (CE), which is an important indication in the era of ecological transformation and the implementation of sustainable development goals.

The researchers emphasize the importance of stakeholder cooperation and co-creation, which indicates the dominant role of coupled and centripetal processes proposed in the Open Innovation model. Appropriate direction of these processes can contribute to the implementation of the circular economy concept in the enterprise. In light of the research results, special emphasis is placed on cooperation with stakeholders and co-creation.

The co-creation approach, when applied to CE, has the potential to improve the operational efficiency of enterprises, can lead to increased production and improved financial results. The emphasized actions primarily fulfill centripetal and coupled processes within the open innovation model. Making a joint effort for innovative solutions promotes the development of

the circular economy, leading to increased resource efficiency. Attention was drawn to regional disparities.

The considerations presented in the study do not exhaust the problem, but can serve as an inspiration for further research efforts aimed at identifying strategic factors positively impacting the benefits of cooperation and co-creation, and thereby promoting the development of the circular economy in pursuit of sustainable development.

Further scientific research on the effects of the practical application of the open innovation paradigm for the development of the circular economy should relate not only to enterprises, but also to cities, regions or the national economy.

7. Conclusions

From a practical point of view, these results may provide valuable insights for managers in enterprises interested in the development of the circular economy in the context of the implementation of sustainable development goals. The study promotes managers' focus on the Open Innovation paradigm for the purpose of accelerating the transition to the circular economy. This especially relates to cooperation with stakeholders and co-creation, which translate to centripetal (outside-in) and coupled processes within the OI model.

Innovative activity based on the Open Innovation formula should not be undertaken in an incidental manner. A strategic approach is recommended. It should be manifested in an innovative strategy leading to the exchange of knowledge and experience and development of lasting partnerships between enterprises. Opening up to cooperation with external partners also requires a strategic approach to the protection of intellectual property rights, determining beneficial relations between stakeholders, and aimed at the development of a circular economy.

Effective use of open innovation approaches requires a supportive and collaborative company culture (Aytekin, Korucuk, 2025). One associated challenge for managers is the transformation of the organizational culture towards openness, rejecting reluctance to cooperate and co-create. Leadership inspiring the effective use of key competences of employees and joint search for new solutions is in line with the strategic goals of an enterprise striving for the development of circular economy as an area important from the point of view of sustainable development.

In the era of development of Industry 4.0, it is necessary to explore the potential for utilization of information and communication technologies – i.e. a wider use of digital platforms and artificial intelligence – in facilitating cooperation, diagnosing existing patterns, forecasting trends and designing innovative solutions in the field of CE.

8. Summary

This article examines the complementarity between the concepts of Open Innovation (OI) and Circular Economy (CE), focusing on how the adoption of OI strategies in companies can facilitate the implementation of CE principles. The author bases the analysis on literature research and a review of secondary research, with a special focus on stakeholder collaboration and co-creation processes. Based on a synthesis of the results of several empirical and literature-based studies, it shows that OI - especially through processes based on external and coupled innovation - can mitigate technical, economic and contextual barriers to the transition to a circular economy. The article concludes with practical recommendations for managers and a call for the conscious use of OI tools in the process of sustainable transformation.

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