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Review Article

Driving Circular Innovation: From Business Model to Industrial Ecosystems

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The problems related to environmental sustainability have led to the redefinition of economic processes, in particular from the previous linear model (take-make-dispose) to circular economic models. This implies changing the way and approach to industrial production, particularly through innovation. This paper focuses on the question of if and in which terms today we can talk about innovative ecosystems as an evolution of industrial districts and clusters, and in which terms they can be capable of pursuing circularity issues by leveraging the innovation process.
The paper aims at tackling the issue by means of a literature review of theories: circularity and business model innovation, spatial diffusion and clusters, innovation ecosystems. From the literature review, we derived an overview of the evolutionary path taken by local production systems from industrial districts and clusters that can lead to circular innovation ecosystems, conceptualizing the possible relationship between local industrial development, innovation, and circularity.

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1. Introduction

The problems related to environmental sustainability have led to the redefinition of economic processes, in particular from the previous linear model (take-make-dispose) to circular economic models. This change occurred because the linear model did not give due attention to environmental problems, such as the quantification and management of waste, or the reduction of negative externalities generated by production.

In circular models, two important aspects are taken into account: the circular economy and industrial symbiosis.[1]

The circular economy is a closed-loop economic model, which favours the reuse of waste generated by production or the extension of the life cycle of a product. Industrial symbiosis, on the other hand, is a strategy that lays the foundations for collaboration between companies and organizations not only within industrial districts, characterized by geographical proximity, but also between organisations which are far apart in order to develop a relationship with each other[2].

In this context, industrial districts, developed into highly specialized clusters, represent territorial ecosystems where the sharing of ideas, skills, and resources between companies and stakeholders promotes innovation and competitiveness[3][4][5].

Having been industrial districts and clusters the privileged contexts in which innovation spread as a competitive element, business model innovation today appears essential for companies to adapt to market changes and maintain a competitive edge. Within innovation ecosystems, the minimization of environmental impacts is achieved through collaboration and interaction between large and small companies that facilitate co-creation of value, providing also technological tools. The aim of this paper is to make a literature review on the topics described and to broaden its panorama. This paper, in particular, is aimed at filling a gap by connecting together different theories addressing business model innovation,

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circularity, and industrial clustering, proposing a unified research framework for the ways in which innovation is rooted in circularity and the spatial organization of firms.

The rest of the paper is organized as follows: paragraph 2 presents the Method adopted for the analysis, as the literature review. Paragraph 3 is focused on the review of the different theories, while paragraph 4 presents results and discussion, including a schematic representation of the different concepts. Concluding remarks are presented in paragraph 5 - conclusions.

2. Method

In this study, we performed a narrative literature review approach to synthesize some main findings in the literature on "business model", "from linear to circular", "business model innovation", "circular business", “industrial clusters”, and "innovation ecosystem".

More in detail, the narrative review, as one of the “traditional” methods for reviewing literature, helps in providing a qualitative interpretation of previous research[6], summarizing the main keywords considering the above-mentioned concepts, allowing exploration of prior works[7][8], identifying the background of the topic at stake, and identifying gaps, inconsistencies, or opportunities for future research[9]. The narrative review process consists of three primary phases: i) literature search and screening, ii) data extraction and analysis (paragraph 2.2), and iii) writing the literature review (Paragraph 3;[10]).

2.1. Literature Search and Screening

That was realized by means of a search of academic databases, including Scopus and Scholar, using a range of keywords and search terms related to “business model innovation theory”[11], "business model", "from linear to circular", "business model innovation", "circular business", and "circular ecosystem". Keywords such as “Industrial districts”, “Industrial clusters”, and “innovation ecosystems” were also added. The different sets of keywords were chosen to capture the core themes of our research, enabling us to focus on the transition from traditional, linear business models to those based on circular economy principles, as well as the innovations that drive this shift. Articles were selected based on their relevance to the research objectives, focusing primarily on peer-reviewed journal articles, conference proceedings, and key books in the field, to provide diverse perspectives and deep insights into the topic under investigation[12]. The selection process prioritized articles that directly addressed the evolution of business models in the context of circular economy and sustainability, as well as those that discussed the interplay between business model innovation and the broader circular ecosystem.

2.2. Data Extraction and Synthesis

The data extraction process involved reviewing and categorizing the selected studies according to their key contributions, methodologies, and theoretical frameworks. As with many narrative reviews, there was a degree of subjectivity involved in selecting which studies to emphasize, and some less relevant studies were excluded to maintain focus on the main objectives of the review[12][8]. This approach, however, allowed us to construct a coherent narrative that highlights the most significant findings in the literature. In line with von Brocke et al.[13], we structured our synthesis around key themes that emerged from the literature, organizing the review to present a clear and cohesive summary of existing knowledge. Findings - following Bandara, Miskon, and Fielt[14] – are presented highlighting the evolution of research in the field, main theoretical contributions, and practical implications. The structured approach followed aimed at reducing the potential biases associated with narrative reviews, while still benefiting from the flexibility and breadth that this method offers.

To ensure the comprehensiveness of our search, we applied these keywords across multiple academic databases, such as Scopus and Google Scholar, ensuring wide coverage of both seminal works and recent advancements in the field.

In addition to keyword-based searches, we employed citation tracking and backward and forward snowballing techniques to identify additional relevant literature. This method allowed us to expand the initial pool of references by examining the sources cited in key papers (backward snowballing) and identifying subsequent papers that cited the key articles (forward snowballing). These techniques helped ensure that the literature review was as exhaustive as possible, incorporating both foundational and cutting-edge research in the field.

3. A review of theories: circularity and business model innovation, spatial diffusion and clusters, innovative ecosystems

3.1. From linear economy to circular and sustainable business model

3.1.1. From linear economy to circular economy

The circular economy is an economic model today that optimizes the use of resources and minimizes waste by

using a closed-loop system with finite resources provided by the planet[15]. Several authors have highlighted the importance of implementing strategies for reducing waste generation and improving the efficiency of resources used, as well as strategies that improve regional employment. [16]. Authors such as Pearce and Turner[17] have contributed to the definition of concepts such as closed circuits, incorporating concepts such as industrial ecology, cradle-to-cradle, loop economy, and regenerative design, highlighting the importance of a systemic approach to balancing economy and environment.

The Ellen MacArthur Foundation, with the support of McKinsey, highlights the circular flow of resources, restoration-oriented design, and product life extension of their components and materials to achieve maximum value for the longest possible time.

Through a literature review, authors such as Kirchherr et al.[18] have provided a definition of the circular economy, defining it as an economic model based on business models that replace the end-of-life of a product with reduction, re-use, recycling, and recovery of materials. This model operates at micro, meso, and macro levels, aiming to achieve sustainable development, promoting environmental quality, and fostering prosperity and social equity.

Nevertheless, weaknesses in the definition have been identified, including simplification of the end-of-life term and limiting the focus to the end-of-life rather than other life cycle stages. For this reason, the authors have amended the definition, proposing a fallacy that sees the circular economy as an economic system able to reduce the input of resources in the production of waste, emissions, and energy losses through recycling, the extension of the useful life, and the maintenance of the value of the products.

The transition from a linear to a circular economy is closely linked to political decisions and the behaviour of companies and consumers[18]. In fact, the linear model is no longer sustainable today because of the limited resources available.[19]. The Ellen MacArthur Foundation describes the circular economy as a regenerative and restorative system that can focus on reduction, recovery, reuse, and recycling[20]. This transition requires systemic change and the involvement of all actors in the value chain[21][20]. To foster this, innovative business models[22], through approaches that include improving resource efficiency and reducing material costs[23], are essential. In any case, strategic partnerships are necessary to implement the circular economy effectively[24].

3.1.2. The Business Model Innovation

In the competitive landscape today (e.g., Skarzynski & Gibson[11]; Tidd & Bessant[25]; Hult[26]), companies must constantly adapt to changing market dynamics. Relying on local product innovation is insufficient for survival, as competitors can quickly replicate these offerings, and global players may dominate local markets. Many firms prefer incremental innovations that do not disrupt their existing value propositions, often influenced by strategic momentum[27], path dependency[28], and prior knowledge.

Only a few companies, possessing unique advantages such as intellectual property rights, can avoid radical business model innovation. The rapid global competition[11][25] [26] has led to shorter product life cycles and quicker obsolescence of traditional business models (e.g., IBM). This necessitates that many organizations reconsider their business models to stay competitive or enter new markets (e.g., Chesbrough[29][11][25]). Prominent firms like Apple, IBM, and Google exemplify "hypercompetitive firms" as defined by D'Aveni[30]. Their success is not solely due to product innovation; rather, it's deeply rooted in business model innovation. The concept gained traction during the dot-com boom of the 1990s, evolving from a means of explaining complex business ideas to a strategic asset for competitive advantage. As an organization's ability to innovate business models improves, it gains significant leverage in the market, especially in an era of digital transformation.

Business model innovation can yield superior returns compared to traditional product or process innovations, becoming a "renewable" competitive advantage. It also assists organizations in achieving social and environmental goals through sustainable technologies. Companies that pursue sustainable business model innovation can enhance their financial, social, and environmental performances while increasing resilience against operational risks. Research on business model innovation has expanded, including numerous reviews and definitions, highlighted in studies by Bieger and Reinhold[31] and others. The present study utilizes the definition provided by Geissdoerfer et al.[32], defining business model innovation as "the conceptualization and implementation of new business models that may involve the development of entirely novel models, the diversification into additional models, the acquisition of new models, or the transformation from one model to another."

Theoretical advancements in business models are crucial for categorizing businesses and informing managerial decisions[33][34]. Although few classifications of sustainable or circular business models exist, frameworks

like the Ellen MacArthur Foundation's ReSOLVE and Bocken et al.'s archetypes provide valuable insights. A well-defined business model is essential for articulating how a business generates and delivers value to customers, outlining its revenue, cost, and profit structure. Crafting an effective business model involves addressing interconnected issues central to sustainable competitive advantage and profit generation. Ultimately, innovative firms must excel in aligning their business models with customer needs and evolving technological trends. However, it is crucial that these models are distinct enough to withstand imitation, enhancing profitability and establishing a competitive edge. In more recent years, in particular, emerging concepts like Circular Oriented Innovation (COI) have surfaced within circular economy literature, focusing on product design, business models, and value networks to address product obsolescence while minimizing resource use[35], de facto bridging a gap between the two different theories on circular economy and business model innovation. The conventional balance between suppliers and customers has shifted due to technological advancements, necessitating a focus on a customer-centric approach.

3.1.3. The Circular Economy and Circular Business Models

The transition to a circular economy within firms involves three key elements: material and product design, logistics, and business models[36]. This study emphasizes the importance of business models in this transition. Existing business models often have limited transferability, and there is no comprehensive framework designed to guide all types of companies in creating circular business models[37]. Established firms face challenges in modifying their business models due to the stickiness of existing resources, path dependencies in current capabilities, and the sunk-cost effect from prior investments.

Recently, many large companies have started collaborating with smaller firms to incorporate circularity into their business models. For instance, Renault has implemented a reverse supply chain in partnership with a startup to remanufacture used automobile parts. Signify, a Philips group startup, offers a light-as-a-service model, maintaining ownership of lighting while charging monthly fees for usage and maintenance. Similarly, H&M collaborates with Sellpy to facilitate the sale of unused clothing, and Adidas has committed to using only recycled plastics by 2024 through its partnership with Parley for the Oceans.

Typically, established firms tend to adopt circular strategies that are less ambitious, primarily focusing on recycling and making minor adjustments rather than embracing more transformative circular business models. Recent research[38] indicates that while circular economy principles are being integrated into corporate sustainability agendas, the emphasis often remains on end-of-life management rather than on adopting higher-level circular business models.

In contrast, startups, as new entrants in the market, have the flexibility to adopt strategies with higher degrees of circularity and can monetize efforts focused on durability and maintenance through models like product-service systems (PSS)[27]. For example, Bundles provides washing machines through a leasing model, exemplifying a successful PSS.

Startups benefit from collaborations with larger firms, as these partnerships can drive innovation in the latter's business models and provide startups with quicker access to markets and necessary financing[39][11][25][26]. To promote sustainable and responsible production, innovations that are environmentally friendly are essential[40][41], alongside sustainable supply chains[42] and new business models that integrate social, environmental, and economic sustainability dimensions[43]. While defining a business model can vary, it broadly reflects "how an organization creates and captures value"[43]. The emergence of business models was notably significant during the dot-com era, birthing innovative business practices[44].

Traditional business models often concentrate on financial performance[45], but sustainable business models (SBMs) aim to leverage sustainability for competitive advantage and enhanced customer value[46]. Initially, SBMs focused on incorporating sustainability considerations[46][47][48]; currently, they are recognized for their potential for competitive edge. Unlike traditional models, SBMs embed sustainability into their value propositions and operations[32]. The SBM literature investigates various strategies for sustainability, including product-service systems and circular business models[22]. SBMs are designed to create sustainable value, engage in proactive stakeholder management, and adopt long-term strategies to close, slow, intensify, dematerialize, and narrow resource loops[43][22][49][50].

Innovating traditional business models is vital for enhancing SBMs, advocating a shift from profit-driven mindsets[51][52][53]. SBMs create new product-service combinations to address complex customer needs, requiring innovative strategies and cooperation with stakeholders[46][54], often borrowing ideas from external sources.

3.2. Innovation, spatial diffusion, industrial localization

3.2.1. Innovation as a spatial diffusion process

The concept of innovation has become central to regional policies through the promotion of coordinated actions aimed at creating innovative ecosystems. In fact, thanks to regional policies, territorial competitiveness is promoted together with sustainable development, taking into account the transitions underway, such as environmental, digital, and the phenomenon of globalisation. Spatial diffusion is a strongly related element of innovation, defined as the movement of events in space and time. In geography, the phenomenon of spatial diffusion has been analysed from several points of view, such as innovation, technology, and geographical economic development[55][56][57]. This analysis has led to the definition of a classification of different types of diffusion: as relocation (which arises when a physical movement occurs and the phenomenon is moved from its origin to a new location) and as expansion (which involves the spatial and temporal extension of a state or event to cover and fill all available space). The latter can occur in different ways, such as direct diffusion (through direct contact), network (through personal connections), hierarchical (taking influence points and spreading to smaller places), or waterfall (cascading from the highest levels to the lowest levels)[58]. Diffusion processes, however, can also take place in a mixed fashion of relocation. The connection between innovation and spatial diffusion results from the way in which technologies, trends, or new ideas spread within a territory. The Industrial Revolution, which began in the 18th century in the United Kingdom and spread first to Europe and then to the rest of the world, developing industrial cities and redesigning local economies, is an emblematic example. Consequently, when we refer to the diffusion of innovation, we are talking about an evolution that happens when geographical, economic, and social constraints cause changes in the territorial asset. The study of this phenomenon is crucial to efficiently plan the development of the territory and understand the localization choices of industrial districts and clusters.

3.2.2. Innovation and industrial localization: districts and clusters

The concepts of circular economy, industrial symbiosis, and diffusion of innovation are interrelated and linked to spatial proximity and industrial location. Over the centuries, industrial localization has always had, and still has today, a strong impact on the development of countries and the competitiveness of enterprises.[59] In fact, the classical theories of industrial localization, such as Weber's, are important to remember in relation to questions concerning the circularity and evolution of industrial districts. The localization theory of Alfred Weber[60] states that there are three main factors that determine the location of enterprises: proximity to raw materials, consumer markets, and accessibility of transport. This theory's ultimate goal is to reduce total expenses and can be extended in a circular perspective, with an emphasis on recycling waste as both waste and second raw materials[61]. According to other theories, including Perroux's[62] theory on growth poles, economic development is structured into strategic clusters that represent actual centers of innovation and have an impact on the nearby territories. The study of these locational choices has led to the development of the concept of an industrial district. In the definition of industrial districts, Marshall in 1919 highlights the districts as a territorial system, within which there are highly specialized and geographically concentrated companies, which can benefit from economies of scale and positive externalities. These benefits derive from market and technological conditions and the firm's external economies. In his view, the technologies employed conform to local and limited production scales, where the market is characterized by standardized growth and stable relationships.

The so-called external economies help to reduce production and transaction costs, while also encouraging innovative dynamics. Thus, in the Marshallian theory of industrial districts, the organizational model is based on a non-hierarchical order, where the spontaneous and self-propellant nature of the production of external economies derives from the evolutionary stability and convergence of a set of socio-economic, institutional, and manufacturing factors. In the following studies, the concept of an industrial district is perceived as a territorial unit, composed mostly of small and medium-sized specialized enterprises, which collaborate within an integrated production system, highlighting the role of collaborative networks in promoting innovation and the competitiveness of the districts themselves.[3][4][5].

Subsequently, the concept of an industrial district evolved into an industrial cluster, defined by Porter as geographical concentrations of interrelated enterprises, suppliers, institutions, and organizations, where they are sector-specific, collaborative, and competitive. Their strong sectoral specialization is their major attribute, which allows the companies involved to share both knowledge and infrastructure, leading to high production efficiency. Indeed, clusters develop advantages from geographical proximity such as innovation, knowledge transfer, and economies of scale and scope. The interconnection between different actors is important within clusters, as this leads to the development of an ecosystem that encourages the competitiveness of companies and regional economic growth. Clusters offer

comparative advantages and facilitate relationships between local firms during production due to their openness. To maintain these advantages, opening up international markets and integrating the value chain is essential, while also adapting to changes[63]. Industrial clusters foster innovation through social and cultural cohesion, knowledge sharing, and continuous interaction between different actors, promoting innovative solutions such as the circular economy and industrial symbiosis.

In this context, environmental sustainability becomes an important factor for the creation of innovative ecosystems, which involve collaboration between companies, governments, and universities with the aim of promoting the diffusion of innovation.[64]

3.3. From clusters to Innovation ecosystems

Innovation within defined territorial contexts, starting from the evolution of the concept of a cluster defined by Porter as "a geographically close group of interconnected companies and associated institutions in a particular field," and the definition of innovative ecosystems that integrate circularity concepts.

An innovative ecosystem is a network of evolving actors, activities, artifacts, and relationships (complementary and competitive), crucial to the innovation capabilities of an individual or group.[65] These systems are characterized by governance, which is responsible for regulating the ecosystem's functioning, aligning the interests of the actors, and improving trust to implement circular practices. Furthermore, the different actors play a crucial role within innovative economic systems, as collaboration between heterogeneous actors is fundamental for the development of innovative and circular solutions.

Key factors in innovation ecosystems			
	Key factors	**Description**	**References**
1	Heterogeneity and Interdependence	Diverse actors with complementary capabilities facilitate problem-solving and reduce conflicts	[66][67]
2	Alignment of Interests	Individual and collective interests must converge for circular goals	[68]
3	Roles and Responsibilities	Clearly defining these roles supports ecosystem assessment	[69]
4	Reliability	Trust among partners is crucial to facilitate entry of new actors and information sharing	[70]
5	Balance	An ecosystem requires a sufficient number of actors to ensure resource circularity	[66]
6	Orchestrator	A key actor coordinates and supports the ecosystem, often a private company or public institution	[70][67]
Key aspects of the actors involved in innovation ecosystems			
7	Multiple Activities in Different Domains:	For example, optimizing manufacturing processes and enhancing recycling	[70]
8	Collective Goals	A shared vision and collective objectives are vital for innovation	[68]
9	Economic and Environmental Benefits	Financial returns and environmental improvements are necessary for the ecosystem's success	[37]

Table 1. *The key factors of innovative systems*

Source: Authors' elaboration from sources cited.

Specifically, the key factors of an innovation ecosystem appear as those in Table 1. Also, in Table 1, we included the key aspects that characterise the actors involved in innovation ecosystems, where their ability to combine their strengths in achieving common objectives is strongly evident.

The concept of clusters as an innovative ecosystem therefore represents a transformation in today's economic and technological environment. Clusters, understood as geographical aggregations of enterprises, characterized by territorial proximity, and interrelated institutions collaborating within a given sector, offer an environment aimed at promoting innovation and economic growth. As a result, it is not just about sharing physical resources or knowledge but building value networks that facilitate access to technologies, finance, and skills through open innovation approaches. As Porter points out in his studies, the so-called clusters facilitate competitiveness through the strengthening of local production capacities, while current scholars emphasize and deepen the role of clusters as useful vectors for co-creation and development of innovative solutions on a global scale.

4. Discussion and Results

The integration of business model innovation, innovation diffusion, industrial clusters, and circular economy principles gives rise to a powerful concept: the circular innovation ecosystem. This dynamic network fosters the development and dissemination of innovative business models that prioritize sustainability and resource efficiency. Innovation thrives in circular innovation ecosystems due to a complex interplay of factors that drive its spread and adoption among various players.

Different concepts, therefore, having their roots in business model theory, local development, and sustainable development, seem to be heading towards an integration in the Circular Ecosystems of innovation.

On one side, in fact, literature on Business Model Innovation Theory, by incorporating environmental value into the business model innovation theory, requires rethinking and redesigning business models to integrate sustainability considerations. This can involve exploring new revenue streams related to environmental products or services, adopting circular economy principles, implementing green supply chain practices, or leveraging technology for environmental monitoring and optimization. The goal is to create business models that

not only generate economic value but also contribute to environmental sustainability.

On the other side, the evolution of local development from industrial districts through to industry clusters has led to different and various levels of integration and spreading of innovation, heading towards sustainability and circularity. Conceptually, local industrial development developed through autonomous drivers in a bottom-up approach - in industrial districts - to more structured actors, driven by some leading industries - in industry clusters - through to the more recent situations in which innovation is a structured and organized component well rooted into the firm's business model and widespread in the same local framework - innovation ecosystems. The innovation diffusion process, therefore, becomes a structured component of the local industrial system, combining bottom-up approaches traditionally coming from SMEs, big companies' R&D Departments, as well as in line with the regional development policies that, in a circular and continuous process, adapt funding opportunities to the local production system characteristics, other than aiming at strategic development. Table 2 reports a conceptual scheme in which the different characteristics of the three industrial systems can be configured in line with the main peculiarities they present.

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Spatial and industrial organization	**Industrial districts**	**Industrial clusters**	**Circular Innovation ecosystems**
Economic dimension	Spatial concentration of homogenous companies, particularly small and medium enterprises (SME)	Spatial concentration of heterogeneous companies in production and sectors. Includes small and medium enterprises (SME) and bigger companies. Other supporting players (stakeholders).	Ecosystem orchestrator of different size enterprises, public bodies, venture capitalists, etc.
Spatial extension	Well defined boundaries	Less defined boundaries	Regions
Regional organization	Smaller space	Wider space	Regional innovation systems
Innovation diffusion	Bottom up; network	Interaction among actors	Managed and orchestrated innovation
Economic production framework	Linear Economy	Linear Economy	Linear / circular economy
Theoretical framework	Marshall[71], Becattini[72]	Porter[73][74][75]	Mercado-Caruso et al.[76]

Table 2. *Industrial Districts, Clusters, Circular Innovation Ecosystems*

Source: Authors' elaboration from sources cited

The evolution from clusters to innovation ecosystems therefore requires the synergistic collaboration and integration of various actors such as universities, government agencies, startups, and private investors. This configuration allows companies to encompass their own innovation limits, generating a "proxy innovation" where external resources are incorporated into processes in order to create added value. Therefore, innovation ecosystems do not only promote innovative products but also help to achieve sustainability goals by responding to the global challenges of ecological transition and digitisation. As highlighted, nowadays the competition is international and no longer local. Indeed, clusters play a strategic role. An emblematic example is the technology clusters (such as Silicon Valley) that work as global hubs that increase the speed of innovation and promote the building of a dynamic entrepreneurial culture. At the same time, some initiatives at the national and regional levels in Europe and Asia are emerging as alternative models that aim for inclusiveness and collaboration with the aim of promoting local territorial development and addressing the specific needs of their economic fabric.

So, the evolution from clusters into innovation ecosystems highlights the importance of achieving an integrated and sustainable vision of economic development and consequently redefines how companies collaborate and compete, making clusters essential elements for promoting sustainable progress (Figure 1).

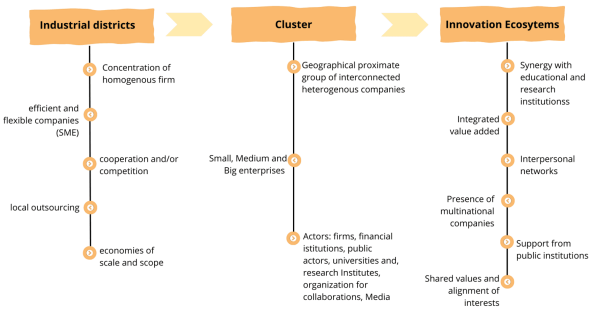

Figure 1. *Evolution from industrial district up to innovation ecosystems*
Source: Authors' elaboration.

5. Conclusions

Is it possible to merge the literature on business model innovation with that dealing with innovation as a spatial diffusion process? How can this fit into the evolution of local production systems from industrial districts to industry clusters? Can we say that the evolution of these concepts, namely business model innovation, innovation

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as a diffusion process, and industrial clusters, can converge into the concept of innovation ecosystems? Can these innovation ecosystems be inserted into the approach of a circular economy? The literature review hereby presented explored, through different keywords, the major characteristics of concepts apparently not related. The interconnectedness of business model innovation, innovation diffusion, industrial clusters, and circular economy emerged. By merging these concepts, we arrive at the powerful framework of circular innovation ecosystems. These ecosystems, characterized by collaboration, knowledge sharing, and resource efficiency, accelerate the development and adoption of sustainable business models. A crucial aspect of this framework is the role of innovation as a spatial diffusion process. By understanding how innovation spreads geographically, we can identify the optimal conditions for its uptake and impact. Industrial clusters and ecosystems serve as important nodes in this diffusion process, facilitating knowledge exchange, collaborative problem-solving, and the emergence of innovative solutions. The circular economy offers a compelling vision for sustainable development, and its implementation within these ecosystems can drive significant positive impacts. By integrating circular principles into business models and production processes, we can reduce waste, conserve resources, and create new economic opportunities. In conclusion, the convergence of these concepts holds the potential to reshape our economic and social systems. By fostering innovation, collaboration, and circularity, we can create a more sustainable and resilient future. Innovation ecosystems and circular innovation ecosystems can therefore represent the more recent frontiers and forms of spatial organization to aim for in order to foster local spatial development, capable of adequately exploiting the different forces shaping production within a sustainable framework. The analysis carried out in the present research has therefore tried to provide a unique framework in which different theories and points of view consider the innovation diffusion and spreading both between different firms and business models, as well as in its spatial components.

Author contributions

SD, FS, GB, MT, AG: Conceptualization; GB: Supervision; SD, FS, GB: Validation; SD, FS: Writing – Original Draft Preparation; SD, FS, GB: Data Curation, Formal Analysis, Investigation, Visualization; SD, FS, GB: Resources, Writing - Writing – Review & Editing.

More specifically, this paper is the outcome of an in-depth collaboration between the authors; however, Giuseppe Borruso, Andrea Gallo, and Moreno Tivan wrote Paragraph 1 – Introduction, Salvatore Dore wrote Paragraphs 2, 3.1.2, 3.1.3, 3.3, Francesca Sinatra wrote Paragraphs 3.1.1 and 3.2, Salvatore Dore and Francesca Sinatra wrote Paragraph 4, and Moreno Tivan wrote Paragraph 5.

Websites

- https://www.ellenmacarthurfoundation.org/topics/circula economy-introduction/overview
- https://jemi.edu.pl/vol-16-issue-3-2020/innovation-by-proxy-clusters-as-ecosystems-facilitating-open-innovation
- https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition
- https://www.researchgate.net/figure/Ecosystem-of-an-innovation-cluster-Source-elaborated-by-the-authors-based-on-85_fig4_337313291
- https://knowledge.csc.gov.sg/digital-issue-07/growing-from-clusters-to-ecosystems/

References

1. ^*Balletto G, Sinatra M, Sinatra F, Borruso G. Industrial Sy mbiosis and Circular Urban Practices. In: International C onference on Innovation in Urban and Regional Plannin g; 2023 Sep; Cham: Springer Nature Switzerland. p. 14-24.*
2. ^*World Economic Forum, Ellen MacArthur Foundation a nd McKinsey & Company (2016), The New Plastics Econo my: Rethinking the future of plastics.*
3. a, b*Becattini G. Riflessioni sul distretto industriale marsh alliano come concetto socio-economico. Stato e mercato. 1989; p. 111-128.*
4. a, b*Sforzi F (2005). "Dal distretto industriale allo sviluppo locale." Lezione inaugurale-Artimio: Incontri pratesi sull o sviluppo locale.*
5. a, b*Sforzi F (2008). "Il distretto industriale: da Marshall a Becattini." Pensiero economico italiano. XVI(2): 1000-101 0.*
6. ^*Sylvester A, Tate M, Johnstone D. "Beyond synthesis: re-presenting heterogeneous research literature." Behaviour & Information Technology. 2013; 32(12): 1199–1215.*
7. ^*Davies P. The relevance of systematic reviews to educati onal policy and practice. Oxford Review of Education. 20 00; 26(3-4):365–378.*
8. a, b*Green BN, Johnson CD, Adams A. Writing narrative lite rature reviews for peer-reviewed journals: secrets of the t rade. Journal of Chiropractic Medicine. 2006; 5(3):101–117.*
9. ^*Cronin P, Ryan F, Coughlan M. Undertaking a literature review: a step-by-step approach. British Journal of Nursi ng. 2008; 17(1):38–43.*
10. ^*Levy Y, Ellis TJ (2006). A systems approach to conduct a n effective literature review in support of information sys tems research. Informing Sci. 9:181-211.*
11. a, b, c, d, e*Skarzynski P, Gibson R. Innovation to the core. B oston, MA: Harvard Business School Press; 2008.*

12. ^ a, b *Baumeister RF, Leary MR. Writing narrative literature reviews. Review of General Psychology. 1997; 1(3):311–320.*
13. ^ *Brocke JV, Simons A, Niehaves B, Niehaves B, Reimer K, Plattfaut R, Cleven A. Reconstructing the giant: On the importance of rigour in documenting the literature search process. 2009.*
14. ^ *Bandara W, Miskon S, Fielt E. A systematic, tool-supported method for conducting literature reviews in information systems. In: ECIS 2011 proceedings [19th European conference on information systems]. AIS Electronic Library (AISeL)/Association for Information Systems. p. 1-13.*
15. ^ *Boulding KE. Economics and ecology. 1966.*
16. ^ *Stahel W, Reday G (1976). The potential for substituting manpower for energy. Geneva: European Commission.*
17. ^ *Pearce DW, Turner RK (1989). Economics of natural resources and the environment. Johns Hopkins University Press.*
18. ^ a, b *Kirchherr J, Reike D, Hekkert M (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling. 127: 221-232.*
19. ^ *MacArthur E (2013). Towards the circular economy. Journal of Industrial Ecology. 2(1): 23-44.*
20. ^ a, b *Ellen M. (2015) TOWARDS A CIRCULAR ECONOMY: BUSINESS RATIONALE FOR AN ACCELERATED TRANSITION Report.*
21. ^ *Yuan S, Pan X (2023). "The effects of digital technology application and supply chain management on corporate circular economy: A dynamic capability view." Journal of Environmental Management. 341: 118082.*
22. ^ a, b, c *Bocken NMP, Short SW, Rana P, Evans S. A literature and practice review to develop sustainable business model archetypes. J Clean Prod. 2014; 65:42–56.*
23. ^ *Tukker A (2015). "Product services for a resource-efficient and circular economy–a review." Journal of cleaner production. 97: 76-91.*
24. ^ *Veleva V, Bodkin G (2018). "Corporate-entrepreneur collaborations to advance a circular economy." Journal of Cleaner Production. 188: 20-37.*
25. ^ a, b, c, d *Tidd J, Bessant JR (2020). Managing innovation: integrating technological, market and organizational change. John Wiley & Sons.*
26. ^ a, b, c *Hult GTM (2012). A focus on international competitiveness. Journal of the Academy of Marketing Science. 40: 195-201.*
27. ^ a, b *Miller D, Friesen PH (1982). Innovation in conservative and entrepreneurial firms: Two models of strategic momentum. Strategic Management Journal. 3(1): 1-25.*
28. ^ *Nelson RR, Winter SG (1982), An evolutionary theory of economic change, Cambridge, MA: The Belknap Press of Harvard University Press.*
29. ^ *Chesbrough H. Business model innovation: it's not just about technology anymore. Strategy & Leadership. 2007; 35(6):12-17.*
30. ^ *D'Aveni RA. Hypercompetition: Managing the Dynamics of Strategic Maneuvering. Free Press, New York. 1994.*
31. ^ *Bieger T, Reinhold S. Das wertbasierte Geschäftsmodell–ein aktualisierter Strukturierungsansatz. Innovative Geschäftsmodelle. 2011; p. 13-70.*
32. ^ a, b *Geissdoerfer M, Morioka SN, de Carvalho MM, Evans S. Business models and supply chains for the circular economy. J Clean Prod. 2018; 190:712–721.*
33. ^ *Baden-Fuller C, Morgan MS. Business models as models. Long Range Planning. 2010; 43(2-3):156-171.*
34. ^ *Yariv Taran and Harry Boer, A Business Model Innovation Typology, Decision Sciences Institute, 2015*
35. ^ *Bigliardi B, Filippelli S. Investigating circular business model innovation through keywords analysis. Sustainability. 2021; 13(9):5036.*
36. ^ *Potting J, Hekkert MP, Worrell E, Hanemaaijer A (2017). Circular economy: measuring innovation in the product chain. Planbureau voor de Leefomgeving. (2544).*
37. ^ a, b *Stewart R, Niero M (2018). "Circular economy in corporate sustainability strategies: A review of corporate sustainability reports in the fast-moving consumer goods sector." Business Strategy and the Environment. 27(7): 1005-1022.*
38. ^ *Hanemaaijer A, Kishna M, Brink H, Koch J, Prins AG, Rood T. Netherlands integral circular economy report 2021. English Summary. Netherlands Environmental Assessment Agency PBL, The Hague. 2021.*
39. ^ *Freeman RE, Phillips RA. Stakeholder theory: A libertarian defense. Business Ethics Quarterly. 2002; 12(3):331-349.*
40. ^ *Cosenz F, Noto G. A dynamic business modelling approach to design and experiment new business venture strategies. Long Range Plan. 2018; 51:127–140.*
41. ^ *De Medeiros JF, Ribeiro JLD, Cortimiglia MN. Success factors for environmentally sustainable product innovation: A systematic literature review. J Clean Prod. 2014; 65:76–8.*
42. ^ *Linton JD, Klassen R, Jayaraman V. Sustainable supply chains: An introduction. J Oper Manag. 2007; 25: 1075–1082.*
43. ^ a, b, c *Brehmer M, Podoynitsyna K, Langerak F. Sustainable business models as boundary-spanning systems of value transfers. J Clean Prod. 2018; 172:4514–4531.*
44. ^ *Nielsen C, Lund M, Eds.; BookBoon.com/Ventus Publishing Aps: Copenhagen, Denmark, 2014; Volume 1, pp. 22–28.*
45. ^ *Upward A, Jones PH. "An ontology for strongly sustainable business models: Defining an enterprise framework compatible with natural and social science." Org. Environ. 2016; 29: 97–123.*

46. ^ a, b, c Sousa-Zomer TT, Miguel PAC. "Sustainable business models as an innovation strategy in the water sector: An empirical investigation of a sustainable product-service system." J. Clean. Prod. 2018; 171: 119–129.
47. ^ Rashid A, Asif FMA, Krajnik P, Nicolescu CM. "Resource conservative manufacturing: An essential change in business and technology paradigm for sustainable manufacturing." J. Clean. Prod. 2013; 57: 166–177.
48. ^ Stubbs W, Cocklin C. "Conceptualizing a sustainability business model." Org. Environ. 2008; 21: 103–127.
49. ^ Ritala P, Huotari P, Bocken N, Albareda L, Puumalainen K. "Sustainable business model adoption among S&P 500 firms: A longitudinal content analysis study." J. Clean. Prod. 2018; 170: 216–226.
50. ^ Linder M, Williander M. Circular business model innovation: Inherent uncertainties. Bus Strateg Environ. 2017; 26: 182–196.
51. ^ Karlsson NP, Hoveskog M, Halila F, Mattsson M. Early phases of the business model innovation process for sustainability: Addressing the status quo of a Swedish biogas-producing farm cooperative. J Clean Prod. 2018; 172: 2759–2772.
52. ^ Hellström M, Tsvetkova A, Gustafsson M, Wikström K. Collaboration mechanisms for business models in distributed energy ecosystems. J Clean Prod. 2015; 102:226–236.
53. ^ Schaltegger S, Lüdeke-Freund F, Hansen E. "Business cases for sustainability: The role of business model innovation for corporate sustainability." Int. J. Innovat. Sustain. Dev. 2012; 6: 95–119.
54. ^ Vezzoli C, Ceschin F, Diehl JC, Kohtala C. "New design challenges to widely implement 'sustainable product-service systems'." J. Clean. Prod. 2015; 97: 1–12.
55. ^ Hagerstrand T. Innovation diffusion as a spatial process. 1968.
56. ^ Gould PR. Spatial Diffusion, Resource Paper No. 4. 1969.
57. ^ Morrill RL (1970). The shape of diffusion in space and time. Economic Geography. 46(sup1): 259-268.
58. ^ Murgante B, Borruso G, Balletto G, Castiglia P, Dettori M (2020). Why Italy first? Health, geographical and planning aspects of the COVID-19 outbreak. Sustainability. 12(12): 5064.
59. ^ Murray AT. Location Theory. International Encyclopedia of Human Geography. 2009.
60. ^ Weber A (1929). Theory of the location of industries (CJ Friedrich, Trans.). University of Chicago Press. (Original work published 1909).
61. ^ Balletto G, Borruso G, Mei G. Location theory and CE. Demolition, constructions and spatial organization of firms –an applied model to Sardinia Region. The case study of the New Cagliari Stadium. In: Computational Science and Its Applications–ICCSA 2019: 19th International Conference, Saint Petersburg, Russia, July 1–4, 2019, Proceedings, Part III 19. Springer International Publishing. p. 535-550.
62. ^ Perroux F (1955) Note sur la notion de pole de croissance, Economie Appliquée, 8: 307-320.
63. ^ Grandinetti R, De Marchi V. Dove stanno andando i distretti industriali? Un tentativo di risposta a partire da un'indagine in Veneto. Studi organizzativi. 2013; (2012/2).
64. ^ Lazzeroni M, Morazzoni M, Paradiso M (2019). Nuove geografie dell'innovazione e dell'informazione. Dinamiche, trasformazioni, rappresentazioni. GEOTEMA. 59: 1-164.
65. ^ Granstrand O, Holgersson M. Innovation ecosystems: A conceptual review and a new definition. Technovation. 2020; 90:102098.
66. ^ a, b Tate WL, Bals L, Bals C, Foerstl K (2019). "Seeing the forest and not the trees: Learning from nature's circular economy." Resources, Conservation and Recycling. 149: 115-129.
67. ^ a, b Parida V, Sjödin D, Reim W (2019). Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. Sustainability. 11(2): 391.
68. ^ a, b Konietzko J, Bocken N, Hultink EJ (2020). Circular ecosystem innovation: An initial set of principles. Journal of Cleaner Production. 253: 119942.
69. ^ Kohtamäki M, Parida V, Oghazi P, Gebauer H, Baines T (2019). Digital servitization business models in ecosystems: A theory of the firm. Journal of Business Research. 104: 380-392.
70. ^ a, b, c Rajala R, Hakanen E, Mattila J, Seppälä T, Westerlund M (2018). "How do intelligent goods shape closed-loop systems?" California Management Review. 60(3): 20-44.
71. ^ Marshall A (1919) "Industry and Trade. A study of industrial technique and business organization", London, Macmillan & Co.
72. ^ Becattini G. (1998), Distretti industriali e made in Italy. Le basi reali del rinnovamento italiano, Torino, Bollati Boringhieri
73. ^ Porter M (1990) The Competitive Advantage of Nations. Free Press, New York. - References - Scientific Research Publishing.
74. ^ Porter ME (1998). Clusters and competition. On Competition. 7: 91.
75. ^ Porter ME (2000). Location, competition, and economic development: Local clusters in a global economy. Economic Development Quarterly. 14(1): 15-34.
76. ^ Mercado-Caruso N, Segarra-Oña M, Peiró-Signes Á, Portnoy I, Navarro E (2022). Eco-innovation and its economic effect on Industrial Clusters-An FsQCA Analysis. Procedia Computer Science. 203: 673-677.

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