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MAPPING THE INTELLECTUAL STRUCTURE OF OPEN INNOVATION IN SMEs: A BIBLIOMETRIC ANALYSIS (2009–2025)

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ABSTRACT

This study provides a bibliometric analysis of research on open innovation in small and medium-sized enterprises (SMEs) over the period 2009–2025. Using a dataset of 500 journal articles indexed in the Web of Science, the study maps the field's intellectual structure, publication trends, influential sources, leading authors, country productivity, collaboration patterns, and thematic evolution. The results show a steady growth in scientific production, particularly after 2017, indicating the increasing consolidation of open innovation in SMEs as a distinct research domain. The literature is concentrated on a limited number of influential journals, especially Technovation and Technological Forecasting and Social Change, while a small group of highly cited publications forms the conceptual foundation of the field. Thematic analysis reveals that the field is primarily structured around open innovation, SMEs, performance, research and development, absorptive capacity, and knowledge. Thematic evolution further indicates a shift from foundational concerns related to firm performance, manufacturing, and strategy towards more recent interests in business models, eco-innovation, digitalization, and empirical contextualization.

1 INTRODUCTION

Small and medium-sized enterprises (SMEs) play a central role in economic growth, employment generation, and the strengthening of national competitiveness. In an increasingly knowledge-based and highly dynamic business environment, innovation has become a critical factor in ensuring the survival and long-term sustainability of SMEs (Janković & Golubović, 2019). Within this context, open innovation has emerged as a prominent paradigm that enables firms to purposefully use both internal and external knowledge flows to accelerate innovation processes and enhance market performance (Odriozola-Fernández et al., 2019).

For SMEs in particular, open innovation offers important opportunities to overcome internal limitations by accessing external ideas,

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technologies, expertise, and collaborative networks. However, the adoption of open innovation is not without challenges. SMEs often face barriers related to limited financial and human resources, weak organizational structures, insufficient managerial capabilities, and difficulties in managing knowledge and intellectual property (Spithoven et.al., 2013; Almeida, 2024). These constraints make the implementation of open innovation more complex in SMEs than in large organizations.

To address these challenges, intellectual capital has increasingly been recognized as a strategic enabler of open innovation in SMEs. Human capital, structural capital, and relational capital can strengthen firms' ability to identify, absorb, share, and exploit knowledge from external sources (Phonthanukitithaworn et al., 2023). Empirical evidence also suggests that open innovation practices can positively influence innovative performance through the development of intellectual capital, particularly by enhancing human and organizational capabilities within SMEs (Sibhato, 2018). In this regard, open innovation is not only a mechanism for accessing external knowledge, but also a pathway for reinforcing the internal competences needed to transform such knowledge into competitive outcomes.

Over the past decade, research on open innovation in SMEs has expanded significantly. Previous review studies have shown that this field has grown rapidly, with growing attention being paid to the effects of open innovation on firm performance, new product development, organizational structure, and knowledge management (Hossain, 2015; Odriozola-Fernández et al., 2019). More recently, bibliometric studies have contributed to mapping the evolution of this body of knowledge, identifying its principal contributors, influential journals, collaboration networks, and emerging themes (Yulianti et al., 2023; Gulia et al., 2024). These developments reflect the increasing maturity of the field and the need for a more systematic understanding of its intellectual structure.

However, what distinguishes the present study from existing bibliometric efforts is twofold. First, while previous reviews have mapped the literature up to 2022 or 2023, this study extends the temporal scope to 2025, capturing the critical post-pandemic period where digital transformation and eco-innovation radically reshaped SME strategies. Second, unlike purely descriptive bibliometric profiles, this study places a strong emphasis on longitudinal thematic evolution and Bradford's law of scattering, offering a dynamic mapping of how the intellectual core of the field has transitioned from basic adoption motives towards complex ecosystem configurations. This updated and dynamic perspective provides a necessary bridge between past foundational theories and contemporary technological imperatives in SME open innovation.

Despite this progress, the intellectual landscape of open innovation in SMEs remains fragmented, particularly about the evolution of themes, conceptual linkages, and research clusters over time. Given the growing volume of publications in this area, it is essential to investigate how the field has developed, which themes have dominated scholarly attention, and what future directions may shape its advancement. Against this background, the present study seeks to address the following questions:

- How has research on open innovation in SMEs evolved during the period 2009–2025?
- What are the major themes and intellectual clusters that have shaped this field?
- How is research in this area distributed across authors, institutions, countries, and journals?
- What patterns of collaboration and knowledge production can be identified?
- Which topics have emerged as the most influential and which areas remain underexplored?
- What future research directions can be derived from the bibliometric structure of the field?

By examining these issues, this study aims to provide a comprehensive overview of the intellectual structure of open innovation research in SMEs. It also seeks to highlight the principal trends, research hotspots, and future pathways that may guide scholars, practitioners, and policymakers interested in the continued development of this important field.

2 MATERIALS AND METHODS

This study adopted a bibliometric approach to examine the development of research on open innovation in small and medium-sized enterprises (SMEs). The bibliographic data were retrieved from the Web of Science Core Collection, which was deliberately selected over other databases such as Scopus or Google Scholar to ensure transparency and analytical rigor. WoS is widely recognized for its strict indexing standards and rigorous peer-review requirements, which guarantees a highly curated dataset of premium scholarly literature. By focusing exclusively on WoS, this study mitigates the risk of "noise" and low-quality publications that often characterize broader databases, thereby providing a more reliable foundation for mapping the true intellectual core of the field.

The search process was based on a keyword-driven strategy combining the core concepts of open innovation and small and medium-sized enterprises (SMEs). The following Boolean query was used:

TS=("open innovation" AND ("small and medium enterprise" OR SME*)) AND DT=Article AND LA=English AND PY=2009-2025*

To improve the relevance and consistency of the dataset, the search was limited to English-language journal articles only. Other document types, such as reviews, conference papers, book chapters, editorials, and notes, were excluded.

After applying the selection criteria and screening the retrieved records for relevance, the final dataset was retained for bibliometric analysis.

The bibliographic data were analyzed exclusively using RStudio through the bibliometrix package and its web-based interface Biblioshiny. This analytical environment was chosen because it provides a reliable and reproducible framework for conducting bibliometric studies and science mapping.

After importing the BibTeX file into Biblioshiny, the dataset was processed to generate the main bibliometric outputs related to publication trends, source productivity, authorship patterns, citation structure, keyword occurrence, and collaboration networks. In addition, the software supported the mapping of the conceptual and intellectual structure of the field based on the metadata extracted from the selected publications.

This procedure enabled a systematic exploration of the literature on open innovation in SMEs and facilitated the identification of its main research patterns and thematic developments.

Some limitations of this study should be critically acknowledged. First, the deliberate restriction to the Web of Science Core Collection, while ensuring high quality, implies a trade-off, as it may have excluded relevant studies indexed in other prominent databases like Scopus. Second, restricting the sample to English-language journal articles may have introduced a linguistic bias, potentially overlooking valuable insights published in local or regional journals. Third, the dataset reflects the state of the database at the time of retrieval; therefore, publications indexed after this date were not included. Despite these limitations, the adopted methodology provides a coherent, rigorous, and transparent basis for examining the evolution and structure of research on open innovation in SMEs.

3. RESULTS

The descriptive overview of the dataset indicates that research on open innovation in SMEs has developed steadily over the period 2009–2026, with a final corpus of 500 journal articles published across 170 sources. Literature appears relatively recent, as reflected by a document average age of 6.27 years, while the average of 42.59 citations per document suggests a noticeable scientific impact of the field. In total, the dataset contains 23,426 references, pointing to a well-established and interconnected knowledge base. From a conceptual perspective, the presence of 1,453 authors' keywords and 800 Keywords Plus indicates considerable thematic diversity and richness in the research domain. In terms of authorship, the field involves 1,300 authors, but only 46 documents were single-authored, with just 39 authors contributing individually, which confirms that the field is largely collaborative. This is further supported by the average of 3.15 co-authors per document and an international co-authorship rate of 36.8%, highlighting a moderate but meaningful level of international research collaboration. Overall, these indicators suggest that the literature on open innovation in SMEs is

both growing and increasingly collaborative, with a solid intellectual foundation and broad thematic scope.

As illustrated in Figure 1, research on open innovation in SMEs has grown steadily over time, although with some fluctuations across the study period. The field recorded a limited number of publications between 2009 and 2012, followed by a gradual increase from 2013 onward and a more pronounced expansion after 2017. Scientific output reached its highest level in 2023, with 63 articles, reflecting the growing academic interest in this topic. Although a slight decline is observed in 2024 and 2025, this decrease may be related to database indexing delays rather than an actual reduction in research activity. In terms of citation impact, earlier publications show relatively higher mean total citations per year, particularly those published in 2009 and 2010, mainly because they have had more time to accumulate citations. By contrast, more recent publications display lower citation averages due to their shorter exposure time. Overall, Figure 1 confirms that the literature on open innovation in SMEs is expanding and gradually maturing as a research field.

Table 1. Descriptive statistics

Description	Results
Timespan	2009:2026
Sources (Journals, Books, etc)	170
Documents	500
Document Average Age	6.27
Average citations per doc	42.59
References	23426
DOCUMENT CONTENTS	
Keywords Plus (ID)	800
Author's Keywords (DE)	1453
AUTHORS	
Authors	1300
Authors of single-authored docs	39
AUTHORS COLLABORATION	
Single-authored docs	46
Co-Authors per Doc	3,15
International co-authorships %	36,8
DOCUMENT TYPES	
Article	500

Source: Elaborated by author based on R Studio using biblioshiny

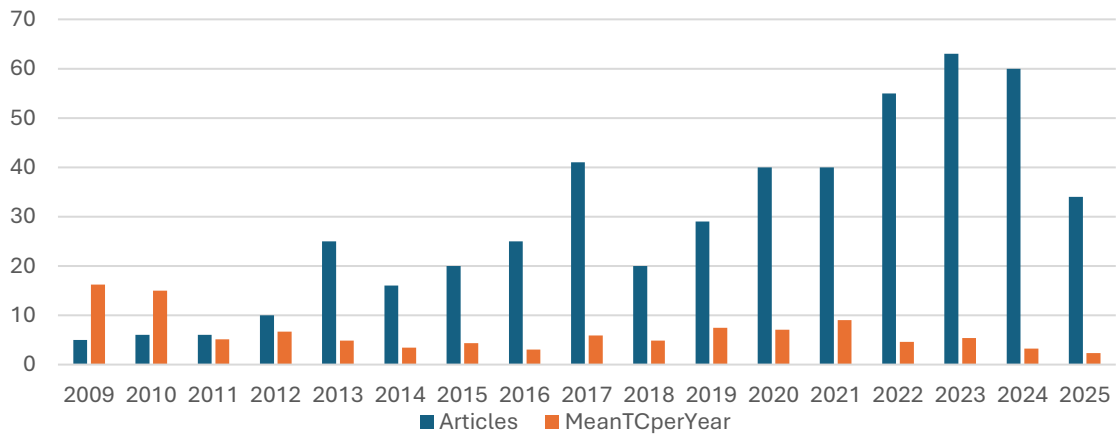

***Figure** 1. Annual Trends in Scientific Production and Mean Citations per Year (2009–2025)*
Source: Compiled by the author based on Web of Science data using Eexel

Table 2 shows that research on open innovation in SMEs is concentrated in a relatively small group of influential journals. Technovation and Technological Forecasting and Social Change stand out as the most impactful sources, recording the highest citation counts and strong h-index and g-index values, which confirms their central role in shaping the field. Technological Forecasting and Social Change is particularly notable for its high h-index (19) and substantial productivity since 2017, whereas Technovation achieved the highest total citations (TC = 2693) and has contributed continuously since 2009. Other journals, such as the Journal of Knowledge Management and Journal of Business Research, also show strong citation performance, indicating their importance in connecting innovation studies with management and business perspectives. Overall, the table suggests that the literature is anchored in high-impact innovation and management journals, reflecting both the maturity and interdisciplinary nature of research on open innovation in SMEs.

***Table 2**. Source impact indicators and productivity metrics of major journals (2010–2025)*

Source	h_index	g_index	m_index	TC	NP	PY_start
Technological Forecasting and Social Change	19	25	1.9	1981	25	2017
Technovation	17	21	0.944	2693	21	2009
Technology Analysis & Strategic Management	13	15	0.929	627	15	2013
European Journal of Innovation Management	12	16	1.2	558	16	2017
International Journal of Innovation Management	12	21	0.667	471	24	2009
Journal Of Knowledge Management	12	16	1.2	1375	16	2017
IEEE Transactions on Engineering Management	11	16	1.571	368	16	2020
Journal of Business Research	10	10	1.25	1408	10	2019
R & D Management	10	13	0.588	677	13	2010
Management Decision	9	11	0.818	316	11	2016

Source: Compiled by the author based on Web of Science data using Biblioshiny

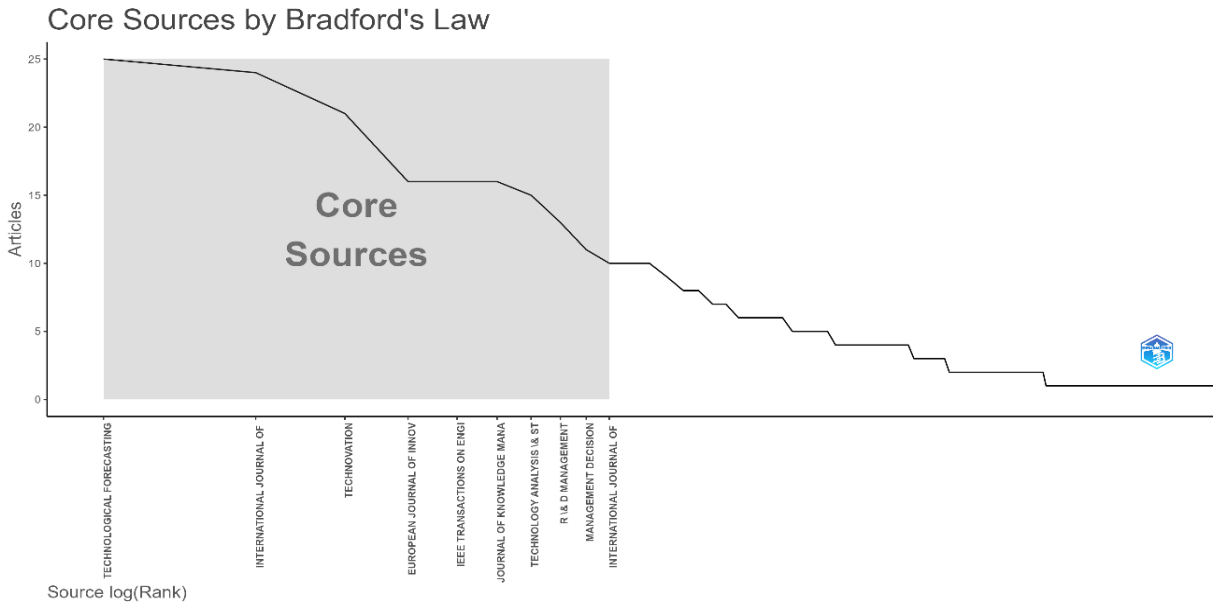

Figure 2. Core Journal Concentration According to Bradford's Law
Source: Elaborated by author based on R Studio using biblioshiny

Based on Bradford's Law, Figure 2 demonstrates that research on open innovation in SMEs is concentrated within a limited number of core journals, followed by a wider dispersion across less productive sources. The core zone (Zone 1) includes the most influential and prolific journals, such as Technological Forecasting and Social Change, International Journal of Innovation Management, and Technovation, which constitute the primary outlets for scholarly contributions in this field. Beyond this nucleus, the second zone comprises a broader set of journals that contribute a moderate number of publications, mainly within the domains of innovation, management, and entrepreneurship. Finally, the third zone is characterised by many journals with only one or two publications each, indicating a high level of dispersion. This distribution confirms that while the field is anchored in a small group of leading journals, it is also widely disseminated across diverse sources, reflecting both the maturity and interdisciplinary nature of research on open innovation in SMEs.

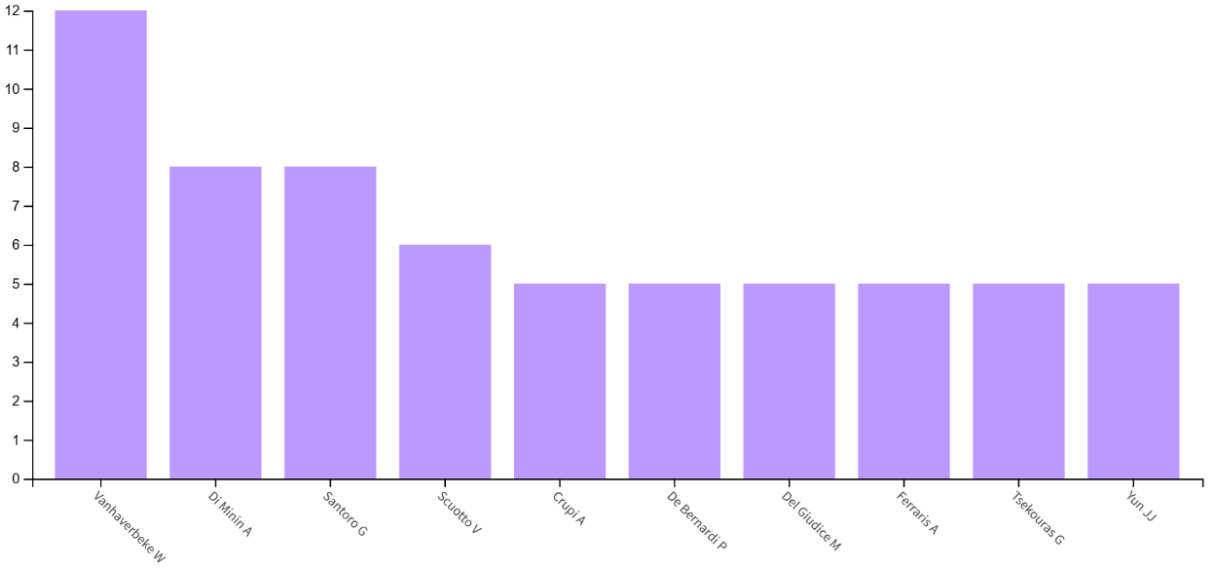

Figure 3. Most relevant authors
Source: Author's elaboration based on Web of Science data.

Figure 4 illustrates the most relevant authors in the field of open innovation in SMEs, based on their number of publications. As shown, Vanhaverbeke W. emerges as the most prolific contributor, with the highest number of publications, highlighting a leading role in shaping the research domain. This author is followed by Di Minin A. and Santoro G., who also demonstrate strong research productivity and consistent contributions to the field. A second group of authors, including Scuotto V., Crupi A., and De Bernardi P., show moderate but significant involvement, indicating their growing influence. The remaining authors, such as Del Giudice M., Ferraris A., Tsakalerou G., and Yun J.J., contribute with a comparable number of publications, reflecting a relatively balanced distribution among emerging contributors. Overall, the figure suggests that while the field is led by a few highly productive scholars, it is also supported by a broader group of active researchers, indicating both consolidation and expansion in this research area.

Table 3. Most Globally Cited Documents in Open Innovation Research in SMEs

Paper	DOI	Total Citations	TC per Year
Van De Vrande V, 2009, Technovation	10.1016/j.technovation.2008.10.001	1310	72,78
Lee S, 2010, Res Policy	10.1016/j.respol.2009.12.009	890	52,35
Cenamor J, 2019, J Bus Res	10.1016/j.jbusres.2019.03.035	593	74,13
Parida V, 2012, J Small Bus Manag	10.1111/j.1540-627X.2012.00354.x	535	35,67

Paper	DOI	Total Citations	TC per Year
Brunswicker S, 2015, J Small Bus Manag	10.1111/jsbm.12120	480	40,00
Spithoven A, 2013, Small Bus Econ Group	10.1007/s11187-012-9453-9	429	30,64
Singh Sk, 2021, J Bus Res	10.1016/j.jbusres.2019.04.040	413	68,83
Popa S, 2017, Technol Forecast Soc Chang	10.1016/j.techfore.2017.02.014	304	30,40
Scuotto V, 2017, Creat Innov Manag	10.1111/caim.12221	300	30,00
Spithoven A, 2010, Technovation	10.1016/j.technovation.2009.08.004	290	17,06

Source: Elaborated by author based on R Studio using biblioshiny

Table 3 An examination of the titles of the most globally cited documents confirms that the intellectual structure of open innovation in SMEs is organized around three major thematic pillars. First, a foundational stream defines the concept, motives, challenges, and organizational models of open innovation in SMEs, as illustrated by seminal studies such as Open Innovation in SMEs: Trends, Motives and Management Challenges and Open innovation in SMEs-An intermediate network model. Second, a performance-oriented stream links inbound openness, external knowledge sourcing, knowledge sharing, and innovation climate to firm and innovation performance. Third, a more recent digitalization-oriented stream extends the field towards digital platforms, digital business, and ambidexterity in entrepreneurial SMEs. Accordingly, the field appears to have evolved from conceptual and structural discussions of open innovation in SMEs towards more dynamic concerns related to organizational performance, digital transformation, and strategic capability development.

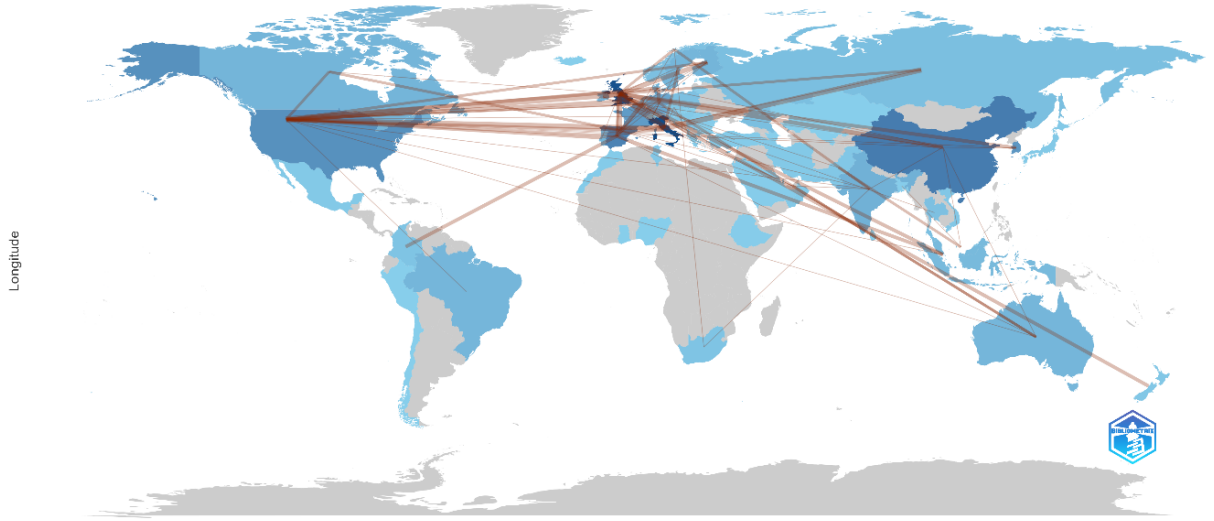

***Figure 4**. Global Country Collaboration Network in Open Innovation Research in SMEs (2009–2025)*
***Source:** Elaborated by the author based on bibliometric data from the study dataset and visualized using Biblioshiny (Bibliometrix package) in R Studio.*

The country analysis reveals a strong concentration of research output in a limited number of countries, led by Italy (238), the United Kingdom (178), China (133), South Korea (109), and Spain (106). This indicates that the field of open innovation in SMEs is driven primarily by a small group of highly productive countries, with a particularly strong European presence. The collaboration map further shows that international cooperation is organized around a few major hubs, notably the United Kingdom, Italy, the United States, China, and India, which occupy central positions in the global collaboration network. Hence, the field is characterized not only by unequal publication productivity but also by a core-periphery collaboration structure in which a limited number of countries dominate international knowledge exchange.

Figure 5. *Keyword Treemap of Open Innovation Research in SMEs (2009–2025)*
Source: *Prepared by the author using Biblioshiny (Bibliometrix package) in R Studio, based on the study dataset.*

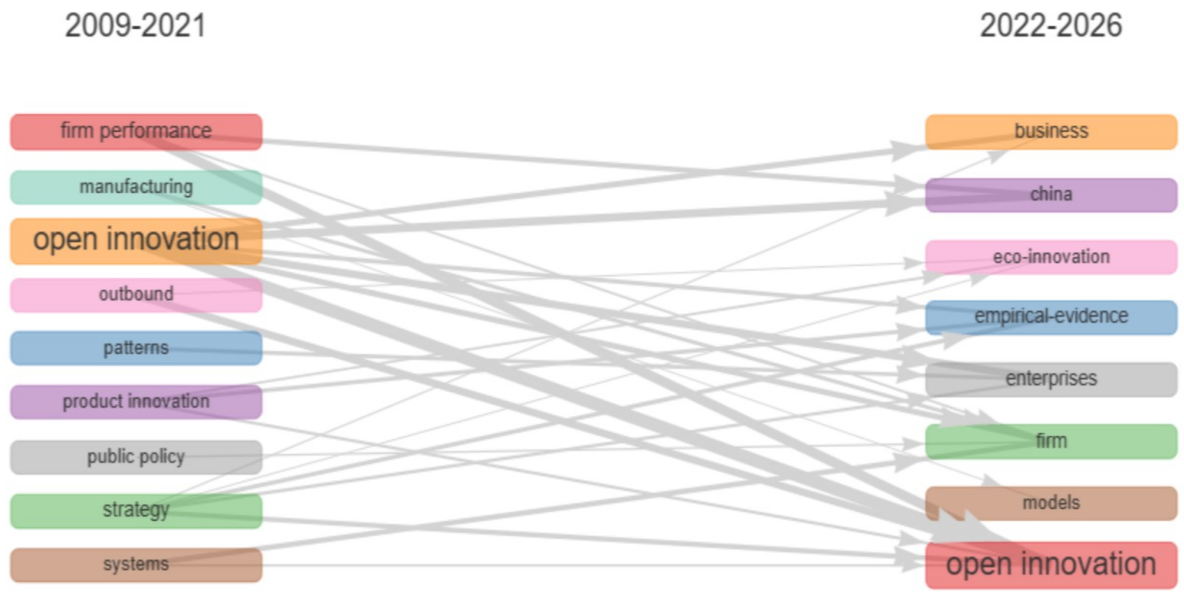

Figure 6. *Thematic Evolution of the Intellectual Structure of Open Innovation Research in SMEs (2009–2021 vs. 2022–2025)*
Source: *Prepared by the author using Biblioshiny (Bibliometrix package) in R Studio, based on the study dataset*

Figures 5 and 6 illustrate the main thematic configuration of the literature on open innovation in SMEs. As shown in Figure 6, the most frequent keyword is open innovation (325; 11%), followed by SMEs (234; 8%) and performance (227; 8%), which confirms that the field is primarily structured around openness, firm type, and performance-related concerns. Other prominent themes include

research and development (159; 5%), absorptive capacity (123; 4%), knowledge (118; 4%), innovation (92; 3%), collaboration (84; 3%), and technology (76; 3%), indicating the importance of knowledge-based capabilities and inter-organizational interaction within the field. In addition, Figure 6 shows that the thematic evolution of literature is marked by both continuity and change. During the 2009–2021 period, the field was associated with themes such as firm performance, manufacturing, outbound, patterns, product innovation, public policy, strategy, and systems. In the 2022–2025 period, the thematic structure shifted towards business, China, eco-innovation, empirical evidence, enterprises, firm, and models, while open innovation remained the central and persistent theme across both periods. These results indicate that the field has expanded from its earlier emphasis on performance and operational dimensions towards a broader and more diversified thematic structure.

3 DISCUSSION

The findings indicate that research on open innovation in SMEs has moved from an emerging topic to a consolidated research field. The steady increase in publications, the relatively high average citations per document, and the broad dispersion across 170 sources suggest both maturation and diversification.

Analytically, the pronounced expansion of scholarly output after 2017 can be explained by broader macro-economic and technological shifts. The widespread integration of Industry 4.0 technologies and the rise of platform ecosystems during this period forced SMEs to realize that internal R&D was no longer sufficient to remain competitive. Consequently, researchers intensified their focus on how SMEs leverage open innovation to survive digital disruption, thereby driving the observed spike in academic production.

This pattern is consistent with earlier bibliometric evidence showing a sustained rise in scholarly interest in open innovation in SMEs. For example, Odriozola-Fernández et al. (2019) described the field as expanding but still structurally concentrated, while Nuryakin et al. (2022) and Sabando-Vera et al. (2022) likewise reported a continuous growth trajectory in publications on open innovation and SMEs. At a broader level, Gao et al. (2020) also showed that open innovation research has expanded considerably over time, which helps explain why the SME-focused stream has become more visible and theoretically developed in recent years. Taken together, the present results confirm that open innovation in SMEs is no longer a peripheral topic, but a stable and increasingly specialized area within innovation and management research.

The source and citation analyses further show that the field is anchored in a relatively small set of influential journals and seminal publications. The centrality of *Technovation*, *Technological Forecasting and Social Change*, *Journal of Business Research*, and *Journal of Small Business Management* suggest that the literature has developed at the intersection of innovation management, strategic management, and SME studies. This result broadly aligns with Odriozola-Fernández et al. (2019), who also identified *Technovation* as a particularly high-impact outlet and highlighted the importance of *Research Policy* and *Journal of Small Business Management* in shaping the field. The dominance of highly cited works by van de Vrande et al. (2009), Lee et al. (2010), Parida et al. (2012), Spithoven et al. (2013), and Brunswicker and Vanhaverbeke (2015) confirms that the intellectual foundations of this domain are built around three closely related concerns: the diffusion of open innovation practices in SMEs, the role of networked and intermediary-based collaboration, and the internal organisational conditions required to benefit from external knowledge. This also echoes the broader open innovation literature, which has long framed the phenomenon around obtaining, integrating, and commercialising knowledge beyond firm boundaries (West & Bogers, 2014).

A major contribution of the present study lies in showing that the field remains strongly performance- and capability-oriented. The prominence of keywords such as *performance*, *research and development*, *absorptive capacity*, *knowledge*, *collaboration*, and *technology* indicates that open innovation in SMEs is still largely interpreted through a resource- and capability-based lens. This is highly consistent with prior empirical work. Parida et al. (2012) showed that different inbound open innovation activities benefit different innovation outcomes,

while Spithoven et al. (2010) and Spithoven et al. (2013) emphasized absorptive capacity as a key precondition for organizing and benefiting from inbound openness, especially in resource-constrained firms. In a similar vein, Popa et al. (2017) demonstrated that innovation climate positively supports both inbound and outbound open innovation and that both forms contribute positively to firm performance. Singh et al. (2021) further reinforced this line of argument by showing that top management knowledge value and knowledge-sharing practices strengthen open innovation and, through it, organizational performance. Accordingly, the current keyword structure suggests that the field has not moved away from its core concern with SME competitiveness; rather, it has deepened the explanation of *how* external openness translates into improved innovation and organizational outcomes.

At the same time, the thematic evolution analysis indicates that the field is undergoing an important shift from foundational and operational issues towards more contextualized and contemporary concerns. Earlier themes such as *firm performance*, *manufacturing*, *outbound*, *strategy*, and *systems* reflect a stage in which scholars were mainly concerned with defining open innovation in SMEs, identifying its motives and barriers, and testing its effects on innovation outputs.

By contrast, the more recent emergence of themes such as business models, eco-innovation, and China provides analytical evidence of how exogenous shocks-such as the COVID-19 pandemic and global sustainability mandates-have redirected the research agenda. The shift towards "eco-innovation" reflects an increasing awareness that open innovation is an essential mechanism for SMEs to achieve circular economy goals, while the focus on "business models" underscores the realization that technological openness must be accompanied by value-capture mechanisms to be profitable.

This interpretation is fully in line with van de Vrande et al. (2009), Lee et al. (2010), and Brunswicker and Vanhaverbeke (2015), who concentrated on motives, management challenges, intermediary mechanisms, and external knowledge sourcing strategies. By contrast, the more recent emergence of themes such as *business*, *eco-innovation*, *empirical evidence*, *models*, and *China* suggests that the field is becoming more application-driven, geographically diversified, and sensitive to digital and sustainability transitions. This evolution corresponds closely to Cenamor et al. (2019), who linked digital platform capability and network capability to SME performance, and to Scuotto et al. (2017), who examined how SME innovation processes are shifting towards digital business. More generally, Bogers et al. (2018) identified digital transformation as one of the key contemporary trends reshaping open innovation research, while Sabando-Vera et al. (2022) found that the intellectual structure of open innovation in SMEs increasingly revolves around firm performance, R&D networks, business management, business models, capabilities, and knowledge transfer. In this sense, the present findings suggest that the field is evolving from a focus on whether SMEs adopt open innovation to a more nuanced interest in how openness is configured in digitally mediated and sustainability-oriented business environments.

The country analysis also provides an important insight into the geography of knowledge production in this field. The strong presence of Italy, the United Kingdom, Spain, France, Portugal, Germany, and Belgium confirm the continued dominance of Europe, while the major roles of China and South Korea point to a strong East Asian contribution.

This geographic concentration can be analytically explained by underlying policy frameworks. The European dominance is heavily driven by institutional funding schemes (such as the EU's Horizon 2020 and Horizon Europe programs) that explicitly mandate SME collaboration with universities and cross-border partners, structurally embedding open innovation into the European SME fabric. Conversely, the rise of China and South Korea reflects aggressive state-backed investments in technology parks and innovation clusters designed to integrate local SMEs into global tech supply chains.

This pattern is broadly consistent with the earlier Web of Science-based study of Odriozola-Fernández et al. (2019), who found that the UK, Italy, South Korea, and Belgium were among the

leading contributors and that European countries clearly dominated the field. However, the present results also indicate a stronger rise of China and a more visible multi-polar structure than earlier studies reported, suggesting that the field has become more internationally diffused over time. The collaboration map strengthens this interpretation by showing that international research is organized around a limited number of hubs, especially the United Kingdom, Italy, the United States, China, and India. This core-periphery structure is theoretically coherent with the SME open innovation literature, which has long stressed the importance of networks, intermediaries, and collective capability-building for smaller firms facing internal resource constraints (Lee et al., 2010; Spithoven et al., 2010). Thus, the international collaboration structure identified here is not merely a bibliometric pattern; it also reflects the substantive logic of open innovation itself, namely that value creation increasingly depends on cross-boundary linkages and collaborative knowledge exchange.

Overall, the discussion suggests that the literature on open innovation in SMEs has developed along a coherent but increasingly diversified trajectory. The field began with foundational efforts to demonstrate that SMEs also engage in open innovation and to explain the motives, barriers, and organizational implications of such openness. It then expanded towards performance-oriented and capability-based explanations, particularly around absorptive capacity, knowledge sharing, and collaboration. More recently, it has entered a new phase characterized by digitalization, business model concerns, eco-innovation, and broader empirical validation across countries and contexts. Therefore, the present study not only confirms the core pillars already identified in previous research but also shows that the field is becoming more mature, more international, and more closely connected to contemporary strategic challenges faced by SMEs.

4. CONCLUSIONS

This bibliometric study mapped the development of research on open innovation in SMEs over the period 2009–2025. The findings show that the field has evolved into a well-established and increasingly dynamic research domain, characterized by steady growth in scientific production, a relatively high citation impact, and a collaborative authorship structure. Although literature remains dispersed across a wide range of journals, it is clearly anchored in a limited number of high-impact sources, particularly those specializing in innovation, technology management, and business research. This confirms that open innovation in SMEs has developed as an interdisciplinary field situated at the intersection of innovation studies, strategic management, and entrepreneurship.

The analysis also demonstrates that the intellectual structure of the field is built around a small number of highly influential publications that have shaped its conceptual and empirical foundations. In particular, the most cited documents reveal that the field initially focused on explaining the motives, forms, and managerial challenges of open innovation in SMEs, before expanding towards performance-related issues, knowledge sourcing, absorptive capacity, and collaboration. More recent developments indicate a growing interest in digital platforms, business models, eco-innovation, and context-specific applications, showing that the field is becoming more diversified and better aligned with contemporary business transformations.

From a geographical perspective, the results reveal a strong concentration of scientific production in a limited number of countries, with a particularly prominent European contribution, alongside the increasing role of Asian countries such as China and South Korea. International collaboration is structured around a small number of central hubs, suggesting that the field is characterized by a core-periphery knowledge network. This finding highlights the importance of cross-border collaboration in advancing the field and suggests that international partnerships remain a key mechanism for knowledge diffusion and scholarly visibility.

The thematic analysis further confirms that open innovation, SMEs, and performance constitute the core pillars of the literature, while research and development, absorptive capacity, knowledge, collaboration, and technology represent its most important supporting themes. At the same time, the thematic evolution analysis shows that the field has moved from a more foundational and operational orientation towards a broader agenda

that increasingly incorporates sustainability, business model innovation, and empirical contextualization. This thematic shift reflects the growing maturity of the field and its capacity to respond to emerging managerial and societal challenges.

From a theoretical standpoint, this study contributes to the literature by demonstrating how the conceptualization of open innovation in SMEs has transitioned. It advances the resource-based view (RBV) and dynamic capabilities theory by revealing that open innovation is no longer viewed merely as a compensatory mechanism for resource-poor SMEs, but as a proactive, endogenous dynamic capability essential for navigating digital transformation and sustainability transitions. By mapping the thematic shift towards eco-innovation and digital business models, this study provides scholars with a clear roadmap of where the theoretical frontiers of SME open innovation currently lie.

In practical terms, the findings offer actionable insights for SME managers and policymakers. For SME managers, the persistence of "absorptive capacity" as a dominant keyword signals the imperative to invest in internal human capital and knowledge-sharing routines; external partnerships will fail if the internal capacity to assimilate knowledge is weak. For policymakers, the core-periphery geographic collaboration map underscores the need to design inclusive innovation policies. Governments should foster intermediate platforms and digital clusters that help peripheral SMEs connect with global innovation hubs, thereby democratizing access to open innovation networks.

Looking forward, several promising avenues for future research emerge from this bibliometric mapping. First, as the literature increasingly intersects with digitalization, future empirical studies should investigate how Artificial Intelligence (AI) and blockchain technologies alter the cost and mechanisms of inbound and outbound open innovation for SMEs. Second, given the rising prominence of eco-innovation, scholars should explore the role of open innovation in accelerating SMEs' transition toward the circular economy. Finally, to overcome the geographic concentration identified in this study, future research must prioritize comparative analyses of open innovation practices in emerging economies, exploring how institutional voids and informal networks shape SME collaboration outside the dominant Euro-Asian clusters.

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