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UNIFYING ECOSYSTEM PERSPECTIVES: A SYSTEMATIC LITERATURE REVIEW OF ENTREPRENEURIAL AND DIGITAL ECOSYSTEMS TO CONCEPTUALIZE THE DIGITAL ENTREPRENEURIAL ECOSYSTEM

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Abstract
This study advances the conceptualization of the Digital Entrepreneurial Ecosystem (DEE) by systematically unifying insights from entrepreneurial and digital ecosystem literatures. Through a rigorous review and bibliometric analysis, it identifies the fragmented nature of existing scholarship and synthesizes key attributes, governance, actors, resources, and digital infrastructures that define DEEs as dynamic socio-technical systems. Unlike traditional entrepreneurial ecosystems, DEEs dissolve locational barriers, enabling ventures to scale globally from inception while fostering distributed collaboration and sustainable innovation. The framework highlights how digital enablers such as platforms, boundary resources, and orchestration mechanisms reshape opportunity recognition, resource mobilization, and venture performance. It also underscores the broader socio-economic significance of DEEs, linking them to Sustainable Development Goals including decent work, reduced inequalities, and sustainable cities. Theoretically, the study clarifies definitional ambiguities and extends ecosystem theory by embedding digital governance and sustainability into its core. Practically, it provides policymakers, entrepreneurs, and institutions with a blueprint for designing inclusive, resilient, and innovation-driven ecosystems. Overall, the research positions DEEs not as peripheral extensions but as a central paradigm in contemporary entrepreneurship, offering both conceptual clarity and actionable guidance for shaping entrepreneurial futures in the digital age.

INTRODUCTION

Entrepreneurship scholarship has long recognized ecosystems as a powerful lens to understand the interdependent networks of actors, institutions, and resources that shape entrepreneurial activity (Rawan et al., 2025; Wibisono, 2023). The entrepreneurial ecosystem perspective emphasizes the socio-economic, cultural, and institutional conditions that enable or constrain venture creation and growth (Sahut et al., 2019), often with a strong focus on regional proximity and localized knowledge bases (Wadichar et al., 2022). In parallel, the rise of digital technologies has given birth to the digital ecosystem discourse, which examines how platforms, infrastructures, and digital artifacts reconfigure interactions among firms, users, and institutions (Senyo et al., 2017; Audretsch & Belitski, 2016). These two

streams of literature have matured largely in isolation, yet their intersection has produced a nascent construct: the digital entrepreneurial ecosystem.

The digital entrepreneurial ecosystem (DEE) can be understood as an embryonic child of entrepreneurial and digital ecosystems, combining the socio-economic foundations of entrepreneurship with the technological affordances of digitalization (Zhang et al., 2022; Elia et al., 2020). This convergence is not merely additive; it reshapes entrepreneurial opportunities, alters resource mobilization, and redefines boundaries by enabling ventures to scale globally from inception. As Bejjani et al. (2023) note, "research on DEEs is still dispersed, and there exists ambiguity in this relevant field." Despite growing scholarly interest, the literature remains fragmented (Alzamel, 2024; Bejjani et al., 2023; Wibisono, 2023; Li & Yao, 2021), with studies variously emphasizing digital platforms, entrepreneurial networks, or innovation ecosystems without a unified conceptual framework.

Early contributions, such as Sussan and Acs (2017), located digital entrepreneurship within the context of users, platforms, and institutions, later refined by Song (2019) into four dimensions: digital user citizenship, digital technology entrepreneurship, digital infrastructure governance, and digital multisided platforms. Other scholars have examined DEEs through case studies (e.g., Du et al., 2018) conceptualized them as collective intelligence systems (Elia et al., 2020). Yet, as the systematic review by Bejjani et al. (2023) demonstrates, these perspectives remain heterogeneous, leading to conceptual ambiguity and limited coherence in the field.

A systematic literature review (Hassan et al., 2026; Secundo et al., 2020) is therefore essential to unify ecosystem perspectives and provide a coherent foundation for conceptualizing the DEE. By synthesizing insights from entrepreneurial ecosystem studies and digital ecosystem research, this review seeks to identify commonalities, divergences, and complementarities that define the digital entrepreneurial ecosystem. Such integration will not only clarify the theoretical underpinnings of DEEs but also highlight their practical significance in shaping entrepreneurial futures, particularly in contexts where digital infrastructures are rapidly expanding. The conceptual framework proposed by Bejjani et al. (2023) illustrates this need, presenting ecosystem attributes such as governance, actors, and resources, and showing how digitalization introduces new forms of autonomy, collaboration, and resource sharing.

Ultimately, this study positions the digital entrepreneurial ecosystem as a nascent but transformative construct, one that reflects the ongoing evolution of entrepreneurship in the digital age. By unifying perspectives across ecosystem literatures, it provides a roadmap for future research and practice, ensuring that the DEE is understood not as a peripheral extension but as a central paradigm in contemporary entrepreneurship. This systematic review thus contributes to conceptual clarity, theoretical advancement, and practical relevance, offering a foundation upon which scholars and policymakers can build to harness the potential of digital entrepreneurial ecosystems.

Literature Review

Entrepreneurial Ecosystem

The concept of the **entrepreneurial ecosystem** (EE) emerged in the 1980s and 1990s as scholars began to move beyond individual entrepreneurs to consider the interconnected networks of actors, institutions, and resources that collectively support venture creation and growth. Early analogies to biological ecosystems (Moore, 1993) emphasized complexity, interdependence, and non-linear evolution. Subsequent definitions highlighted systemic conditions such as networks of entrepreneurs, leadership, finance, talent, knowledge, and support services (Stam & Spigel, 2018), as well as the role of policy, culture, and markets (Isenberg, 2010). Brown and Mason (2014) described EEs as "sets of interconnected entrepreneurial actors, organizations, institutions and processes which coalesce to govern performance within the local entrepreneurial environment."

Recent systematic reviews confirm that the EE literature remains fragmented, with definitional ambiguities and inconsistent frameworks across regions. Wadichar et al. (2022) found that most EE studies are conceptual, with limited empirical grounding, and that theoretical underpinnings are often absent, and nearly half of reviewed papers lacked a specified theory. Where theory is applied, social capital, social network, and institutional perspectives dominate. Their review also highlighted geographic imbalances: most EE research is concentrated in the US and Europe, with relatively few studies in Asia and Africa, leaving gaps in understanding how ecosystems function in resource-constrained or institutionally weak contexts.

Building on this, Miah et al. (2025) traced the evolution of EEs into **digital entrepreneurship ecosystems (DEEs)**, noting that traditional EE frameworks often fail to capture the dynamics of digital transformation. They argue that while EEs historically emphasized local embeddedness, digitalization dissolves locational barriers and enables global connectivity. Their bibliometric and topic modeling analysis of 1,234 articles identified six latent themes in EE/DEE research: (1) digital entrepreneurship in academia, (2) women's entrepreneurship and gender roles, (3) ecosystem innovation, (4) government policy and economic strategy, (5) social entrepreneurship and sustainability, and (6) startup innovation and incubation. They propose the **Quadruple Helix Model (QHM)**, integrating academia, government, industry, and civil society, as a comprehensive framework to foster inclusivity, innovation, and sustainability in ecosystems.

The broader literature also stresses that ecosystems are dynamic and context-dependent. Cantner et al. (2020) proposed lifecycle models to compare ecosystems across industries and regions, while Colombelli et al. (2017) highlighted governance shifts from hierarchical to relational forms as ecosystems expand. These perspectives reinforce the idea that ecosystems evolve through phases of emergence, growth, and maturity, shaped by institutional and cultural contexts. Guerrero et al. (2021) further argued that well-configured ecosystems contribute to economic development by supporting innovative, high-growth ventures, while simultaneously advancing social and environmental well-being. This aligns with the growing emphasis on sustainable entrepreneurial ecosystems, which balance economic growth with the triple bottom line of social and environmental goals.

Taken together, these insights portray entrepreneurial ecosystems as complex, adaptive systems that foster innovation, venture creation, and regional development. Yet, they remain conceptually fragmented, with definitional ambiguities, theoretical gaps, and limited empirical validation. The literature also reveals significant geographic and contextual disparities, particularly in developing economies where institutional voids, resource constraints, and policy inconsistencies hinder ecosystem development. Addressing these gaps requires stronger theoretical integration, methodological diversification, and frameworks that incorporate inclusivity and sustainability. By consolidating these perspectives, scholars can move toward a more coherent and globally relevant understanding of entrepreneurial ecosystems, especially in context of DEE, ensuring they are not only engines of economic growth but also vehicles for social equity and long-term resilience.

Digital Ecosystem

The concept of digital ecosystems has emerged as a socio-technical framework where individuals, organizations, and technologies interact to co-create value. Early work drew on biological analogies (Moore, 1993; Iansiti & Levien, 2004a, 2004b), emphasizing interdependence, adaptability, and co-evolution. In business contexts, ecosystems were initially understood as economic communities of loosely coupled actors producing goods and services (Moore, 1996), later extended into digital environments where platforms mediate collaboration and competition (Nachira et al., 2007; Briscoe & de Wilde, 2006).

Mukhopadhyay and Bouwman (2019) highlight governance and orchestration as central challenges in platform ecosystems. They identify five aspects of governance design, ecosystem architecture, coordination mechanisms, value co-creation, value

appropriation, and architectural principles, that platform leaders must balance. Their review shows that traditional governance models based on principal–agent relationships (Tiwana et al., 2010; Jansen & Cusumano, 2013) are insufficient for multi-industry ecosystems where complementors are not formally contracted (Gulati et al., 2012). Instead, alternative theories such as resource dependency (Ulrich & Barney, 1984; Mukhopadhyay et al., 2015), collective action (Nikayin et al., 2013; de Reuver et al., 2015), and boundary resources (Ghazawneh & Henfridsson, 2013) have been applied to explain how control and collaboration are managed.

Senyo et al. (2019) define digital business ecosystems (DBEs) as socio-technical environments where digital infrastructures enable collaborative value creation across industries. They emphasize four defining characteristics: platforms as enablers of collaboration (Selander et al., 2013), symbiosis among actors (Senyo et al., 2017), co-evolution in response to opportunities and threats (Peltoniemi, 2006), and self-organization through learning and adaptation (Adner, 2006). DBEs rely on both organized long-term alliances and ad-hoc collaborations (Camarinha-Matos & Afsarmanesh, 2008), illustrating their dynamic and flexible nature.

Koch et al. (2022) address the definitional ambiguity surrounding digital ecosystems. They note the proliferation of related terms, platform ecosystems (Parker et al., 2016; Hein et al., 2018), software ecosystems (Jansen et al., 2009; Manikas & Hansen, 2013), and the sharing economy (Schor & Cansoy, 2019; Sundararajan, 2013), and warn against the "everything-is-an-ecosystem" effect. To resolve this, they propose seven key properties: servitization (Cusumano, 2015; Hein et al., 2019), network effects (Rong et al., 2018; Kenney et al., 2019), shifts in value creation (Frenken & Schor, 2017; Jansen & Bloemendal, 2013), winner-takes-all dynamics (Bosch, 2009; Cusumano, 2017), openness (Schreieck et al., 2016), collaboration (Basole et al., 2015), and efficient use of idle assets (Hawlitschek et al., 2016). These criteria provide a more rigorous foundation for distinguishing true digital ecosystems from loosely related systems.

Rojas and Chiappe (2024) extend the discussion into education, showing how digital ecosystems integrated with artificial intelligence can personalize learning and foster collaboration. They identify four core components, networks, applications, services, and users (Kim et al., 2010; Islas Torres, 2019), as fundamental to ecosystem functioning. Their review highlights both opportunities, such as improved accessibility and personalized learning (Vuk et al., 2022; Vera, 2023), and challenges, including equity, transparency, and ethical data use (Cornejo-Plaza & Cippitani, 2023; Fang & Tse, 2022). This perspective illustrates how digital ecosystems extend beyond business into societal domains, shaping knowledge sharing, innovation, and inclusion.

Synthesized together, these studies portray digital ecosystems as complex, adaptive systems requiring careful governance, inclusive design, and theoretical clarity. They highlight opportunities for innovation, scalability, and personalization, while also pointing to challenges of definitional ambiguity, governance complexity, and inequality. By consolidating insights from economics (Evans & Schmalensee, 2008; Rysman, 2009), information systems (Yoo et al., 2010; Wareham et al., 2014), and management (Gawer, 2014), scholars can move toward a more coherent and globally relevant understanding of digital ecosystems.

Methodology

Massaro et al. (2016) emphasize that the adoption of a systematic literature review (SLR) strategy enables scholars to identify emerging research trends and formulate prospective research questions. They further argue that SLRs guide researchers toward novel and compelling trajectories through systematic evaluation and synthesis of extensive scholarly literature, even in domains where reviews already exist. Earlier, Tranfield et al. (2003) underscored the necessity of systemization and reliability in reviews, marking a methodological evolution that has since expanded to encompass qualitative synthesis and meta-analysis techniques (De Bem Machado et al., 2021).

Furthermore, according to Centobelli et al. (2021) and Secinaro et al. (2020), bibliometric analyses are particularly effective in examining variables such as authorship, keywords, citations, and references within a specific research domain. Therefore, this study integrates bibliometric analysis alongside the SLR. The advantage of combining both approaches is advocated by numerous scholars (Khakwani et al., 2025; Secinaro et al., 2021; De Bem Machado et al., 2021; D'Adamo & Rosa, 2019), who argue that the integration of bibliometric mapping with systematic review provides consistent and rigorous analysis of studied resources. Using this methodology, valuable data were collected from multiple reliable sources, especially Scopus-indexed journals, and analyzed through bibliometric techniques to map co-occurrence of keywords, co-citation networks, and author collaborations.

In line with these methodological advances, the present study employs an SLR to provide a comprehensive overview of the DEE as an emergent construct at the intersection of entrepreneurial and digital ecosystem literatures. The methodology is structured around a series of predefined stages to ensure rigor and reproducibility in the identification, selection, analysis, and synthesis of relevant scholarship.

Search Strategy

A comprehensive search strategy was developed using a combination of keywords and Boolean operators ("AND", "OR", "NOT") to capture the breadth of research on entrepreneurial ecosystems, digital ecosystems, and their convergence into DEEs (see Table 1). Searches were conducted across major databases including Scopus and Web of Science, complemented by Google Scholar to ensure coverage of interdisciplinary contributions. To strengthen inclusivity, hand-searching of key journals (e.g. *Technological Forecasting and Social Change*, *Small Business Economics*, *Sustainability*) and reference lists of identified articles was also undertaken, ensuring that seminal works and highly cited studies were incorporated.

Moreover, in order to ensure more transparency and reproducibility, the review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). The PRISMA framework provided a structured pathway through the stages of identification, screening, eligibility, and inclusion (see Figure 1). Thereafter, the final sample of 51 studies was included in this SLR.

Table 1. List of Boolean operators

Theme	Entrepreneurial Ecosystem + Digital Context
Code	("entrepreneurial ecosystem" OR "entrepreneurship ecosystem") AND ("digital" OR "digitalization" OR "digitization" OR "ICT" OR "information technology")
Theme	Digital Ecosystem + Entrepreneurship
Code	("digital ecosystem" OR "platform ecosystem" OR "business ecosystem" OR "software ecosystem") AND ("entrepreneurship" OR "entrepreneurial" OR "startup" OR "venture creation")
Theme	Digital Entrepreneurial Ecosystem (DEE) Direct Term
Code	("digital entrepreneurial ecosystem" OR "DEE") OR (("entrepreneurial ecosystem") AND ("digital transformation" OR "digital economy"))
Theme	Others
Code	("platform ecosystem" OR "digital platform" OR "multi-sided platform") AND ("entrepreneurship" OR "new venture" OR "startup innovation")

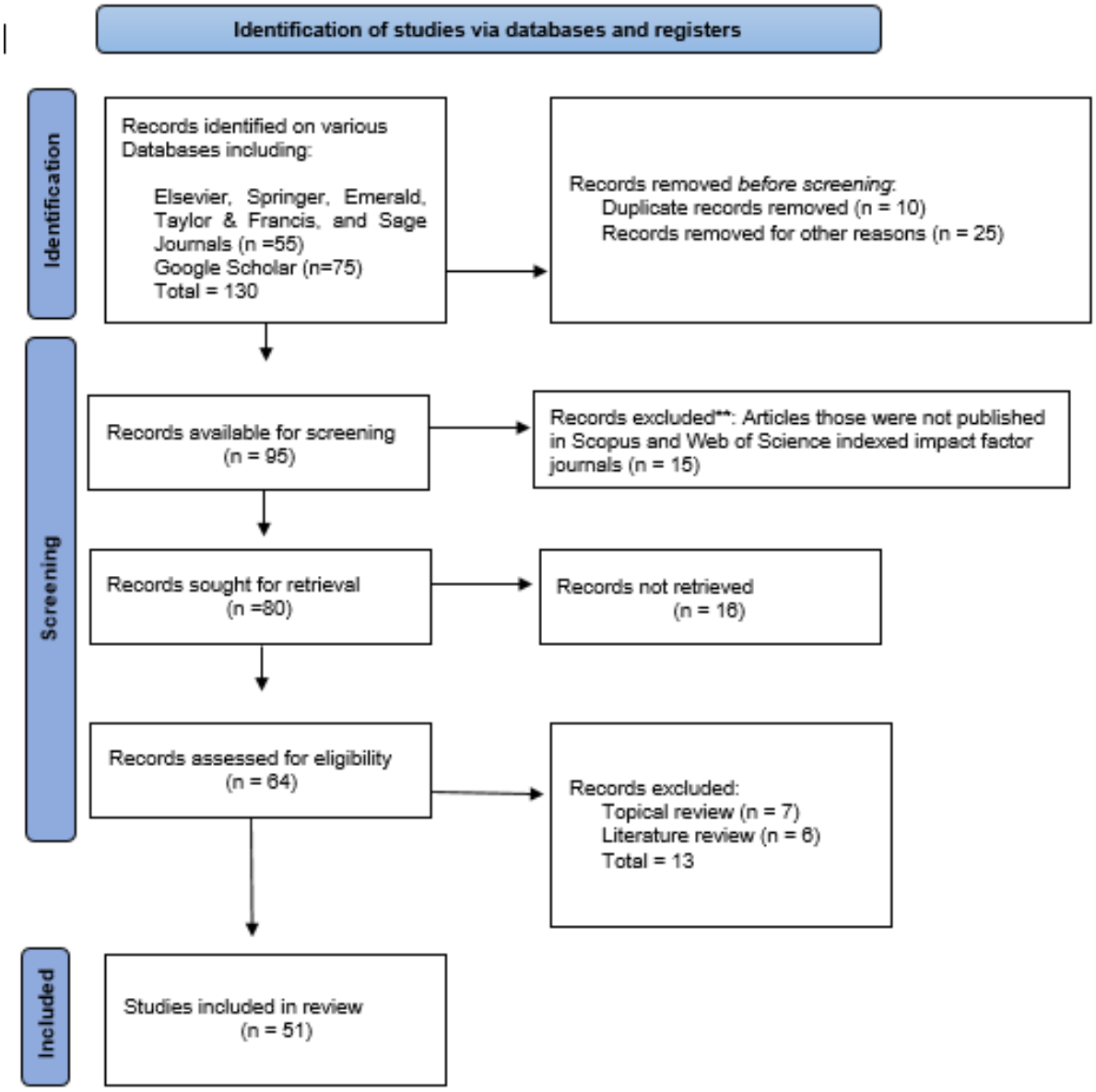


Figure 1. PRISMA Flow Chart Diagram

Source (s): Author(s) own work

Data Analysis

In the data analysis phase, this SLR applies two complementary forms of examination that are fundamental to systematic literature reviews and bibliometric studies: **descriptive analysis** (including citation analysis and bibliographic coupling) and **content analysis** (such as keyword co-occurrence and cluster mapping). To operationalize these analyses, the study employs the visualization capabilities of **VOSviewer**, a software tool developed by Van Eck and Waltman (2010). VOSviewer served as the primary instrument for conducting visual and network-oriented bibliometric analysis, enabling the systematic mapping of author collaboration networks, thematic clusters, and keyword co-occurrence structures (McAllister et al., 2021). This dual approach ensures both quantitative rigor and qualitative depth in uncovering the intellectual structure and thematic evolution of research on digital entrepreneurial ecosystem.

Descriptive Analysis

Descriptive analysis in this review focuses on summarizing and interpreting the principal characteristics of the collected studies, such as the temporal evolution of publications, the types of academic contributions, and the research methods employed (Díaz-Millón & Olvera-Lobo, 2021; Massaro et al., 2016). This stage provides a structured overview of how scholarship on digital entrepreneurial ecosystems has developed over time, highlighting methodological diversity and shifts in research emphasis.

Timeline of studies: The timeline of publications on DEE reveals a clear trajectory of growth, consolidation, and diversification (see Figure 2). Between 2017 and 2020, the field remained relatively nascent, with only two publications per year. This period can be seen as the formative stage, where foundational concepts were being introduced but scholarly engagement was still limited.

A sharp increase occurred in 2021, with seven publications, marking the emergence phase. This surge reflects growing recognition of DEEs as a distinct research domain, likely driven by the acceleration of digital transformation during the pandemic. However, 2022 saw a dip to four publications, suggesting a temporary slowdown, possibly due to shifting research priorities or the time required for scholars to consolidate frameworks.

The years 2023 and 2024 represent the peak of scholarly interest, with 10 and 11 publications respectively. This indicates that DEEs had become a mainstream topic, attracting diverse methodological approaches and theoretical perspectives. The peak in 2024 aligns with broader trends in entrepreneurship and digitalization research, where scholars increasingly examined ecosystems through lenses of sustainability, inclusivity, and governance.

Post-2024, the number of publications declined to six in both 2025 and 2026 (projected). This stabilization suggests the field may be entering a maturity phase, where research is less about volume and more about depth, focusing on refining definitions, integrating theories, and addressing empirical gaps.

Overall, the timeline illustrates a **three-stage evolution**:

- **Formative (2017–2020):** Low output, conceptual groundwork.
- **Emergence (2021–2022):** Rapid growth, initial frameworks.
- **Peak and Maturity (2023–2026):** High visibility, followed by stabilization and deeper inquiry.

This trajectory underscores that DEEs are no longer peripheral but have become a recognized strand within entrepreneurship and digital ecosystem scholarship, with future research likely to emphasize comparative studies, empirical validation, and policy implications.

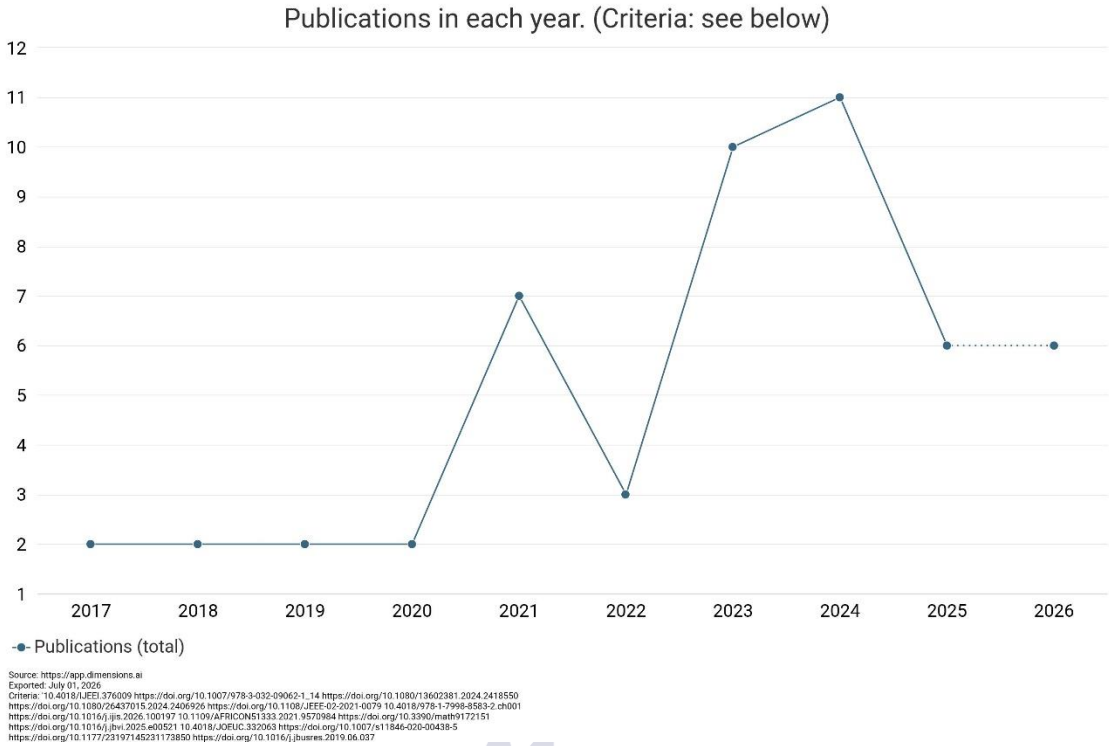


Figure 2. Timeline of included studies

Examining publications in each Research Category: The distribution of publications across research categories highlights how scholarship on DEE has been shaped by disciplinary priorities (see Figure 3). The overwhelming majority of contributions, 41 publications, fall under *Commerce, Management, Tourism and Services*. This dominance reflects the strong anchoring of DEE research in business and management studies, where entrepreneurship, innovation, and ecosystem dynamics are most directly theorized and empirically examined.

By contrast, *Information and Computing Sciences* (5 publications) and *Human Society* (4 publications) represent smaller but important streams. These contributions often focus on the technological infrastructure of digital ecosystems and the societal implications of entrepreneurial activity, respectively. The presence of categories such as *Biomedical and Clinical Sciences*, *Philosophy and Religious Studies*, and *Language, Communication and Culture*, each with 2 publications, suggests that DEE research is beginning to attract interdisciplinary interest, extending beyond management into ethical, cultural, and sector-specific domains.

The remaining categories, including *Built Environment and Design*, *Creative Arts and Writing*, *Economics*, *Environmental Sciences*, *Mathematical Sciences*, and *Psychology*, each with a single publication, indicate exploratory efforts. These scattered contributions show that DEEs are being tested as a conceptual lens in diverse contexts, from sustainability and environmental innovation to creative industries and behavioral studies.

Overall, the timeline of disciplinary engagement suggests three phases:

- **Concentration in management and commerce**: Establishing DEEs as a business and entrepreneurship construct.
- **Expansion into computing and social sciences**: Addressing digital infrastructure and societal impact.
- **Emerging inter-disciplinarity**: Early explorations in health, environment, culture, and psychology.

Furthermore, Table depicts the analysis of publications aligned with the *Sustainable*

Development Goals (SDGs) shows that research on DEE is most strongly connected to *Goal 8: Decent Work and Economic Growth*, with three publications accumulating 463 citations (mean 154.33) (see Table 2). This reflects the centrality of entrepreneurship and digital innovation in fostering inclusive economic opportunities. *Goal 11: Sustainable Cities and Communities* is represented by three publications but with a lower citation mean (18.00), indicating emerging interest in how DEEs contribute to urban resilience and smart community development. *Goal 9: Industry, Innovation and Infrastructure* has two publications (42 citations, mean 21.00), underscoring the role of digital ecosystems in advancing technological infrastructure and industrial innovation. Meanwhile, *Goal 4: Quality Education* and *Goal 10: Reduced Inequalities* are each represented by a single publication, with modest citation counts (11 and 17 respectively), suggesting that while DEEs intersect with education and equity, these areas remain underexplored. Overall, the distribution highlights that DEE scholarship is most mature in addressing economic growth, while contributions to sustainability, infrastructure, education, and inequality are still developing, pointing to opportunities for future interdisciplinary expansion.

Table 2. Publications indicating areas in Sustainable Development Goals

Category	Goal Number	Publication	Citations	Citations mean
Decent Work and Economic Growth	8	3	463	154.33
Sustainable Cities and Communities	11	3	54	18.00
Industry, Innovation and Infrastructure	9	2	42	21.00
Quality Education	4	1	11	11
Reduced Inequalities	10	1	17	17

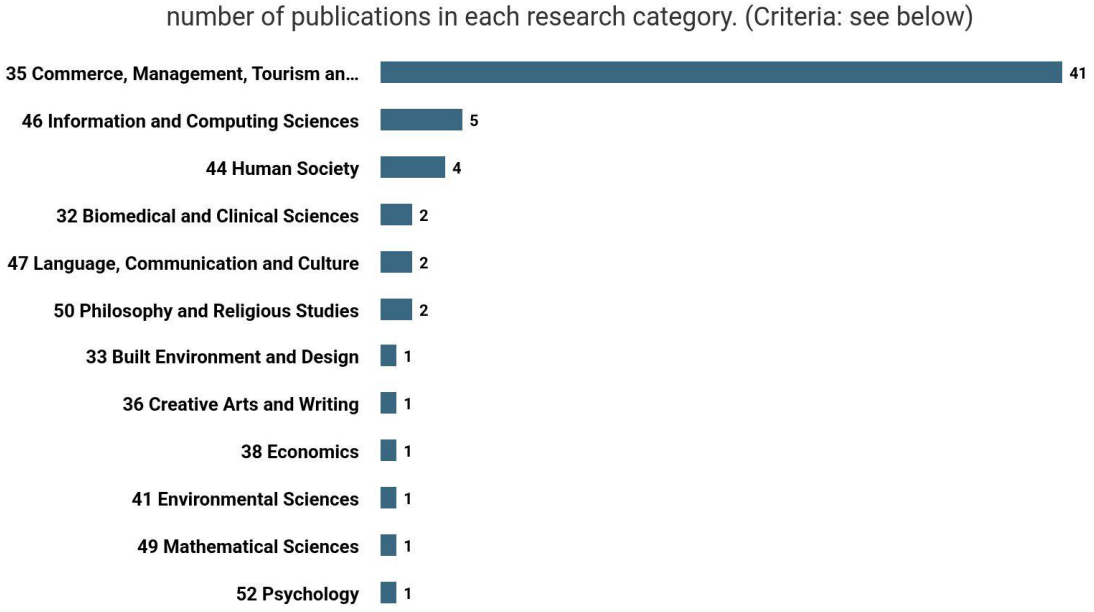


Figure 3. Publications in each category

Geographical Analysis of studies: Given in Figures 4 and 5, studies demonstrates a clear hierarchy of research activity and influence across countries. At the forefront, *China* leads with 13 publications, supported by strong collaboration networks and 630 citations, reflecting its rapid expansion in digital entrepreneurship scholarship. The *United States* and *Italy* each contribute 7 publications, but their impact diverges, while the US commands the highest citation count (1925), Italy achieves remarkable influence with 1118 citations, underscoring the depth and resonance of its contributions. The *United Kingdom* also records 7 publications, with 235 citations, positioning itself as a hub for policy and governance perspectives.

Among secondary contributors, *France* (4 publications, 533 citations) and *Spain* (4 publications, 136 citations) highlight Europe's strong engagement, often tied to conceptual debates and sectoral applications. *Hungary* (4 publications, 44 citations) and *Australia* (3 publications, 172 citations) add regional diversity, with Australia's work often linked to innovation ecosystems. Emerging voices such as *Brazil* (2 publications, 17 citations), *Russia* (2 publications, 50 citations), *India* (2 publications, 8 citations), *Portugal* (2 publications, 63 citations), *Estonia* (2 publications, 34 citations), and *Poland* (2 publications, 25 citations) illustrate the growing global spread of DEE research, albeit with modest citation impact compared to core hubs.

Taken together, the data reveal three tiers of engagement: **core hubs** (China, US, UK, Italy), which shape global discourse; **secondary contributors** (France, Spain, Australia, Hungary), which provide regionally significant insights; and **emerging contributors** (Brazil, Russia, India, Portugal, Estonia, Poland), which signal the diffusion of DEE scholarship into diverse socio-economic contexts. The network visualization further underscores strong cross-country collaboration, suggesting that DEE research is not only expanding geographically but also becoming increasingly interconnected. This global spread points toward a future where comparative and cross-regional studies will enrich understanding of how digital entrepreneurial ecosystems evolve under different institutional and cultural conditions.

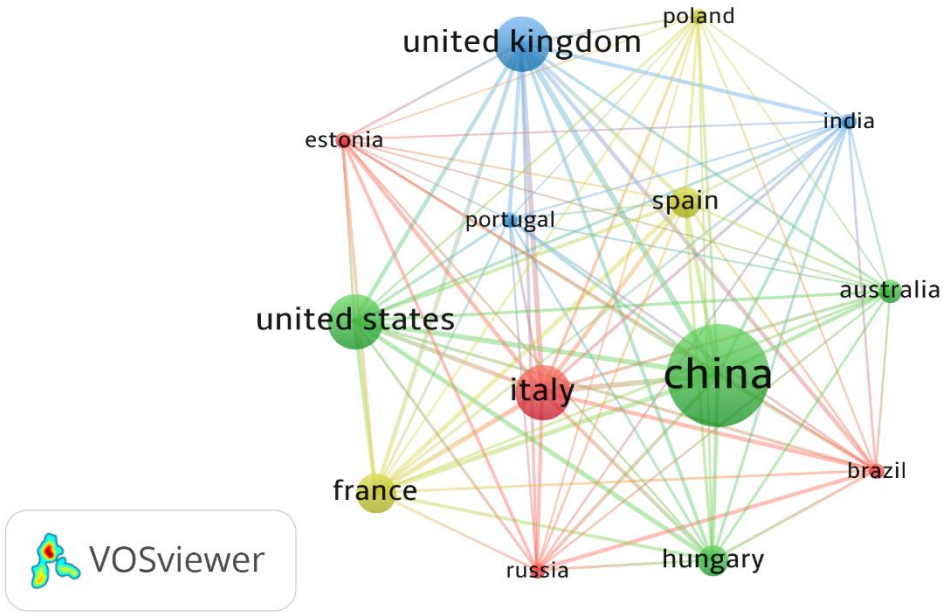
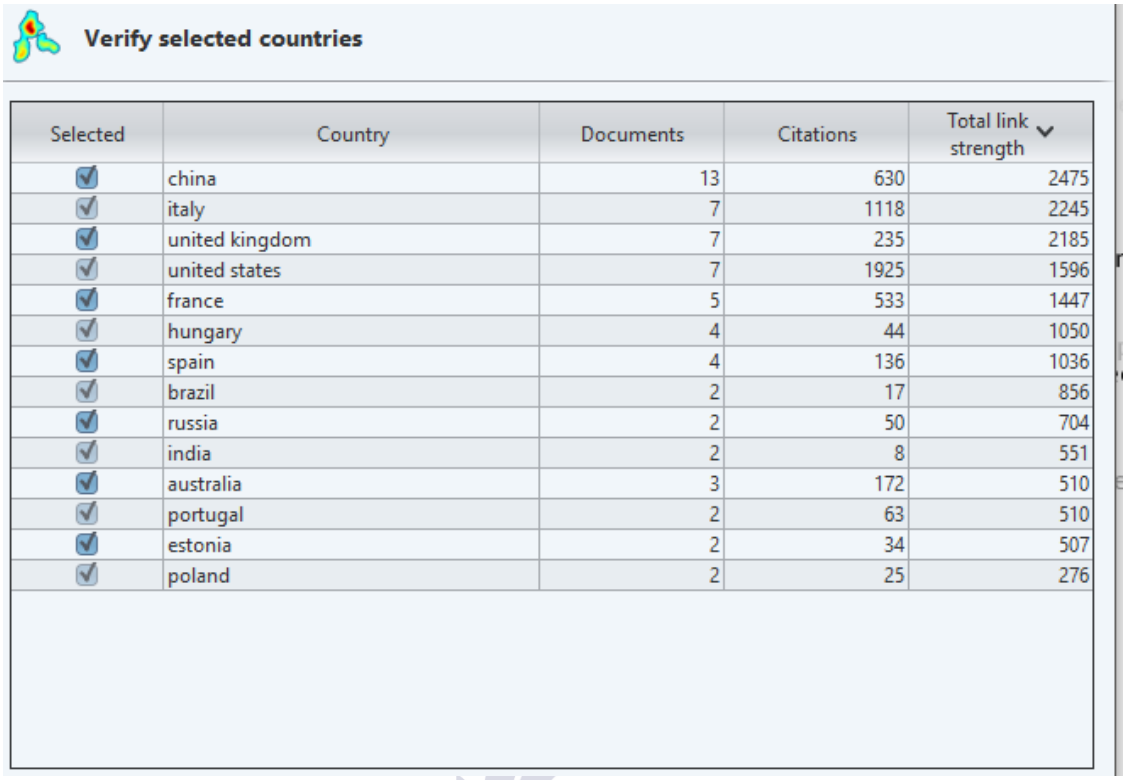


Figure 4. Bibliographic analysis for countries



Selected	Country	Documents	Citations	Total link strength
☑	china	13	630	2475
☑	italy	7	1118	2245
☑	united kingdom	7	235	2185
☑	united states	7	1925	1596
☑	france	5	533	1447
☑	hungary	4	44	1050
☑	spain	4	136	1036
☑	brazil	2	17	856
☑	russia	2	50	704
☑	india	2	8	551
☑	australia	3	172	510
☑	portugal	2	63	510
☑	estonia	2	34	507
☑	poland	2	25	276

Figure 5. Countries' list in VOSviewer

Source Distribution: The **density visualization** of sources provides a clear picture of how academic journals contribute to the scholarship, particularly in this research domain (see Figure 6). Larger and more central nodes such as *Small Business Economics*, *Journal of Business Research*, and *Technological Forecasting and Social Change* indicate high citation density and strong thematic relevance, positioning them as core outlets where DEE research is most frequently published and referenced. These journals act as intellectual anchors, shaping the theoretical and empirical foundations of the field.

Surrounding these core sources are mid-sized nodes like *Sustainability*, *European Journal of Innovation Management*, and *The Journal of Technology Transfer*, which represent specialized but influential contributions. Their density suggests that DEE research is not confined to entrepreneurship journals alone but is also integrated into broader discourses on innovation, sustainability, and technology management.

Smaller nodes such as *Chinese Management Studies*, *Digital Business*, and *Frontiers of Business Research in China* highlight emerging or regionally focused outlets. While their citation density is lower, they contribute to diversifying the field by contextualizing DEE research within specific geographies or niche domains. The presence of journals like *Frontiers in Psychology* and *Humanities and Social Sciences Communications* further illustrates the interdisciplinary expansion of DEE scholarship, linking entrepreneurial ecosystems to behavioral and societal dimensions.

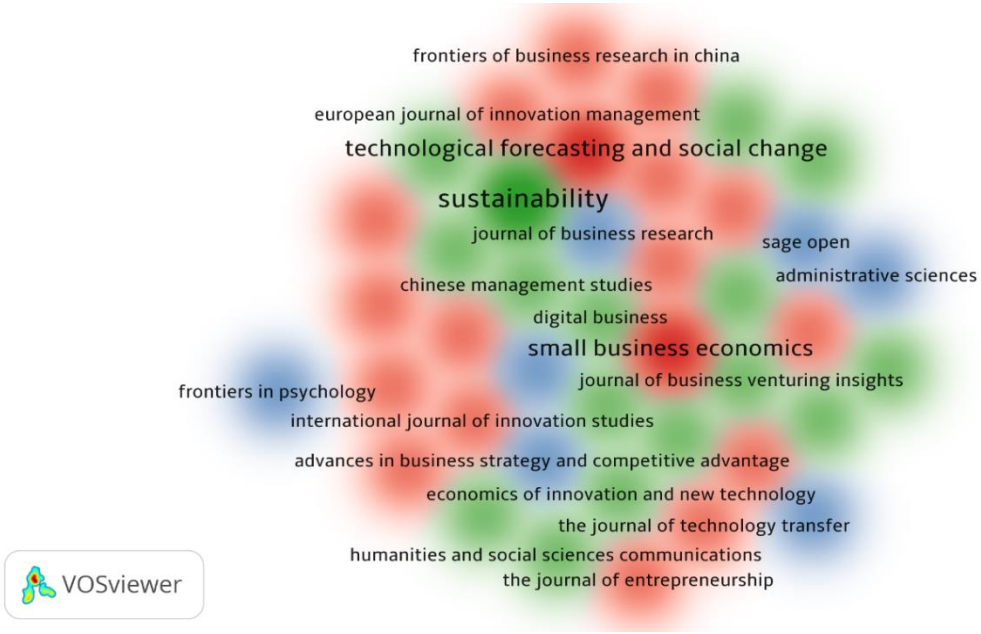


Figure 6. Density visualization of sources

Bibliographic coupling of authors: The bibliographic coupling analysis of authors in DEE research highlights how intellectual linkages form clusters of scholars who share common references and conceptual foundations (see Figure 7). The clustering reveals eight distinct groups, each representing thematic orientations and collaborative strengths.

Cluster 1 includes influential figures such as *Zoltan J. Acs*, *Hamid Etemad*, *Vanessa Ratten*, *Jean-Michel Sahut*, and *Fiona Sussan*. This group is heavily anchored in entrepreneurship and ecosystem theory, often linking DEEs to regional development, innovation systems, and entrepreneurial identity. Their coupling suggests a strong theoretical grounding and cross-disciplinary influence.

Cluster 2 features *Wenyu Du*, *Alessandro Margherita*, *Gianluca Elia*, and *Giuseppina Passiante*, among others. This cluster emphasizes digital transformation, platform ecosystems, and managerial perspectives, bridging entrepreneurship with digital business models. Their shared references highlight the convergence of management and technology in shaping DEEs.

Cluster 3 brings together *Robert A. Baron*, *Sascha Kraus*, *Satish Nambisan*, and *Norbert Kailer*. This group is closely tied to entrepreneurial cognition, innovation, and digital entrepreneurship, reflecting strong psychological and managerial dimensions. Their coupling underscores the role of behavioral and strategic perspectives in DEE scholarship.

Cluster 4 and **Cluster 5** are largely composed of Chinese scholars such as *Lu Chen*, *Ruoyu Jin*, *Han Lin*, *Kaibo Yang*, and *Weiren Cen*, alongside established figures like *Shaker A. Zahra*. These clusters highlight the growing contribution of Chinese research to DEEs, often focusing on digital innovation, governance, and institutional contexts.

Cluster 6 includes *Cristina Fernandes*, *Veland Ramadani*, and *Pedro Mota Veiga*, reflecting European perspectives on entrepreneurship, internationalization, and digital ecosystems. **Cluster 7**, with *Unai Arzubiaga* and *Alfredo De Massis*, emphasizes family business and entrepreneurial ecosystems, while **Cluster 8** introduces emerging voices such as *Mariya Dedova* and *Marco Savastano*, signaling diversification into new contexts and geographies.

Overall, bibliographic coupling shows that DEE research is anchored by established scholars in entrepreneurship and innovation, while

simultaneously expanding through new contributors from Europe, Asia, and Latin America. The clustering demonstrates both consolidation of core theories and diversification into interdisciplinary and regional perspectives, ensuring that DEE scholarship evolves through collaboration and thematic variety.

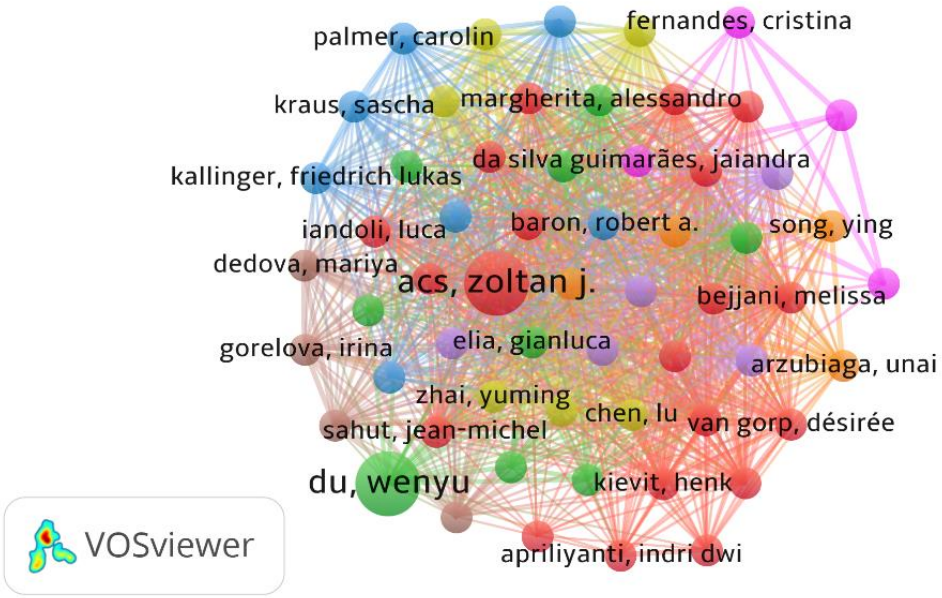


Figure 7. Bibligraphic coupling of Authors

Author(s) institutional affiliation: This study also highlights that research on DEE is shaped by contributions from a diverse set of universities across the United States, Europe, and Asia. For this purpose, list of authors with most number of publications and citations are mentioned in Table 3.

Table 3. Author(s) institutional affiliation

	Name	Institute	Numner of Publications	Citatatons	Citatatons mean
1	Wenyu Derek Du	Beihang University, China	2	200	100
2	Zoltan J Acs	George Mason University, United States	2	819	409.5
3	Fiona Sussan	University of Phoenix, United States	1	819	819
4	Gianluca Elia	University of Salento, Italy	1	967	967
5	Alessandro Margherita	University of Salento, Italy	1	967	967
6	Jean-Michel Sahut	IDRAC Business School, France	1	418	418
7	Satish Nambisan	Case Western Reserve University, United States	1	263	263
8	Robert Alan Baron	Oklahoma State University, United States	1	263	263

9	Melissa Bejjani-Cazaré	Friedrich Schiller University Jena, Germany	1	128	128
10	Wan Liu	Zhejiang University, China	1	178	178
11	Ying Song	Chongqing Technology and Business University, China	1	104	104
12	Norbert Kailer	Johannes Kepler University of Linz, Austria	1	576	576
13	Shascha Kraus	University of Johannesburg, South Africa	1	576	576
14	Giuseppina Passiante	University of Salento, Italy	1	967	967
15	Carolin Palmer	Augsburg Technical University of Applied Sciences, Germany	1	576	576

Co-citation Analysis of top 10 cited Docuument: The co-citation analysis of the top ten most cited documents (see Table 4) in the DEE domain reveals the intellectual backbone of the field. Foundational works such as Sussan & Acs (2017) and Nambisan (2021) are consistently co-cited, establishing the theoretical link between entrepreneurial ecosystems and digital transformation. Elia, Margherita, & Passiante (2020) and Sahut (2019) provide strong European contributions, emphasizing managerial and innovation perspectives, while Baron (2018) and Kraus (2018) anchor the psychological and strategic dimensions of entrepreneurship (see Figure 8). The clustering also highlights Du (2020) and Song (2021) from China, reflecting the growing Asian scholarship in DEEs.

Table 4. List of Top 10 documents

Title	Authos(s)	Source	Citations	Link Strength	Total Links	Cluster
From a marketplace of electronics to a digital entrepreneurial ecosystem (DEE): The emergence of a meta-organization in Zhongguancun, China	Du et al. (2018)	Info Systems Journal	185	57	24	4
Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process	Elia et al. (2020)	Technological Forecasting and Social Change	1638	239	36	3
Digital entrepreneurship: A research agenda on new business models for the twenty-first century	Kraus et al. (2018)	International Journal of Entrepreneurial Behavior & Research	1715	92	31	3
Digital entrepreneurship: global maps and trends of research	Zhai et al. (2022)	Journal of Business & Industrial Marketing	109	146	31	2

The digital entrepreneurial ecosystem	Sussan and Acs (2017)	Small Business Economics	1634	72	26	2
Digital entrepreneurial ecosystems: A systematic literature review	Bejjani et al. (2023)	Technological Forecasting and Social Change	234	294	32	2
The Digital Entrepreneurial Ecosystem—a critique and reconfiguration	Song (2019)	Small Business Economics	437	241	35	2
. Digital entrepreneurship ecosystem as a new form of organizing: the case of Zhongguancun	Li et al. (2017)	Frontiers of Business Research in China	150	48	23	4
Digital entrepreneurship ecosystems: Then vs. now-a future perspectives	Miah et al. (2025)	Digital Business	45	126	27	1
The age of digital entrepreneurship	Sahut et al. (2019)	Small Business Economics	825	184	33	3

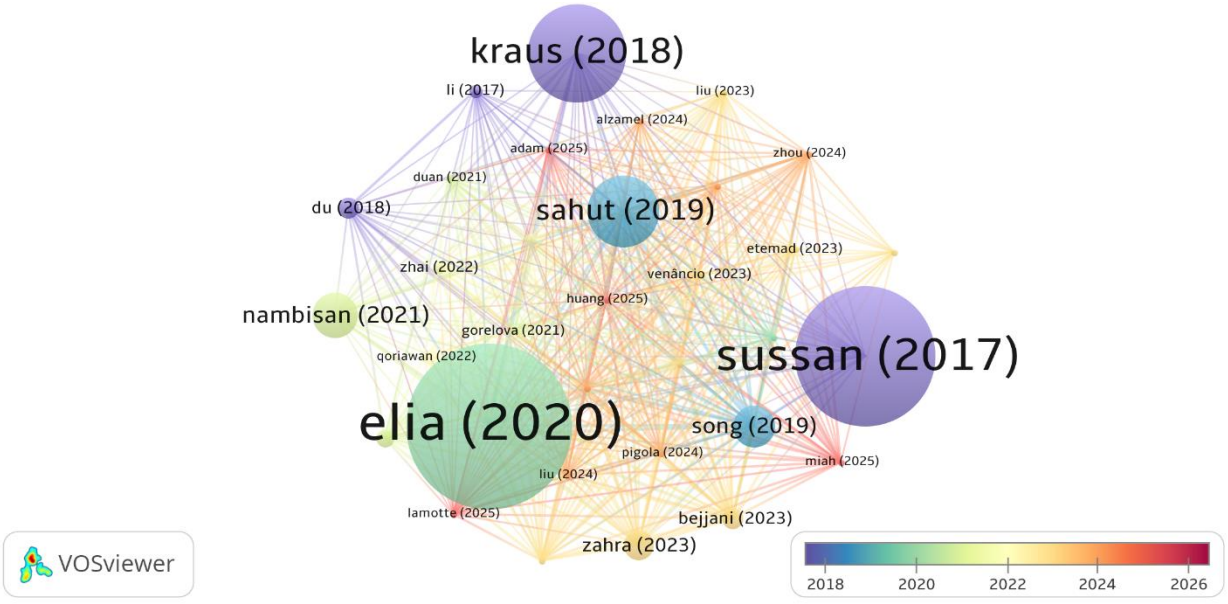


Figure 8. Overlay Visualization of Highly Cited Documents

Content Analysis

Co-occurrence of Keywords Analysis: The co-occurrence of keywords analysis, incorporating the clustered data, shows how research on DEE is organized into interconnected thematic domains (see Figure 9).

Cluster 1 (Red) brings together terms such as *digital age*, *digital ecosystem*, *digital platform*, *entrepreneur*, *opportunity recognition*, and *venture performance*. This cluster emphasizes the technological foundations of DEEs and their direct link to entrepreneurial processes and outcomes, highlighting how digital infrastructures enable opportunity recognition and performance.

Cluster 2 (Green) centers on *DEE*, *digital startup*, *digitalization*, *entrepreneurial bricolage*, and *sustainable entrepreneurial performance*. This grouping reflects the managerial and adaptive

aspects of DEEs, showing how startups leverage bricolage and digitalization to achieve sustainability.

Cluster 3 (Blue) integrates *decent work*, *digital innovation*, *economic growth*, *entrepreneurial intention*, *entrepreneurship ecosystem*, *income generation*, and *policymaking*. This cluster connects DEEs to broader socio-economic outcomes, aligning with Sustainable Development Goals by linking digital entrepreneurship to work, growth, and policy frameworks.

Cluster 4 (Yellow) includes *digital entrepreneurial ecosystem*, *entrepreneurial opportunity*, *knowledge acquisition*, *sharing capability*, *sustainability*, and *user entrepreneurial opportunity*. This cluster highlights learning, knowledge flows, and sustainability, emphasizing how DEEs foster capability building and opportunity creation.

Cluster 5 (Purple) focuses on *digital economy*, *digital entrepreneurial strategy*, *digitalization*, and *unicorn*. This cluster reflects high-growth ventures and strategic positioning within the digital economy, pointing to the rise of unicorns as emblematic outcomes of DEEs.

Cluster 6 (Orange) with *governance structure*, underscores institutional and organizational dimensions, showing that DEEs are embedded in governance frameworks that shape their evolution. Taken together, these clusters reveal that DEE scholarship is structured around technological foundations, entrepreneurial processes, socio-economic outcomes, knowledge flows, strategic growth, and governance structures. This interconnectedness confirms that DEEs are studied not only as digital infrastructures but also as socio-economic systems with implications for sustainability, policy, and high-growth entrepreneurship.

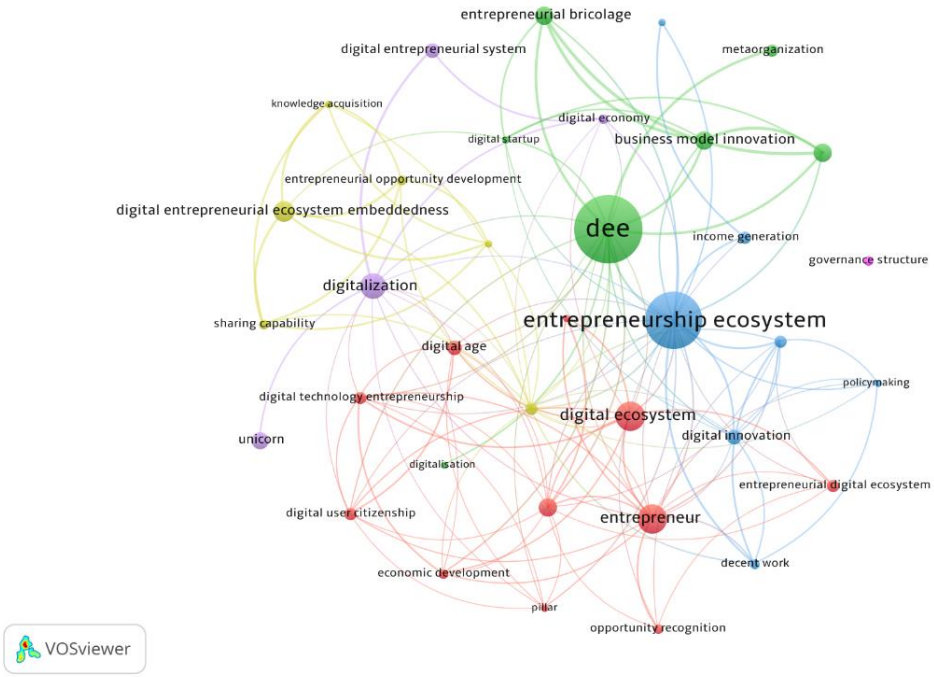


Figure 9. Co-occurrence of keywords Analysis

Future Research Themes: The co-occurrence of keywords analysis was complemented by a systematic content analysis of 30 papers. This approach was adopted because content analysis enables the identification of emerging research areas, thematic gaps, and potential directions for future inquiry by examining recurring patterns and clusters within the literature (Hassan et al.,

2026; Secundo et al., 2020). It also serves to highlight underexplored topics and provides nuanced insights into how the field can evolve, offering a roadmap for scholars to address overlooked dimensions and expand the scope of DEE studies (Goyal & Kumar, 2020).

1. Technological Foundations and Digital Infrastructure

Research on the technological foundations of DEEs focuses on the digital platforms, infrastructures, and technological artifacts that enable entrepreneurial activity within ecosystems. This includes the examination of multisided platforms, cloud computing, artificial intelligence, big data analytics, blockchain, and Internet of Things (IoT) technologies, all of which shape how value is created and shared (Zhang et al., 2022). Scholars are interested in how these technologies dissolve geographic barriers and support ventures in scaling globally from inception (Rojas and Chiappe, 2024). Furthermore, understanding how governance structures and boundary resources are designed to facilitate interoperability and collaboration across diverse actors remains a key area of interest (Elia et al., 2020). Exploring these technological affordances helps clarify the capabilities and constraints that digital infrastructures impose on entrepreneurial dynamics, providing critical insights for both theory and practice.

2. Entrepreneurial Processes and Opportunity Creation

This theme delves into how entrepreneurs navigate and seize opportunities within DEEs by focusing on cognitive and behavioral processes such as opportunity recognition, bricolage, and adaptive strategy formulation (Gorelova et al., 2021). It investigates how digitalization transforms traditional entrepreneurial processes by enabling novel business models and accelerating venture creation and growth (Zahra et al., 2022). Understanding how startups creatively combine available resources in digital contexts sheds light on the mechanisms of innovation and sustainability in these evolving ecosystems (Li & Yao, 2021). This research deepens knowledge about how digital tools and networks influence entrepreneurial intent and decision-making, highlighting the intersection between technological and human factors in shaping entrepreneurial outcomes (Rawan et al., 2025).

3. Governance, Institutional Context, and Ecosystem Structure

Governance is fundamental to orchestrating the complex and dynamic interactions within DEEs (Wibisono, 2023). This theme examines various governance models beyond traditional hierarchical or market-based frameworks to include relational and collaborative mechanisms suitable for digitally enabled ecosystem configurations (Zahra et al., 2022). It explores how institutions and public policies can facilitate or hinder ecosystem functioning, focusing on issues like resource allocation, trust-building, and regulatory frameworks. Scholars study the roles of orchestrators, platform owners, and institutions in balancing autonomy and coordination among actors (Sussan and Acs, 2017). Investigating governance is crucial for understanding how ecosystem actors collectively manage interdependencies and how institutional arrangements evolve during different ecosystem lifecycle stages (Bongiorno et al., 2026).

4. Socio-Economic and Sustainable Development Impacts

Digital entrepreneurial ecosystems are increasingly recognized for their potential to contribute to socio-economic development aligned with Sustainable Development Goals (SDGs). This theme investigates the impact of DEEs on decent work, economic growth, sustainable cities, innovation infrastructure, and social inclusion (Pigola et al., 2024). It explores how digital entrepreneurship can create inclusive economic opportunities, promote income generation, and support urban resilience (Alzamel, 2024). By linking DEEs to policy frameworks and sustainable development objectives, research illuminates how these ecosystems can drive not only economic but also social and environmental value, emphasizing the importance of balancing commercial success with broader societal goals.

5. Multidisciplinary and Cross-Regional Contextualization

Given the global diffusion of DEE research, this theme calls for more comparative and context-sensitive studies that consider geographic, cultural, institutional, and sectoral differences (Marinelli et al., 2023). It highlights the importance of understanding how local conditions such as regulatory environments, resource availability, and societal norms influence the emergence and effectiveness of DEEs (Song, 2019). Research in this area seeks to bridge gaps in knowledge regarding ecosystem dynamics in developing economies and resource-constrained contexts (Mekuria et al., 2021). These insights are essential for designing tailored ecosystem development policies and for sharing best practices across diverse regions, fostering a globally inclusive understanding of digital entrepreneurship ecosystems.

6. Collaboration, Networks, and Social Capital in DEEs

Collaboration and network dynamics form the social fabric of DEEs, fostering innovation and venture success. This theme focuses on how actors within digital ecosystems build trust, share knowledge, and engage in collective problem-solving (Etemad, 2023). It examines mechanisms through which social capital is accumulated and mobilized, enabling collective intelligence and coordinated action (Mohammadi et al., 2026). Understanding these network structures and relationships is vital for identifying how innovation ecosystems function as adaptive and resilient systems (Rawan et al., 2025). This research area also sheds light on the interplay between formal alliances and ad-hoc collaborations that characterize the flexible and dynamic nature of DEEs.

7. Digital Inequality, Inclusiveness, and Ethical Data Use

As DEEs grow, they raise important questions about digital divides, inclusiveness, and ethical governance. This theme addresses challenges related to equitable access to digital infrastructure, the participation of marginalized groups, and transparency in data usage (Venâncio et al., 2023). It explores frameworks to mitigate the risks of exclusion and bias, ensuring that digital entrepreneurship benefits a broad spectrum of society (Miah et al., 2025). Additionally, it assesses the ethical handling of data and algorithms within ecosystems, focusing on privacy, fairness, and consent. Research here aims to promote responsible design and governance of DEEs to uphold societal trust and prevent adverse social consequences.

8. Ecosystem Lifecycle, Evolution, and Resilience

DEEs are not static; they evolve through stages of emergence, growth, maturity, and renewal (Tsukanova et al., 2024). This theme studies how ecosystems develop over time and adapt to technological disruptions, market shifts, and external shocks. It highlights factors that influence the resilience and sustainability of ecosystem structures and governance models as they transition between lifecycle phases (Nambisan & Baron, 2019). Understanding these dynamics provides insights into how DEEs can maintain vitality, foster continuous innovation, and reorganize in response to changing conditions, thereby contributing to long-term entrepreneurial and economic success (Gorelova et al., 2021).

9. Strategic Growth, Market Dynamics, and Platform Power

This theme investigates the competitive and strategic aspects of DEEs, focusing on high-growth ventures such as digital "unicorns," market dynamics shaped by network effects, and power asymmetries inherent in platform ecosystems (Liu et al., 2023). It explores how dominant platforms influence entrepreneurial diversity, ecosystem entry and exit, and innovation trajectories (Etemad, 2023). Research examines how startups navigate winner-takes-all markets and develop strategic positioning to survive and thrive. These insights are crucial for understanding the balance between competition and collaboration and for informing policies that foster healthy, competitive, and innovative DEEs.

10. Measurement, Metrics, and Policy Implications

To effectively support and regulate DEEs, rigorous measurement and evaluation frameworks are essential (Raut et al., 2021). This theme focuses on the development of quantitative and qualitative metrics to assess ecosystem performance, innovation outputs, socio-economic impacts, and governance effectiveness. It also examines how these metrics can inform policymakers and ecosystem orchestrators in crafting evidence-based strategies and interventions (Song, 2019). Enhancing measurement tools supports empirical research, facilitates benchmarking across regions and sectors, and helps track DEE development over time, contributing to both theoretical advancement and practical policy design (Venâncio et al., 2023).

Discussion

Proposed Conceptual Framework for DEE Research

This systematic review can be articulated as a multi-layered construct that integrates entrepreneurial foundations, digital enablers, governance mechanisms, and sustainability outcomes (see Figure 10). At the base, ecosystem foundations encompass policy, finance, culture, human capital, and markets, reflecting the socio-institutional conditions emphasized in entrepreneurial ecosystem studies. These are reconfigured through digital enablers such as platforms, infrastructures, digital artifacts, and orchestration mechanisms, where concepts like boundary resources, collective action, and resource dependency highlight how coordination and value co-creation occur in distributed, multi-actor settings. Within this environment, ecosystem actors and processes, entrepreneurs, institutions, users, and civil society, engage in digital user citizenship, entrepreneurial bricolage, opportunity recognition, and knowledge acquisition, often structured as meta-organizations and embedded in the Quadruple Helix Model (academia, government, industry, civil society) to ensure inclusivity and innovation. Finally, the outcomes and sustainability layer captures venture performance, unicorn emergence, and alignment with Sustainable Development Goals, particularly decent work, reduced inequalities, and sustainable cities. Distinctive terms such as distributed governance, platform orchestration, sustainable entrepreneurial performance, and institutional voids in developing economies underscore the evolving challenges and opportunities. The framework thus positions DEEs as dynamic socio-technical systems where autonomy, collaboration, and resource sharing converge to redefine entrepreneurship in the digital age, offering scholars conceptual clarity, policymakers actionable guidance, and entrepreneurs pathways to scale sustainably.

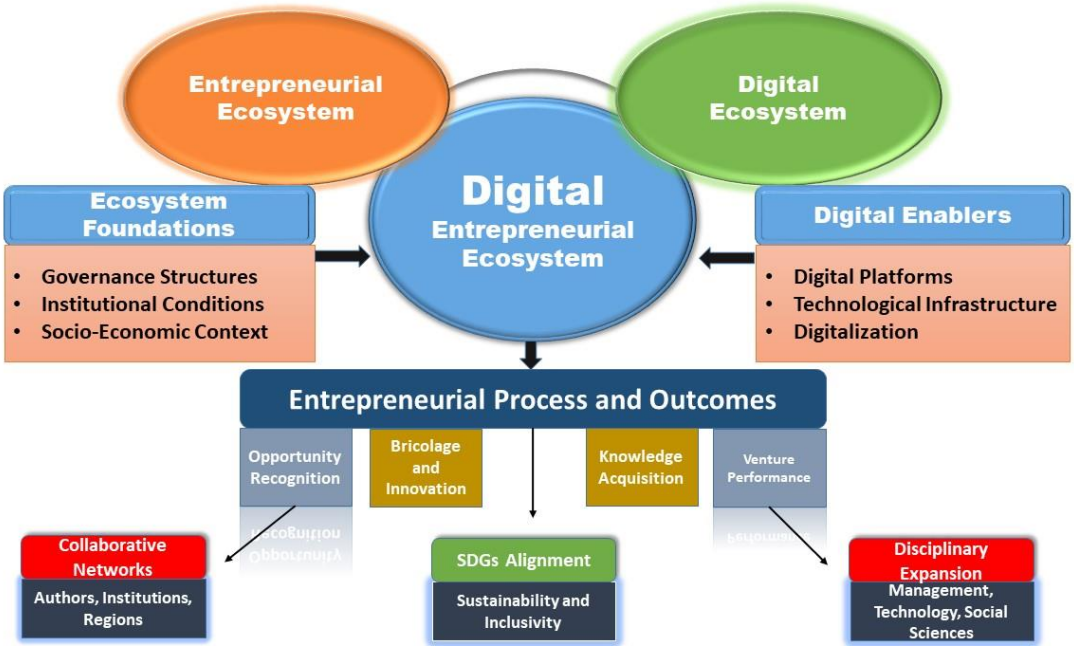


Figure 10. Proposed Conceptual Framework

Theoretical Implications

The theoretical implications of this study are significant because they advance ecosystem scholarship by clarifying the conceptual position of DEEs as a distinct paradigm within entrepreneurship and digital transformation research. First, the study demonstrates that DEEs are not simply an additive overlap of entrepreneurial and digital ecosystems but rather dynamic socio-technical systems characterized by distributed governance, boundary resources, and orchestration mechanisms. This challenges traditional ecosystem theory, which has often emphasized local embeddedness and hierarchical structures, by showing how digital infrastructures dissolve locational barriers and enable global scalability from inception.

Second, the integration of the Quadruple Helix Model (academia, government, industry, civil society) into the DEE framework expands theoretical lenses beyond market dynamics to include inclusivity, social equity, and collaborative innovation. This enriches ecosystem theory by embedding sustainability and stakeholder diversity as core attributes rather than peripheral considerations. Third, the study highlights the importance of meta-organizational structures, entrepreneurial bricolage, and digital user citizenship as processes that redefine entrepreneurial agency in digital contexts. These terms provide new conceptual tools for scholars to analyze how autonomy and interdependence coexist in ecosystems shaped by digital technologies.

Finally, by aligning DEEs with Sustainable Development Goals such as decent work, reduced inequalities, and sustainable cities, the study extends theoretical debates on entrepreneurship from purely economic outcomes to triple bottom line performance, economic, social, and environmental. This positions DEEs as a transformative construct that bridges ecosystem theory with sustainability and governance literatures, offering scholars a roadmap to explore comparative, interdisciplinary, and future-oriented research directions.

Practical Implications

The practical implications of this study are wide-ranging, offering guidance for policymakers, entrepreneurs, and institutions on how to harness DEE for sustainable and inclusive growth. For

policymakers, the findings emphasize the importance of designing integrated governance frameworks that combine digital infrastructure investment with supportive regulations, enabling startups to thrive while ensuring equitable access to resources. This is particularly critical in regions facing institutional voids, where coordinated policies can reduce barriers to financing, foster digital literacy, and strengthen entrepreneurial resilience. For entrepreneurs, the study highlights how digital platforms, boundary resources, and orchestration mechanisms can be leveraged to accelerate opportunity recognition, bricolage, and knowledge acquisition, thereby enhancing scalability and venture performance. It also underscores the potential of DEEs to support the emergence of unicorn ventures and innovative startups that contribute to both local and global economies. For academia and industry, the framework encourages collaborative knowledge exchange and co-creation, aligning research and practice with Sustainable Development Goals such as decent work, reduced inequalities, and sustainable cities. Civil society actors are equally implicated, as their participation ensures inclusivity, social equity, and responsiveness to community needs. Overall, the study provides a blueprint for action, showing that DEEs are not only engines of digital innovation but also vehicles for building resilient, inclusive, and sustainability-oriented entrepreneurial futures.

Conclusion

In conclusion, this study establishes the DEE as a transformative paradigm that unifies entrepreneurial and digital ecosystem perspectives into a coherent framework for the digital age. By synthesizing fragmented scholarship, it clarifies conceptual ambiguities and highlights how governance, actors, resources, and digital infrastructures interact to reshape opportunity recognition, resource mobilization, and venture scalability. The findings demonstrate that DEEs are not peripheral extensions but central systems that enable global connectivity, distributed collaboration, and sustainable innovation. Outcomes extend beyond venture performance to include contributions toward decent work, reduced inequalities, and sustainable cities, underscoring their relevance to broader socio-economic and environmental goals. Ultimately, this review contributes both theoretical clarity and practical guidance, offering scholars a roadmap for advancing research and providing policymakers and entrepreneurs with a blueprint to foster resilient, inclusive, and innovation-driven ecosystems in the digital era.

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Ethical approval This research being conceptual does not need ethical approval.

Data Availability Not applicable.

Code Availability Not applicable.

Competing Interest The author(s) hereby declare no competing interest.

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