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Unveiling the Role of Digital Innovation in Women's Entrepreneurial Ecosystem: A Bibliometric Perspective

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ABSTRACT

This study aims to analyze the interwoven relationship between digital innovation, entrepreneurial ecosystems, and the role of women-led businesses in driving innovation. By retrieving 533 academic papers published between 1987 and 2023, a bibliometric analysis was conducted. This study tries to unravel research trends, influential authors, seminal papers, and emerging themes of the field. Using advanced visualization tools, the study maps the intellectual structures of this field. The findings highlight both opportunities and challenges that women entrepreneurs face in general. It is observed that technology opens doors to new markets, resources, and business models. At the same time, it also brings forth some challenges like access to funding, digital literacy, and systemic biases. By identifying the gaps in the existing literature, this study provides a blueprint for future research. In conclusion, the study also reflects on the real-life success story.

KEYWORDS: Entrepreneurial Ecosystem, Digital Innovation, Women Entrepreneurship, Bibliometric Analysis, Economic Development

TRACK 7: Entrepreneurship

WORD COUNT: Summary (140 words) and Body of the Paper excluding Tables and References (5101)

1. INTRODUCTION

The digital revolution, a transformative force driven by the widespread adoption of technology, is reshaping society and fostering innovation. Over the past decade, this revolution has dramatically altered the entrepreneurial ecosystem (EE), sparked innovation and created new opportunities for entrepreneurs of all genders (Olsson and Bernhard, 2021). This transformation is urgent and significant, as it enables businesses to grow and compete on a global scale. Digital innovation is the integration of digital technologies into business models, processes, and products. It acts as the linchpin that allows businesses to outperform their competitors and gain a competitive edge in the 21st century (Yoo et al., 2010). Key technologies such as big data analytics, AI (Artificial Intelligence), blockchain technology, and IoT (Internet of Things) are revolutionizing sectors and opening up new possibilities for entrepreneurs (McKinsey Global Institute, 2013).

The entrepreneurial ecosystem (EE) is a web of interconnected components that play a pivotal role in supporting the growth and survival of businesses (Spigel, 2017; Stam, 2015). This interconnectedness, which spans cultural, social, and material attributes, provides a sense of community and support to the entrepreneurs. It encompasses a diverse range of stakeholders, including investors, mentors, incubators, accelerators, universities, government agencies, and other support organizations, all of whom contribute the necessary resources and support for entrepreneurs to innovate and create new ventures (Isenberg, 2010). This robust support system fosters a sense of belonging and confidence in entrepreneurs, reassuring them that they are not alone in their journey of innovation.

In this rapidly evolving landscape, women entrepreneurs play an increasingly significant role, as they contribute to economic growth, job creation, and innovation (Hughes et al., 2012; Jennings and Brush, 2013). Yet, it is observed through the literature they are treated secondary to men and are often underrepresented. This is mainly due to the unique challenges rooted in structural and cultural barriers that hinder the full potential of women entrepreneurs in the EE (Noguera et al., 2013; Wang et al., 2019). Additionally, barriers like limited access to capital, gender-related stereotypes, and restricted networking opportunities (Basaffar et al., 2018; Brush, 1992) hinder their performances. Recognizing the importance of their contributions, there is an urgent need to understand the experiences and challenges faced by women entrepreneurs in tech-based innovation. This understanding is crucial for developing more inclusive policies and a supportive environment that can help women entrepreneurs overcome these challenges and thrive in the digital revolution.

Against this backdrop, this study aims to achieve several key objectives. First, it seeks to identify the key trends and emerging themes in literature. Second, it aims to determine the most influential authors and publications shaping this field of research, thereby identifying the foundational and emerging scholarly work. Lastly, the study highlights the primary challenges and opportunities for WEs in leveraging digital innovation within the EE. This research seeks to contribute to the ongoing discourse and guide best practices in the field by addressing the objectives.

2. METHODOLOGY

To achieve the following objectives listed above, a bibliometric analysis is conducted. This allows for a systemic and quantitative review of existing literature on digital innovation, entrepreneurial ecosystem, and women entrepreneurship. The data was retrieved from the Scopus database due to its extensive coverage of high-quality, peer-reviewed academic literature.

2.1. Data Collection and Search Strategy

The data retrieval process involved constructing a comprehensive search query using relevant keywords and Boolean search operators to ensure a broad yet targeted selection of articles. The search query used in the study is “(TITLE-ABS-KEY("digital innovation" OR "digitalization*" OR "innovation*" OR "tech* based innovation" AND "entrepreneurial ecosystem" OR "women entrepreneur" or "female entrepreneur") AND PUBYEAR > 1986 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA,"BUSI") OR LIMIT-TO (SUBJAREA,"SOCI") OR LIMIT-TO (SUBJAREA,"ARTS")) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (SRCTYPE,"j")) AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (LANGUAGE,"English")))”. After applying several filters (in context to subject area, document type, publication stage, source type, language, and publication year), 533 articles were taken into account for the bibliometric study (quantitative review).

2.2 Screening and Selection Criteria

A stepwise approach was adopted to refine the search results and ensure the inclusion of the most appropriate research articles for the study. The initial search (on July 9, 2024) yielded 1,160 documents, which were then screened based on inclusion and exclusion criteria. The filtering process is detailed in Figure 1. Through the rigorous selection process, a final dataset of 533 journal articles was obtained for the study.

Identification	Database and Search String		
	Database: “SCOPUS”	TITLE-ABS-KEY (“digital innovation” or “digitalization*” or “innovation*” or “tech* based inclusion” AND “entrepreneurial ecosystem” or “women entrepreneur” or “female entrepreneur”)	1160 documents were obtained in search results
Screening	Inclusion & Exclusion Criteria		
		LIMIT-TO (SUBJECT AREA, "Business, Management & Accounting," "Social Sciences," and "Art and Humanities")	987 documents remained after this criterion
		LIMIT-TO (DOCUMENT TYPE, “Article”)	658 documents remained
		LIMIT-TO (PUBLICATION STAGE, “Final”)	625 documents remained
		LIMIT-TO (SOURCE TYPE, “Journal”)	622 documents remained
		LIMIT-TO (LANGUAGE, “English”)	606 documents remained
Included		LIMIT-TO (PUBLICATION YEAR, “1987-2023”)	533 documents for final review
		The final number of articles used for bibliometric analysis	533 articles

Figure 1: Screening and Selection Process for Bibliometric Analysis

2.3. Data Analysis Approach

To analyze the collected data, VOSviewer (VOSviewer_1.6.20_exe) software (Van Eck and Waltman, 2010) and Biblioshiny (RStudio version 2024.12.1+563) software (Aria and Cuccurullo, 2017) were employed. This tool is widely used in bibliometric studies to visualize relationships within academic literature. The following bibliometric parameters were examined:

- Co-occurrence Keywords
- Overlay Visualization of Keywords
- Co-authorship Countries
- Bibliographic Coupling (Sources)
- Density Visualization (Bibliographically Coupled Sources)
- Co-citation Cited Authors
- Co-citation Cited Reference
- Reference Spectroscopy
- Thematic Mapping

Additionally, content analysis was performed to supplement the bibliometric findings. This qualitative approach provided deeper insights into the challenges and opportunities for WEs in digital innovation. The integration of both quantitative bibliometric analysis and qualitative content analysis ensures a comprehensive understanding of the research landscape, enabling the formulation of well-informed policy recommendations.

3. RESULTS & DISCUSSION

3.1. Descriptive Statistics

Figure 2. represents the growing trend in academic publications related to the intersection of “Digital Innovation”, “Women Entrepreneurs”, and “Entrepreneurial Ecosystem” over time. The x-axis (Year) shows the publication years from 1987 to 2023, while the y-axis (No. of Documents) indicates the number of published documents each year. The key observations from the graph are:

(a) In the early years (1987-2013): There were very few documents with almost negligible research output. The field was relatively unexplored.

(b) The gradual growth (2015-2018): A slight increase in the number of publications indicates growing research interest in this research domain.

(c) The significant surge (2019-2023): Here, the number of publications rapidly increased, and we can see a peak in 2023 with 123 documents. This shows a tremendous increase in scholarly interest in the topic, possibly due to increased focus on digital transformation, fintech solutions, global initiatives targeting women's entrepreneurship, and the growth of digital platforms supporting WEs or women-led businesses.

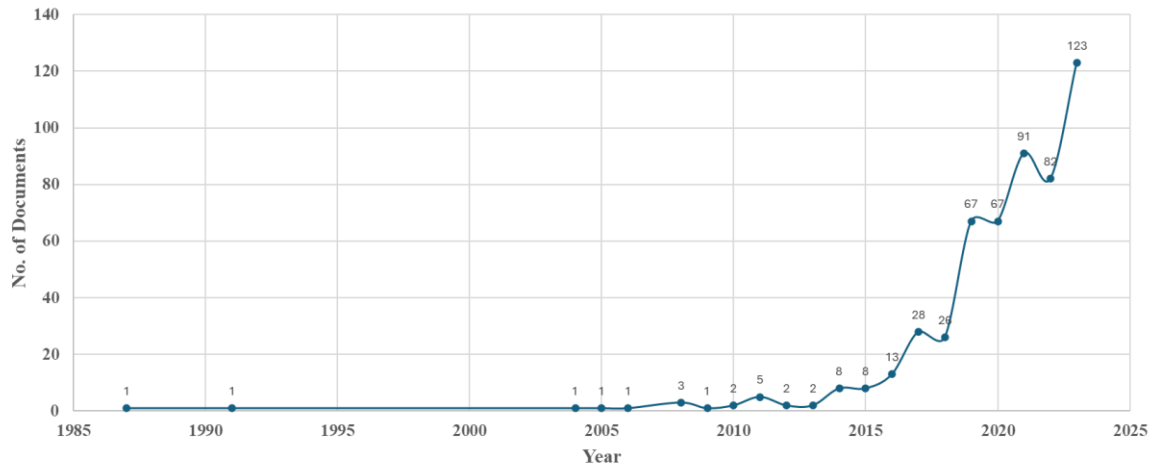


Figure 2: Document Production Over the Years

Figure 3. represents the number of academic publications in this domain across different countries. The x-axis indicates the number of papers published, while the y-axis lists the top contributing countries to this domain. The United States leads with 111 publications, indicating strong academic and policy interest in digital innovation and women's entrepreneurship. The United Kingdom is the second-largest contributor, reflecting a strong research activity in this domain. Additionally, emerging research hubs like India (45) and Italy (45) have also contributed because of India's push for women's entrepreneurship through digital platforms and Italy's focus on gender-inclusive policies and digital innovation. This graph represents a snapshot of global research trends as it highlights the dominance of Western (like the U.S. and the U.K.) research, but emerging economies like India, China, and Brazil are catching up.

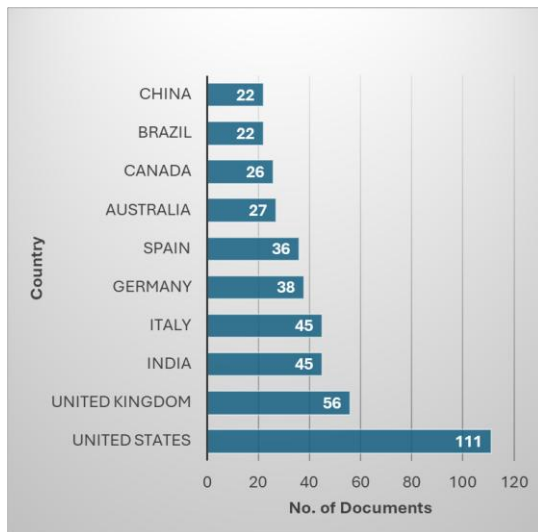


Figure 3: Leading Countries

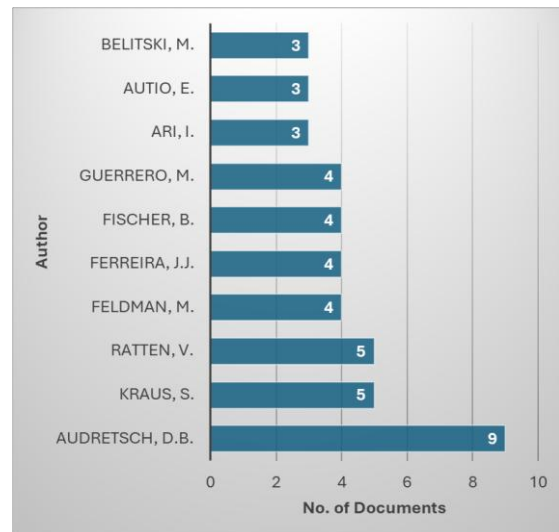


Figure 4: Leading Authors

Figure 4. lists the top contributing authors in the research domain. The x-axis shows the number of research publications by each author, while the y-axis lists the prolific authors in this field. Prof. Audretsch is the most influential author with nine documents (contributing extensively to research on entrepreneurship, innovation, and ecosystem dynamics). Followed by Prof. Kraus and Prof. Ratten with five documents each. They have major contributions, possibly in areas like digital entrepreneurship, women's participation in the business ecosystem, and policy influences.

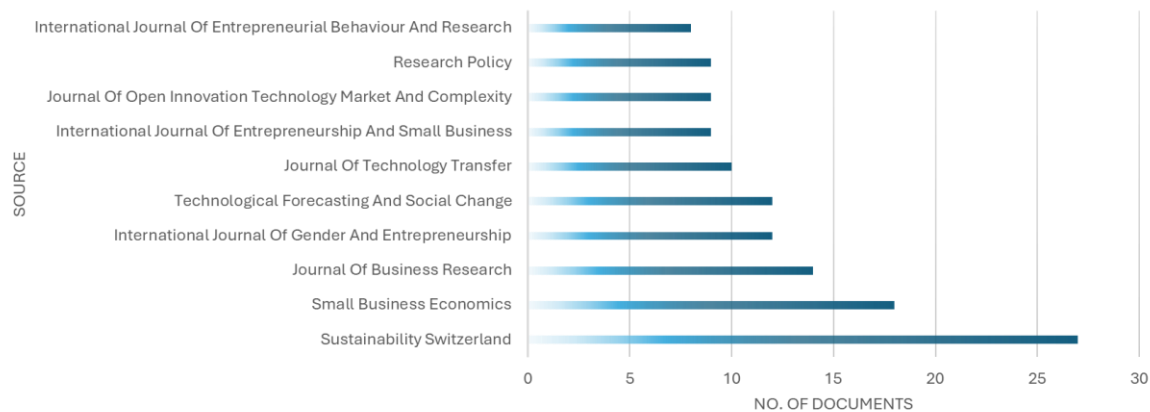


Figure 5: Leading Journals

Figure 5. represents the top academic journals publishing in this domain. The x-axis (No. of Documents) shows the number of published papers, while the y-axis lists the most active journals in the field. Sustainability Switzerland is the leading journal with 27 publications, and it has the h-index of 169. This is an international and cross-disciplinary journal with no restriction on the length and type of paper. Followed by “Small Business Economics” (well-known for its focus on entrepreneurship, SMEs, etc.) with 18 documents and “Journal of Business Research” (major focus on business and management research) with 14 documents.

3.2. Inferential Statistics

In the keyword co-occurrence (Figure 6 (a)), “Cluster 1” (red color) focuses on the key theme of “Innovation and Entrepreneurship in Emerging Economies.” This cluster emphasizes developing an understanding of different systems and networks that foster or hinder innovation and entrepreneurship, with a particular focus on regional development and sustainability. Entrepreneurial universities and innovation ecosystems are essential in fostering innovation and supporting startups. However, the rise of digital transformation and COVID-19 has directed new research areas, reflecting how crisis and technological shifts affect ecosystems (Figure 6 (b)). Cluster 2 (green color) focuses on the theme of “Policy, Development, and Performance” by highlighting the importance of strategic initiatives in fostering entrepreneurship and improving performance metrics. The role of policy initiatives is relevant in the entrepreneurial environment, and they are well-recognized, as they can support the disadvantaged section of society, particularly women's entrepreneurship, in stimulating innovation and economic development. Lastly, cluster 3 (blue color) focuses on “Gender, Technology, and Education,” and this intersection develops an understanding of gender dynamics in entrepreneurship and how education acts as a bridge to support diverse entrepreneurial ventures. It is increasingly studied, focusing on empowering women entrepreneurs and ensuring gender equality is essential.

The growing body of research in this area emphasizes the importance of human capital as an essential element in equipping individuals with the necessary skills. Additionally, keywords like digital transformation, women empowerment, sustainable development, COVID-19, and technology transfers are trending topics in the field. This trend is reflected in the overlay visualization, which shows the evolution of research themes over time. The color gradient indicates the progression of research focus, with recent studies (marked in yellow and green) shifting toward emerging themes. Moreover, resilience (Figure 6 (b)) is becoming a key area in the context of global crisis, and it is also featured as an emerging theme. Research increasingly focuses on how WEs navigate uncertainties and leverage digital tools to build sustainable and adaptive business models.

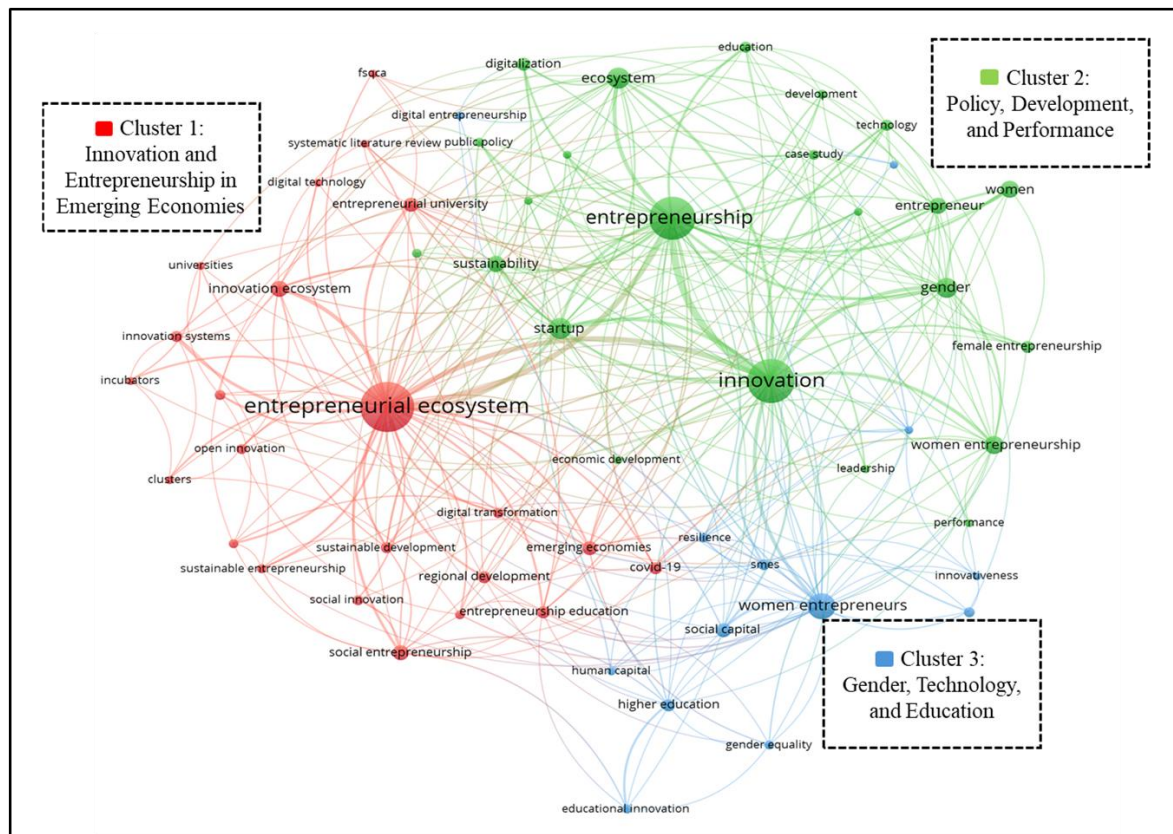


Figure 6(a): Co-occurrence Keywords

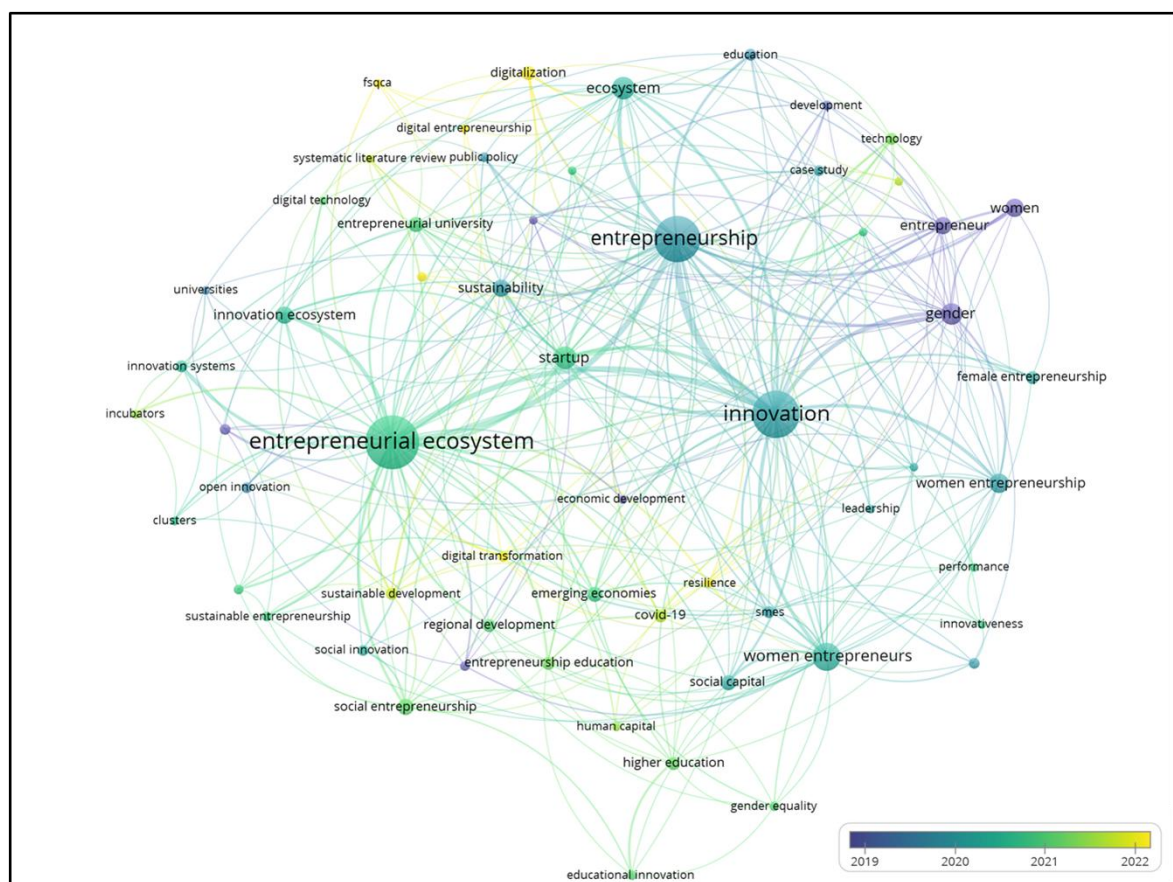


Figure 6(b): Overlay Visualization of Keywords

In this bibliometric analysis, the co-authorship pattern of countries (Figure 7) reflects the shared research interests among countries with similar research goals. 'Cluster 1 (red color)' is dominated by European countries, as well as countries such as China, South Africa, Pakistan, and New Zealand. The presence of countries other than Europe highlights the importance of WEs in the entrepreneurial ecosystem and also focuses on their significant contribution despite regional contexts. The commonality lies in their shared focus on entrepreneurial research, driven by economic development needs and the pursuit of gender equality.

The 'Cluster 2 (green color)' is a blend of North American, European, and other emerging countries, in which the United States emerged as the most influential one. This cluster shows the United States (97) has the highest total link strength. Followed by the Russian Federation (26), Brazil (22), and Canada (19). It is observed countries like the United States and Canada have strong collaboration in terms of research. The reasoning could be the geographical proximity and presence of the world's leading universities in the region. Additionally, the presence of countries like India (10), Switzerland (7), and South Korea (6) shows a growing relevance of the research in women's entrepreneurial ecosystem. Furthermore, the presence of Middle Eastern countries like Morocco, Israel, Iran, and Bahrain shows the growing significance of women entrepreneurs in Islamic countries.

The 'Cluster 3 (blue color)' is a blend of 12 countries. This mainly consists of European countries and Latin American countries. Germany tops the chart in terms of total link strength, making it the most collaborative country in the cluster. This is followed by Spain (30) and Chile (17), making a significant stride in the research domain. The reasoning could be their continued effort toward Industry 4.0, AI-driven startups, and women-led tech enterprises. Countries such as the Netherlands (14), Finland (9), Mexico (10), Sweden (8), Peru (7), and Denmark (7) exhibit a moderate collaboration level.

The 'Cluster 4 (yellow color)' presents a mix of 9 countries from different regions of the world. Australia is the leading country in the cluster. This showcases its active presence in the global research community focusing on WEs. This cluster also has a presence of Southeast Asian countries (such as Bangladesh, Malaysia, and Indonesia) alongside Middle Eastern nations (such as Saudi Arabia). This reflects the growing importance of research on women's participation in traditionally male-dominated societies. Further highlighting the growing importance of women-led businesses in both developed and developing nations.

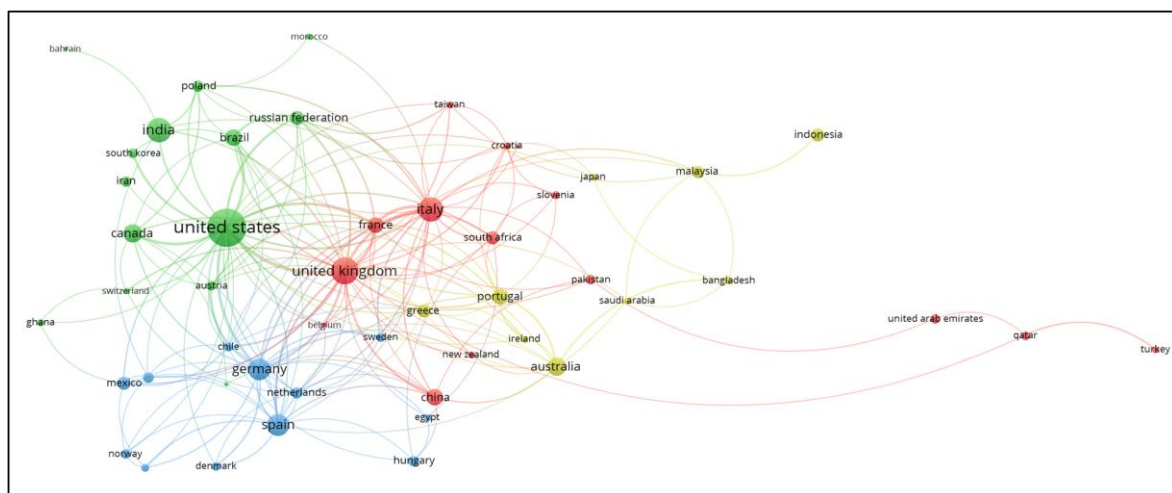


Figure 7: Co-authorship Countries

In addition to this, the average publication year was identified using the map file details of Figure 7. It represents the mean year of publication for documents associated with a particular country in the dataset, helping to identify whether the publications are more recent or older. The study shows the most recent studies are conducted in countries like Ireland (2022.5), Chile (2022), and South Africa (2021.79). While the older studies are conducted in countries like Israel (2014.5), New Zealand (2016), and Norway (2016.38).

Figure 8(a). presents the bibliographic coupling of sources (which means the strength of bibliographically coupled sources is determined by the number of shared references they have). The criteria selected for the study is the minimum number of 50 citations per source and atleast three documents per source. Based on these parameters, 37 out of 241 sources met the threshold for the study. The bibliographic coupling analysis resulted in the formation of three clusters: the first cluster consists of 16 sources, the second cluster consists of 13 sources, and the third cluster consists of 8 sources.

On the basis of the number of citations, “Journal of Technology Transfer” is the leading source with 1033 citations in Cluster 1 (red color). This is followed by “International Journal of Gender and Entrepreneurship” with 348 citations and “Entrepreneurship and Regional Development” with 258 citations. In Cluster 2 (green color), “Strategic Entrepreneurship Journal” has the highest number of citations (1442). This is followed by “Research Policy” with 1198 and “Small Business Economics” with 924. Lastly, in Cluster 3 (blue colour), “Technological Forecasting and Social Change” leads with a total of 964 citations. Followed by “Journal of Business Venturing Insights” with 700 citations and “Journal of Business Research” with 517 citations.

Figure 8(b). presents density visualization of the bibliographically coupled sources based on the “total link strength”. The analysis reveals that “Small Business Economics” (Cluster 2) has the highest link strength (3120). Followed by “Journal of Business Research” (Cluster 3) with a total of 2332 link strengths and “Sustainability (Switzerland)” (Cluster 2) with a total of 2322 link strengths. These findings reveal that the sources are among the most influential and frequently referenced within the field.

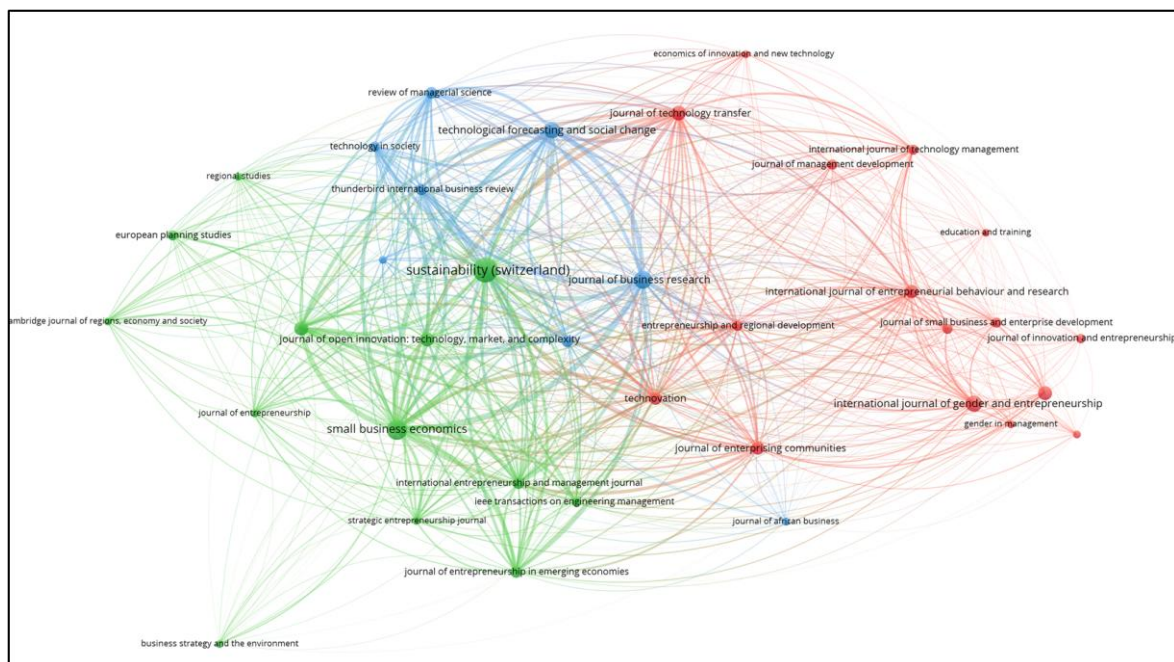


Figure 8 (a): Bibliographic Coupling of Sources

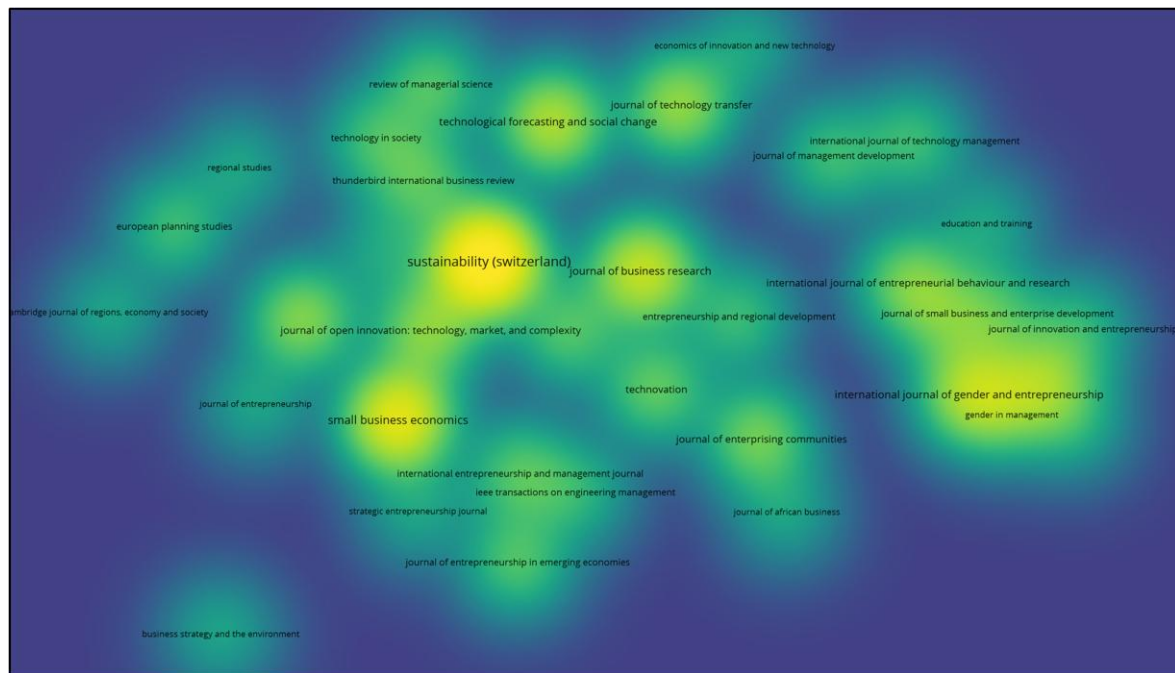


Figure 8 (b): Density Visualization of Bibliographically Coupled Sources

In this bibliometric analysis, Figure 9. presents co-citation cited authors (refers to the authors whose work is cited together by another author). There are a total of three clusters with 45 prolific authors. The first cluster (red color) comprises scholars who focus on the interrelation between digital innovation and EEs (Autio et al., 2018; Sussan and Acs, 2017). These authors are co-cited together because they provide a foundational lens to the field of EEs, which are crucial for the diffusion of digital technologies for tech-based entrepreneurship. Their work illustrates the importance of regional and global networks that ease the flow of knowledge, talent, and capital (Acs et al., 2017; Audretsch and Lehmann, 2005). For instance, Spigel (2017) highlights the role of local culture and social networks in shaping entrepreneurial outcomes, whereas Stam and Ven (2021) explore the dynamics between ecosystem actors and the regional growth of the firms. The second cluster (green color) delves into the institutional frameworks and policy mechanisms necessary for the survival of women-led businesses in the entrepreneurial ecosystem. The scholars in this cluster have primarily focused on government policies, academic institutions, and industry collaborations. This results in creating a conducive environment for entrepreneurs, including tech-based ventures (Etzkowitz and Leydesdorff, 2000; Siegel and Wright, 2015). This research is essential as it highlights how to tailor institutional support to foster digital innovation and support women entrepreneurs (Shane, 2000). For instance, a study has shown the impact of entrepreneurial education and support programs on startup success. This further highlights the need for inclusive policies that address the barriers women face in tech entrepreneurship (Fayolle and Gailly, 2015). This work is essential for developing a deep understanding of the policy and institutional dynamics that shape the EEs. Lastly, the third cluster (blue color) shows the intersection of gender and entrepreneurship in the entrepreneurial ecosystem (Brush et al., 2009; Welter et al., 2014). These authors are co-cited because of their significant contributions to understanding the gender dynamics in the entrepreneurial landscape. Additionally, they focused on the challenges and opportunities for women in entrepreneurship. The research highlights the challenges such as accessing resources, networks, and capital within EEs, particularly in tech-based innovation sectors (Brush et al., 2018; Brush et al., 2002). Several studies have discussed societal norms and gendered expectations shaping the experiences of WEs. These also advocated for inclusive

policies and practices that support women in the male-dominated tech sector (Ramadani, 2015; Ratten, 2016). This enhances women's participation and success at the same time.

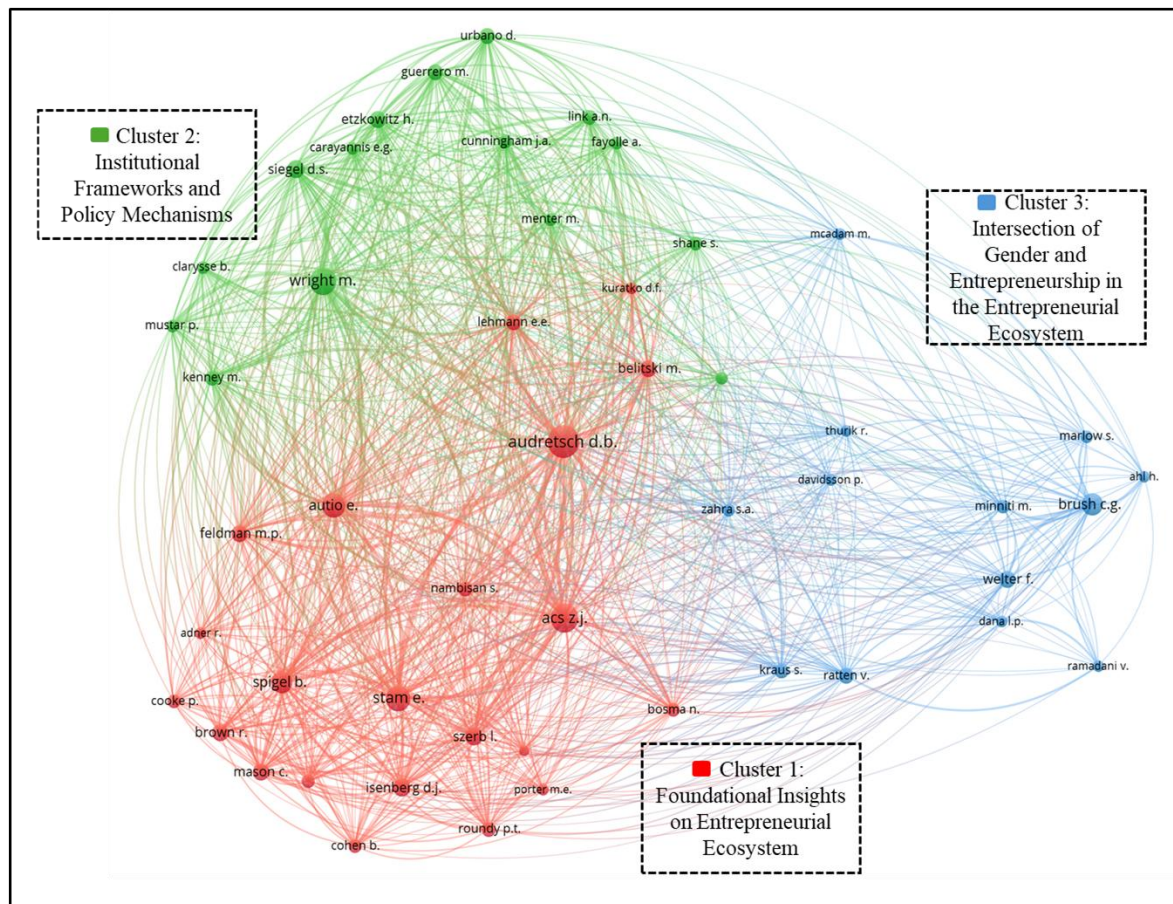


Figure 9: Co-citation Cited Authors

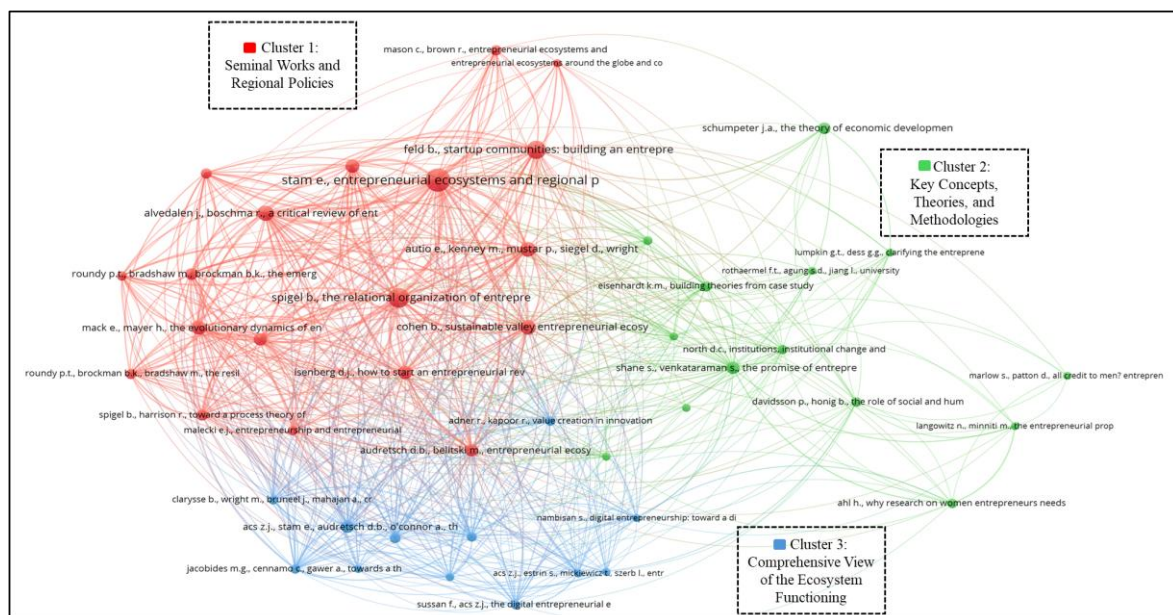


Figure 10: Co-citation Cited References

Figure 10. presents three clusters of co-citation cited references (which means scholars frequently refer to these works together). The Cluster 1 (red color) has a number of 19 documents. This cluster collectively contributes to the conceptualization, development, and analysis of entrepreneurial ecosystems. This cluster consists of seminal works by Spigel (2017), Stam (2015), Isenberg (2010), and Feld (2012) that lays the theoretical foundations of the field. Additionally, Alvedalen and Boschma (2017) critically reviewed the evolution of these theories and their real-world applications. Empirical research conducted by Ács et al. (2014) focuses on measuring EEs across diverse economic and geographic contexts. At the same time, regional and policy perspectives are examined (Cohen, 2006) by highlighting the importance of local factors. Several studies on sustainability and evolution within ecosystems are explored (Roundy et al., 2017;2018). Further, this cluster also highlights ongoing debates and future research directions, ensuring the continued advancement of the research domain (Cavallo et al., 2019).

The 'Cluster 2' (green color) consists of 14 documents. It provides a comprehensive understanding of key concepts, methodological advancements, and theories in entrepreneurship. Yin (2003) provides necessary insights into case study research, which is widely employed in the entrepreneurship domain. Seminal work by Schumpeter (1934) focuses on innovation and opportunity recognition; while North (1990) introduces the effect of institutional changes on society. This cluster also reflects on the realm of entrepreneurial orientation and knowledge spillovers, highlighting the role of strategic decision-making (Lumpkin and Dess, 1996; Acs et al., 2009). Additionally, the significance of human and social capital for gaining competitive advantage (Barney, 1991) demonstrates how resource-based perspectives shape entrepreneurial performance. Lastly, this cluster also presents gender-focused entrepreneurship research (Ahl, 2006; Marlow and Patton, 2005).

The 'Cluster 3' (blue colour) consists of 12 documents, offering a comprehensive view of the ecosystem's functioning. This cluster integrates theoretical frameworks, such as the ecological perspective on competition (Moore, 1993) and dynamic capability theory (Teece, 2007), explaining the adaptive nature of the entrepreneurial ecosystem. Additionally, it highlights that the entrepreneurial ecosystem serves as a dynamic and interconnected system that drives digital innovation (Nambisan, 2017; Sussan and Acs, 2017) and fosters economic growth (Audretsch et al., 2019). Several studies within this cluster emphasize the structural and strategic dimensions of ecosystems (Adner, 2017; Jacobides et al., 2018). Further, Autio et al. (2018) examine digital affordances and the emergence of digital entrepreneurial ecosystems.

Table I. presents the top 10 reference papers in the entrepreneurial ecosystem research, based on "total link strength" identified through co-citation analysis. Stam (2015) emerges as the most influential work. This is frequently co-cited with other foundational studies and has a total link strength of 352. This is followed by Spigel (2017), with total link strength of 313. Alvedalen and Boschma (2017) land in the third position, with total link strengths of 224. These studies have made significant contributions by offering critical perspectives on the structural and conceptual dimensions of EE.

Table I: Top Ten Papers from Co-citation Cited References

References	Cluster	Total Link Strength	Citation
stam e., entrepreneurial ecosystems and regional policy: a sympathetic critique, european planning studies, 23, 9, pp. 1759-1769, (2015)	1	352	78
spigel b., the relational organization of entrepreneurial ecosystems, entrepreneurship: theory and practice, 41, 1, pp. 49-72, (2017)	1	313	55
feld b., startup communities: building an entrepreneurial ecosystem in your city, (2012)	1	172	46
alvedalen j., boschma r., a critical review of entrepreneurial ecosystems research: towards a future research agenda, european planning studies, 25, 6, pp. 887-903, (2017)	1	224	35
autio e., kenney m., mustar p., siegel d., wright m., entrepreneurial innovation: the importance of context, research policy, 43, 7, pp. 1097-1108, (2014)	1	176	31
cohen b., sustainable valley entrepreneurial ecosystems, business strategy and the environment, 15, 1, pp. 1-14, (2006)	1	200	30
mack e., mayer h., the evolutionary dynamics of entrepreneurial ecosystems, urban studies, 53, 10, pp. 2118-2133, (2016)	1	180	27
isenberg d.j., how to start an entrepreneurial revolution, harvard business review, 88, 6, pp. 40-50, (2010)	1	149	26
acs z.j., autio e., szerb l., national systems of entrepreneurship: measurement issues and policy implications, research policy, 43, 3, pp. 476-494, (2014)	1	156	24
audretsch d.b., belitski m., entrepreneurial ecosystems in cities: establishing the framework conditions, the journal of technology transfer, 42, 5, pp. 1030-1051, (2017)	1	144	23

Reference Spectroscopy is presented in Figure 11. The black line represents the absolute number of references cited from each publication year. There has been a surge in citations since 1999, indicating that the field has gained significant academic attention in the past two decades. The red represents the deviation from the 5-year median of citations, which highlights years with significantly higher or lower citations than the ongoing trend. Further, the peaks in this line help in identifying the years when foundational works were published.

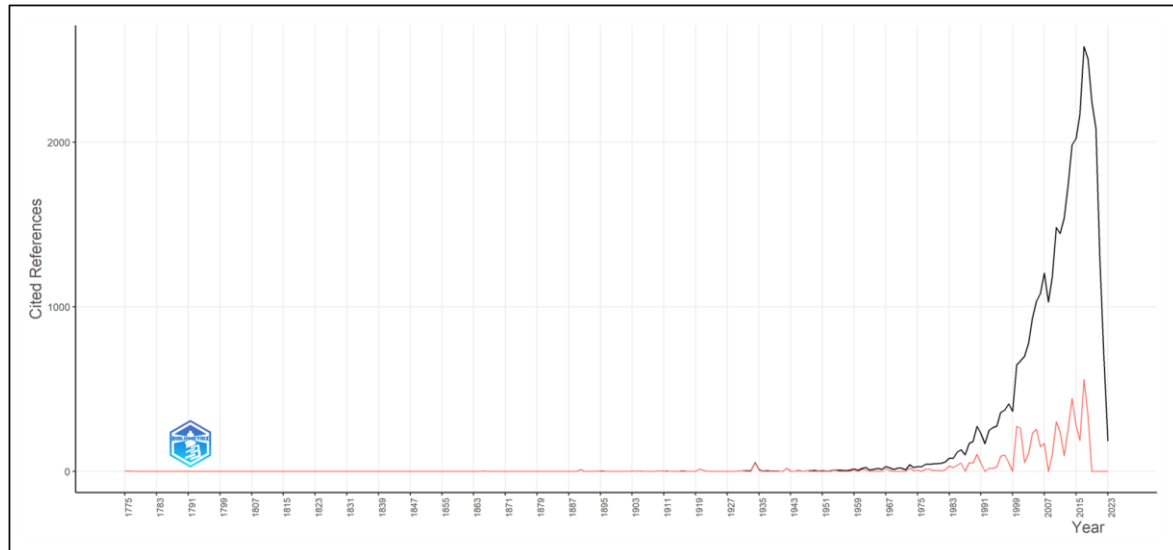


Figure 11: Reference Spectroscopy of the Study

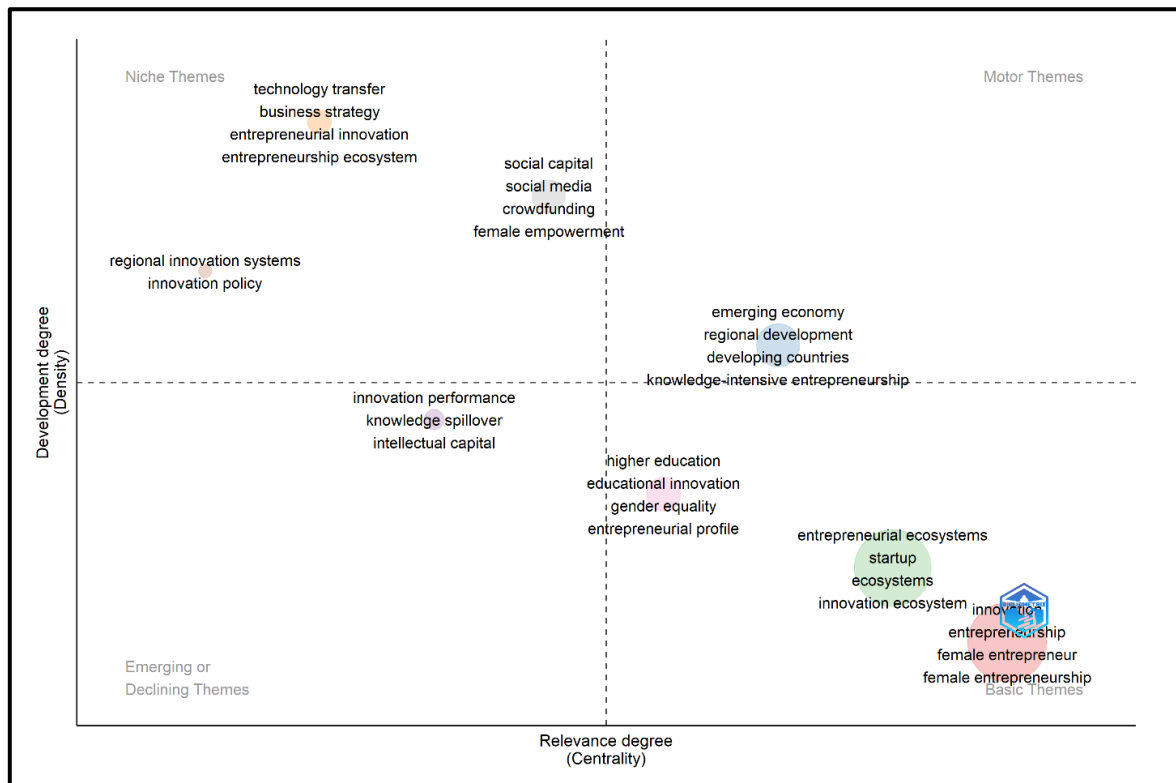


Figure 12. Thematic Mapping

In this bibliometric analysis, Figure 12 presents a thematic map using Biblioshiny (RStudio) based on the degree of relevance on the x-axis and the degree of development on the y-axis. Here, the degree of relevance reflects the centrality effect, which means measuring the connectedness of the particular theme to other themes in the research field; while the degree of development reflects the density effect, which means measuring the internal development of the theme based on the strength of connections within the theme. The mapping is based on the division of four quadrants.

The thematic map presented in this study was generated using “Author’s Keywords” with a predefined limit of 120 words. The Walktrap clustering algorithm was employed to identify different thematic clusters within the dataset. To enhance the clarity and accuracy of the

analysis, common keywords (such as education, intermediaries, rural, etc.) and country names (such as Africa, Brazil, Canada, China, etc.) were systematically removed. Additionally, a synonym file (such as Emerging Economy; Emerging Economies, Incubators; Incubator, etc.) was created to standardize the variations in terminology and to ensure consistency in the represented keywords. Through the iterative refinement process, the final thematic map was developed. This has a four-quadrant structure. The first quadrant is Motor Themes (high centrality, high density), which represent well-developed and influential research areas that drive academic progress in the field. The top keywords in this theme are emerging economy regional development, developing countries, and knowledge-intensive entrepreneurship. The second quadrant is the Basic Theme (high centrality, low density), which serves as a foundational concept in the field but may require further theoretical refinement. This includes top keywords like higher education, entrepreneurial ecosystems, startup, ecosystems, innovation ecosystem, female entrepreneurship, etc. In this quadrant, we can also see small and large clusters. The big clusters represent highly developed and widely studied themes, while the small ones highlight that they are at an early stage of academic exploration. The distance between clusters also has a significant meaning. The closer ones highlight strong conceptual or methodological connections, while the distant ones suggest weak or indirect relationships between the themes. The third quadrant is the Niche Theme (low centrality, high density), which has specialized themes with limited influence on broader research. This includes keywords such as technology transfer, business strategy, social capital, social media, regional innovation systems, innovation policy, etc. Lastly, the fourth quadrant is the emerging or declining themes (low centrality, low density). This quadrant shows that if themes emerge, they might gain importance in the future; if themes decline, they may lose relevance. This includes keywords like innovation performance, knowledge spillover, and intellectual capital.

The findings from the content analysis of this bibliometric review highlighted the varied opportunities and challenges that are faced by the WEs in the context of digital innovation. The opportunities that act as catalysts for WEs to excel are the increase in incubators and open innovation platforms, which facilitate access to resources, as well as regional development initiatives that support entrepreneurial activity. Additionally, increased social capital, improved access to educational facilities, and enhanced funding opportunities contribute to empowering WEs. However, despite these opportunities, the challenges come mid-way to hinder the progress of WEs, which prohibits them from moving forward. The challenges are the lack of income and financial independence, which refrains them from accessing the required training and education facilities. Additionally, lack of family support and gender-related biases restrict their ability to take advantage of the digital innovation in the EE.

Furthermore, the bibliometric analysis identifies four key conceptual themes that define the intersection of digital innovation and women's entrepreneurship (presented in Figure 13). Firstly, digital innovation encompasses the integration of advanced technologies to enhance entrepreneurial processes. Secondly, WEs (challenges, opportunities, and impact within the entrepreneurial landscape) are central to this research domain. Thirdly, the EE plays a critical role by providing institutional support, policy frameworks, funding mechanisms, networking opportunities, and mentorship programs. Finally, the outcome of these interactions is evident in the form of business growth, sustainability, innovation diffusion, and economic empowerment. This will eventually make a mark in achieving the Global Sustainable Development Goals and also contribute to the current corpus of literature by exploring the role of digital innovation in fostering entrepreneurial outcomes.

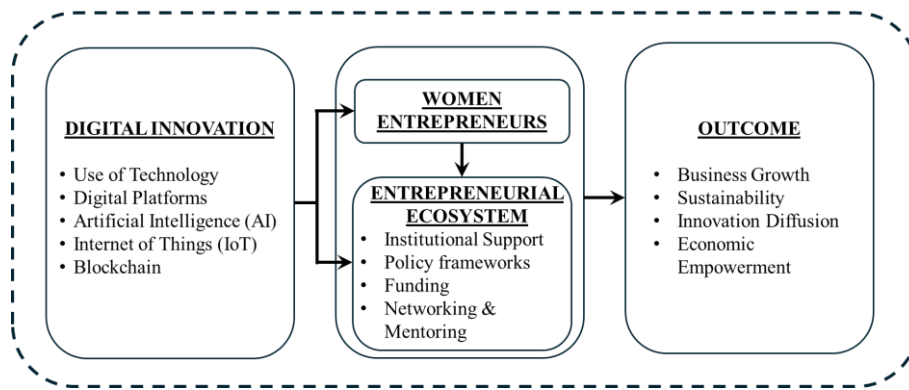


Figure 13. Author's Own

4. CONCLUSION

The bibliometric analysis used in this research highlighted how an ideal scenario can be curated for WE, where innovation, support, growth, and adaptability are interrelated, which offers immense opportunities to them, creating value for the entire society. This not only empowers the women economically but also leads to inclusivity and social sustainability. By fostering an environment that promotes digital innovation, WE can overcome structural barriers and actively contribute to achieving SDG 5. The findings indicate that digital innovation serves as a key driver of entrepreneurship by providing women with access to resources, networks, and markets that were previously difficult to navigate.

In this context, we have a notable example of WE leveraging digital innovation to build a successful venture named “Nish Hair by Parul Gulati” in India. Her brand disrupted the beauty and hair industry by utilizing digital platforms (her own website, nishhair.com), social media marketing (using Instagram, YouTube, and influencer collaboration), and e-commerce platforms (like Amazon) to connect customers directly. Parul Gulati identified a gap in high-quality and easy-to-use hair extensions in the Indian market. She immediately grabbed the opportunity and capitalized on the power of digital tools. In this way, the actress-turned-entrepreneur created an aspirational brand. Her brand has a strong online presence. This proves how digital ecosystems can help women entrepreneurs in expanding their businesses without relying on traditional retail channels. The success of the brand stretches upon the importance of digitalization, personal branding, and direct consumer engagement as key factors. From an entrepreneurial ecosystem research perspective, this case study represents how digital innovation can lower entry-level barriers for WEs. She cracked this code by reducing dependence on traditional supply chains, eliminating intermediaries, and allowing direct contact with the targeted consumers. This case also highlights how digital storytelling can play a significant role in establishing consumer trust and loyalty. However, this case study reflects some challenges like ensuring continuous engagement in this highly competitive market, overcoming societal biases, and navigating issues related to operational efficiency that are common for women entrepreneurs in digital innovation. Future studies could investigate case studies such as “Nish Hair” to gain insights into the long-term impact of digital innovation on women-led businesses. Further, the case studies can measure the global impacts of tech-based businesses led by women.

The bibliometric findings provided insights into the thematic mapping, co-cited authors, co-cited references, and keywords used that shape the discourse around women entrepreneurship in the digital era. The findings paved the way for inferring the challenges and opportunities faced by WE in digital innovation. The study also underscores the importance of

entrepreneurial ecosystems, policy frameworks, and digital transformation in shaping the future of women entrepreneurs.

From a policy perspective, the study provides valuable insights for government, academicians, policymakers, and industry stakeholders aiming to create a more enabling environment for women entrepreneurs. This study highlights the need for targeted interventions such as financial inclusion initiatives, digital literacy programs, and mentorship networks that can bridge the gender gap in entrepreneurship, as we are five years away from 2030. Policymakers can utilize these findings to design support mechanisms tailored to the unique needs of women-led businesses, ensuring equitable access to funding, technology, and market opportunities. Further, academicians can benefit from this study, as it offers a comprehensive view of existing literature. This study carves ways for scholars to explore new dimensions, such as the role of artificial intelligence, blockchain technologies, and big data in shaping women-owned enterprises. The findings also call for an interdisciplinary study integrating perspectives from business, technology, gender studies, and economic development. For industry stakeholders, this study emphasizes the importance of corporations, incubators, and accelerators to design targeted programs that support WEs in scaling their businesses. Encouraging collaborations can further drive innovation and market competitiveness.

Despite the fact this research provides significant insights, there remains a considerable scope for future research. Further research can expand this analysis to enrich the understanding of WE in the digital innovation landscape by utilizing additional databases such as Web of Science, Science Direct, and Google Scholar. The study solely focuses on final published articles from the journal category. Only articles written in English were taken into consideration. Keeping this in the picture, future studies can expand their horizons using these bibliometric trends across different linguistic and cultural contexts. Additionally, longitudinal studies could provide deeper insights into the same. Comparative studies across different cultural and economic settings would help shed light on how women's entrepreneurship is shaping up in the digital era.

In addition to this study, qualitative research methods like case studies, in-depth interviews, and ethnographic studies can offer a deeper understanding of the lived experiences of WEs. Examining intersectional factors such as race, religion, class, ethnicity, and geography can further enrich the conversation on empowerment, diversity, and inclusion. In this way, future research can add depth and a broader perspective to the discussion.

In conclusion, this research creates a groundwork for advancing the research of women's entrepreneurship in the digital age. By building on the aforementioned findings, future research can contribute to a more accurate understanding of how digital innovation plays a role in creating more inclusive economic opportunities for women. Through continued scholarly efforts and supportive measures, women entrepreneurs can better position themselves to thrive in an increasingly digital and interconnected world.

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