



# A Bibliometric Analysis of Digital Entrepreneurship

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## Abstract

In a digitally driven society, the present research endeavor aims to map the topic of digital entrepreneurship, based on the existent research published in the Web of Science database for providing a systematic and integrative review of the literature, using both quantitative and qualitative approaches. To achieve the set goal, a bibliometric study was undertaken using the VOSviewer software and a systematic review of the academic literature was conducted. Performing the bibliometric analysis on 3366 publications indexed in the Web of Science has returned 178 relevant terms, divided into 6 clusters. In brief, the clusters feature the effects of information and communications technologies adoption on economic activities, with general debates on the reconsideration of traditional business, sharing economy, and performance, with reference to digital entrepreneurship. The focus on digital instruments (i.e., digital platforms, social media, Internet) and the need for dynamic capabilities are seen as promoters of adopting new business models and strategies for increasing firms' performance. Additionally, the emergence of a digital entrepreneurial ecosystem, having as a starting point elements such as smart city, big data, and artificial intelligence, was analyzed, as well as the creation of new start-ups, in the context of the digital divide. The research limitations relate to the use of a single database, a restrictive Boolean interrogation, the spotlight on a time frame when the debate is still growing, and also, the insufficient space allocated to the measurements of aspects. Thus, the future research directions will expand the analysis to other databases for achieving a more comprehensive bibliometric approach and will include another period, for comparing the results. The value of the article is represented by the up-to-date literature on digital entrepreneurship analyzed using quantitative and qualitative methods. The originality of the topic and the gap discovered in prior research on digital entrepreneurship led us to adopt an integrated approach, using a bibliometric analysis.

**Keywords** Digital entrepreneurship · Bibliometric analysis · Business · Entrepreneurship · Digital transformation

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## Introduction

The adoption of new digital technologies as a driver of digital transformation (Kraus et. al., 2021) and the progress associated with the age of speed can be seen as trends in every activity and all society's aspects (Stolterman & Fors, 2004) and trends that have led to a reconsideration of the entrepreneurial paradigm, essentially for staying competitive. The changeover determined by digital transformation—perceived more than technological shift (Bouncken et. al., 2021) and associated with the dynamism of the entrepreneurial process—was strongly highlighted in the academic literature, pointing up to the innovative landscape of the society, that gradually has started to integrate the *digital* into its DNA and transforming it into an intrinsic value (Baiyere et. al., 2020). The complexity of the digital transformation process can be deduced by assuming the related definitions and perspectives that are still under debate, illustrating a holistic approach to the culture of change (Mergel et. al., 2019) and to the technological implications on different structures (Kraus et. al., 2021). Accordingly, there can be identified major directions in defining digital transformation, assuming a technological, organizational, or social perspective (Reis et. al., 2018). In this context, the market is “embracing *on the fly* new digital technologies” (Volkman & Gavrilesu, 2022), involving people and technology (Nadkarni & Prügl, 2021) not limited to simple automation, but essentially the creation of new capabilities (Martin, 2008). Progressively, the development of the Internet and the expansion of information and communication technologies (ICT) has facilitated the rise of different types of entrepreneurial opportunities (Wiesboeck et. al., 2020) (Steininger et al., 2022) and, subsequently, different forms of entrepreneurship, mainly oriented to spot the effects of market transformations. Concerning this, over time, researchers have addressed similar topics such as Internet entrepreneurship, e-entrepreneurship (Matlay, 2004), technology entrepreneurship (Venkataraman, 2004), or cyber-entrepreneurship (Shabbir et al., 2016) to illustrate technologies' impact on the business environment; the central idea is preserved and the key-elements are overlapping (Giones & Brem, 2017) (Kollmann et al., 2022), but several elements are specifically distinguished. Based on the existing literature, a recent study identified three major periods in debating the development of digital entrepreneurship as a field per se (Kollmann et al., 2022), assuming the emergence of different information and communication technologies. Hence, these can be distinguished as the Seed Era (1990–2000), the Startup Era (2001–2015), and finally, the Expansion Era (2016–20xx). Establishing new processes in the network economy (Kollmann, 2006), as a feasible and inventive approach to conduct businesses (Oumlil & Juiz, 2018), was an obvious reaction of the real economy to the rapid spread of technological instruments (Kollmann, 2006), associated with concepts as *Internet entrepreneurship* (Kollmann, 1998) and *e-entrepreneurship* (Matlay, 2004). Starting with the high-tech industries (Gans & Stern, 2003) and a technology-push (Brem & Voigt, 2009), the mix between entrepreneurship and technology-based innovation was tagged as *technology entrepreneurship* (Ferreira et al., 2016), aiming to exploit science and engineering opportunities (Beckman

et. al., 2012). Likewise, the cyber-entrepreneur established a company centered around electronic commerce (an e-business startup), with its primary operations focusing on leveraging Internet technologies to exploit networks (Bret & Champagneaux, 2000) (Carrier et. al., 2004). Putting together all the previous arguments, the common roots in diagnosing the impact of technology on entrepreneurship make it difficult to distinguish between these fields. Lately, the emergence of digital technologies has translated into traditional entrepreneurship and determined the development of a new category of activities, known in the academic literature as *digital entrepreneurship*. (Nambisan, 2017). However, the process of building a theoretical background on digital entrepreneurship is relatively new, even though the issues of innovation and *going digital* (Baiyere et. al., 2020) have been key points in prior entrepreneurship studies. To a large extent, digital entrepreneurship asserts the connection between entrepreneurship and ICT (Kollmann et al., 2022), with a focus on their bidirectional relationship. In other words, digital entrepreneurship represents “the intersection of digital technologies and entrepreneurship” (Nambisan, 2017) or “the creation, development, and growth of new businesses by exploiting digital technologies and business models” (Shen et al., 2018), which has a strong potential for driving economic and social development (Zaheer et al., 2019). Building on these assumptions, Sussan and Acs (2017) have provided a new conceptual framework that includes these fields, namely, the digital entrepreneurial ecosystem, comprising four key elements: “digital infrastructure governance, digital user citizenship, digital entrepreneurship and digital marketplace.” Each of these elements has become a part of everyone’s digital life nowadays, where the available ICT resources are part of the business ecosystem, which is exploited to achieve entrepreneurial profits. From certain points of view, digital transformation is seen as a key factor in achieving success in a competitive market process (Morobito, 2022). Hence, it can be stated that “technological advancement with new ways of establishing and performing business” (Hull et al., 2007) has led to a shift in entrepreneurial activities and transformed them into digital ones, by using digital tools and platforms such as social media and e-commerce platforms to identify, assess, and exploit opportunities for creating innovative products or services (Le Dinh et al., 2018). In other words, entrepreneurial activities are significantly influenced by digital technologies, including the Internet, mobile devices, data analytics, cloud computing, and various digital platforms (Ngoasong, 2018).

Even though innovation has been strongly debated in the literature, the effects of digital transformation on entrepreneurship are still a new field that must be studied, especially due to its impact on today’s social and economic activities. Well established as the driving force of the market process, entrepreneurs are key actors in every change. Thus, the rapid change in technological innovation is strongly associated with similar changes in entrepreneurship, or in other words, technological progress is a decisive factor in economic activities. However, notwithstanding the expanding discussion around digital entrepreneurship, a noticeable research deficit still exists, necessitating extensive research and synthesis. In light of the emergence of the topic and, consequently, the insufficient research literature addressing a holistic approach (Fernandes et al., 2022), the present

research endeavor seeks to undertake a systematic exploration and mapping of digital entrepreneurship. Hence, through this, it will facilitate the understanding of digital entrepreneurship, based on identifying the main associated concepts, having as a facilitator a cluster approach, supported by a bibliometric study.

To address the identified research gap, the main purpose of the article is to map the topic of digital entrepreneurship, based on the existent research published in the Web of Science database for providing a systematic and integrative review of the literature, using both quantitative and qualitative approaches. Following the established purpose, the research objectives were designed in the subsequent manner:

- (1) To assess the research topic's trends over the selected time frame (1989–February 2023), for describing the work on digital entrepreneurship
- (2) To identify the main research fields that have addressed the topic, taking into consideration the institutional affiliation of the authors
- (3) To present an overview of digital entrepreneurship across spatial dimensions
- (4) To distinguish the main directions in the analysis of digital entrepreneurship, based on the most frequent keywords, endorsing a cluster approach
- (5) To map the topic of digital entrepreneurship, starting from the co-occurrence of the key terms, by using VOSviewer software

Based on these statements, the methodological approach has been properly adapted for achieving the proposed goal and the established objectives by using the analysis technique on previous publications and an exhaustive review of the literature. Thus, a bibliometric study, based on co-occurrence keywords of 3366 publications, will be performed for grouping by cluster the main debates that gravitate around digital entrepreneurship topics. Supporting the methodological approach with a logical flow, the paper will be structurally designed as follows: firstly, the methodological approach will be depicted; secondly, the bibliometric analysis will be performed, and the results will be discussed; finally, the limitations of the study and the future research directions will be highlighted.

The findings of the paper hold different implications in the academic literature and practice. In terms of knowledge contributions, it should be stated that the research provides a recent state of the art related to the digital entrepreneurship topic. The significant increase in the use of digital instruments for entrepreneurial activities led to the development of associated concepts, such as digital platforms and digital processes. Due to its relative novelty, the subject of digital entrepreneurship remains insufficiently unexploited, even if the academic literature has started to allocate debate space for it. The cluster approach, adopted for this study, brings to the fore the main existent ideas, starting from the keywords' connections, and offers the premises for further investigations. Therefore, as market adaptation is a mandatory requirement for businesses' survival, a spotlight on the literature can facilitate the understanding of digital entrepreneurial activities, with implications in the practical area. Under these circumstances, starting from the identified gaps and main directions, the practitioners can develop new areas

where digital entrepreneurship leads to profits and increases competitiveness, but also can improve consumer engagement strategies. This picture is fulfilled by the potential to actively participate in building the digital entrepreneurial ecosystem, by endorsing knowledge transfer and collaboration between different actors (i.e., businesses, academic staff, students, policymakers). Finally, starting from understanding the landscape of digital entrepreneurship, policymakers can work to improve the particular policies, to foster innovation, by addressing the potential of related activities.

## Methodology

The methodological approach adopted in the present paper was designed in order to achieve the proposed goal, namely, *to map the topic of digital entrepreneurship*, starting from the previous research studies, which were addressed in the academic literature. To achieve the proposed goal, a bibliometric analysis was performed, considering the topic under debate. Hence, the novelty of the subject and the gap identified in previous research that addressed the issue of digital entrepreneurship led us to adopt an integrated approach, designed in several steps. A synoptic view of the logical process is provided in Fig. 1.

### (1) DATA COLLECTION

**Source:** Web of Science, Advanced Search

**Boolean query:** TS = *digita\* entrepreneur\** OR TI = *digita\* entrepreneur\** OR  
AB = *digita\* entrepreneur\**

**Timespan:** (first available material) 1989 – end of February 2023  
All languages (title, abstract and keywords available in English)

### (2) RESULTS & EXPORT DATA

**Results:** 3.366 articles, conference papers, early access, books, book chapters

**Export data:** full data and citation exported in .txt format

### (3) SCREENING PROCESS

**Screening articles:** import in VOS Viewer; co-occurrence analysis of the keywords; minimum no. of occurrence of a keyword: 10

**Screening results:** 10.396 keywords; the most relevant 60% were extracted: 338 meet the threshold

**Screening refinement:** similar terms were merged; connectors, proper nouns and others (authors, journals etc.) were eliminated

### (4) FINAL RESULTS & ANALYSIS

**Final screening results:** 178 terms, divided in 6 clusters

**Cluster analysis**

TS=Topic | TI=Title | AB=Abstract

Fig. 1 Bibliometric analysis steps

Firstly, an advanced interrogation that aimed to return relevant results related to digital entrepreneurship was conducted on the selected database, namely, Web of Science. The database was selected assuming the following criteria: (1) the coverage of high-quality research, previously reviewed by the specialists (Skute, 2019) (Carracedo et al., 2021); (2) the relevance in the academic literature through including comprehensive work from all around the world (Ferreira et al., 2022); and (3) the frequent use in bibliometric studies (Zupic & Čater, 2015). The search query included the terms “digita\* entrepreneur\*” in their title (TI), abstract (AB), or keywords, where \* character provides a more specific dimension of the search due to the fact that includes derivative terms. Under these assumptions, for 1989 to the end of February 2023 timespan, the Web of Science platform returned 3366 publications, including articles, conference papers, early access, books, and book chapters, which were exported for further processing. The selected time was restricted by the first publication that met the Boolean requirements (1989) and the most recent indexed materials, when the study was performed (end of February 2023). Additionally, “all languages” was selected, but it should be mentioned that all returned results provide titles, keywords, and abstracts in English. As a note, the majority of the studies are available in English (94.86%), and a small minority are in other languages (1.96% Spanish; 1.21% Russian; 0.70% Portuguese; 1.27% other languages). Under these circumstances, the results of the research are not altered. VOSviewer software, version 1.6.19, was used for performing the bibliometric analysis.

The bibliometric research concerning digital entrepreneurship involved a co-occurrence analysis of the keywords. Fundamentally, the co-occurrence analysis delivers a visual representation of the connections among different criteria, such as keywords, publication, and co-authorship (where each of the selected criteria represents a different category of study) by mapping the links between them. Natural language processing techniques are used to identify words in text data (van Eck & Waltman, 2023), and based on this, the links between the terms were identified and graphically illustrated. To increase the relevance of the research, a minimum of 10 occurrences has been established per keyword. During the screening process, the 60% most relevant were extracted from the 10,396 returned keywords. To design an accurate network connection between the keywords, a refinement stage was required. The first step was represented by the term normalization. Specifically, it has proceeded to the merger of the similar or identical terms differently presented by authors and to the correction of spelling differences (i.e., *small firm*, *small firms*, *SME*, and *SMEs* were merged under *SME* term), by using a VOSviewer *thesaurus* file. Secondly, after the elimination of connecting terms, proper nouns, and others (authors, journals, connecting terms, etc.), the final results returned 178 terms, divided into 6 clusters. The clustering process of the final results was realized through VOSviewer, based on the connection algorithms that group the terms based on their relationship/connection (van Eck & Waltman, 2023). The literature will support the interpretation of each cluster.

Complementary to the quantitative approach, a systematic review—assuming a proposed methodology (Xiao & Watson, 2019)—was conducted on digital entrepreneurship. To achieve an appropriate framework on the topic and to create the premises for a better understanding of key elements in defining digital entrepreneurial

activity, relevant related studies were consulted, analyzed, and synthesized. Taking into consideration these assumptions, through the systematic review or an integrative systematic review (Pollock & Berge, 2017), an objective investigation of the existent research can be performed (Averis & Pearson, 2003) (Boell & Cecez-Kecmanovic, 2015).

## Results and Discussions

In recent decades, significant changes in traditional entrepreneurship have been observed due to the constant transfer of technological trends into economic activities (Keen & Williams, 2013). The emergence of the Internet and other digital technologies—as vectors of reforming the old habits of the market actors—was progressively integrated into entrepreneurial decisions and activities and led to digital venture creation (Kollmann, 1998). Based on this metamorphosis of entrepreneurship, significant changes were observed, even in terms of conceptualization of the existent realities. As was briefly illustrated in the introductory section, the academic literature allocated various spaces to demonstrate the intricacies between entrepreneurship and technological transformation, by using different terms such as e-entrepreneurship, technology entrepreneurship, Internet entrepreneurship, or cyber-entrepreneurship to describe an entrepreneurial approach digitally oriented. Recently, it can be stated that in an ICT era, the innovative dimension of the market process is strongly highlighted by the development of *digital entrepreneurship* as a study field, with numerous issues that are still under debate. Given the previous arguments and the importance of understanding this topic, we agree that a spotlight on digital entrepreneurship is required, taking into consideration that the information and communication technologies' impact on entrepreneurship has become progressively an important debate subject in the literature, inter-connected with the transformation of society. In this context, the evolution of the research on the topic exponentially increased with the digitalization trend, as can be identified in Table 1.

Furthermore, an examination of the categorization of publications (Table 2) reveals that the most prominently represented fields are as follows: business (874 materials), management (815 materials), economics (363 materials), education (308 materials), and computer science (203 materials). These categories primarily emanate from research contributions authored by scholars affiliated with institutions located predominantly in the USA (14.46%), the UK (9.98%), China (9.26%), Italy (7.69%), and Germany (7.15%). Based on the number of publications, the most

**Table 1** Digital entrepreneurship: the evolution of the topic in the research literature

1989	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	12	8	8	12	7	16	21	20	42
2014	2015	2016	2017	2018	2019	2020	2021	2022	02.2023
50	68	116	201	278	455	495	722	751	55

Source: own processing of Web of Science data

**Table 2** General information related to the analyzed materials

Materials by language	No	Materials by country	No
English	3.193	USA	487
Spanish	66	UK	338
Russian	41	China	312
Other languages	66	Other countries	2.229
Materials by research area	No	Materials by institution	No
Business	874	N8 Research Partnership	70
Management	815	University of London	40
Economics	363	Polytechnic University of Milan	32
Education	308	UDICE French Research Universities	31
Computer sciences	203	University of California System	30
Other areas	803	Other institutions	3.162
Most cited paper			Citations
Nambisan et al. (2017). Digital Innovation Management: Reinventing Innovation Management Research in a Digital World. <i>MIS Quarterly</i> , 23–238			948
Nambisan, (2017). Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship. <i>Entrepreneurship Theory and Practice</i> , 41(6), 1029–1055			838
Nambisan et al. (2019). The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. <i>Research Policy</i> , 48, 1–9			599
Warner and Wäger (2018). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. <i>Long Range Planning</i> , 52(3), 326–349			595
Autio et al. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. <i>Strategic Entrepreneurship Journal</i> , 12(1), 72–95			507



significant efforts to study digital entrepreneurship were observed in the case of N8 Research Partnership, University of London, Polytechnic University of Milan, and UDICE French Research Universities. To complete this framework, it should be stated that the most cited papers that address the analyzed topic are, mainly, related to Nambisan's work, which is seen as a leading author in the field of digital entrepreneurship.

A bibliometric examination of this topic has the potential to identify the main research trajectories in the field of academic exploration into digital entrepreneurship. With a focus on the identification and exploration of keyword clusters, such an attempt offers an alternative for an overview of the existing research literature. Starting from this point, dividing and analyzing the literature on digital entrepreneurship into clusters, according to keywords co-occurrence, are convergent with research objectives. As the previous part provides relevant information related to the methodological design, the process of analyzing the output is the next step. Therefore, Fig. 2 represents a graphic illustration of the resulting clusters, where each of them can be examined by colors. The nodes represent the connection between the keywords, taking into consideration their weight; each cluster comprises more nodes, where a small distance between keywords defines a strong connection between the nodes and vice versa. Also, it should be highlighted that the clusters are not overlapping (van Eck & Waltman, 2023, pp. 4–5). Table 3, which systematically compiled the top 10 terms related to the analyzed topic, provides complementary, relevant information.

As we can notice, *entrepreneurship* is the most co-occurred term in our analysis and belongs to the red cluster, which also includes a perspective of ICT's *impact* on

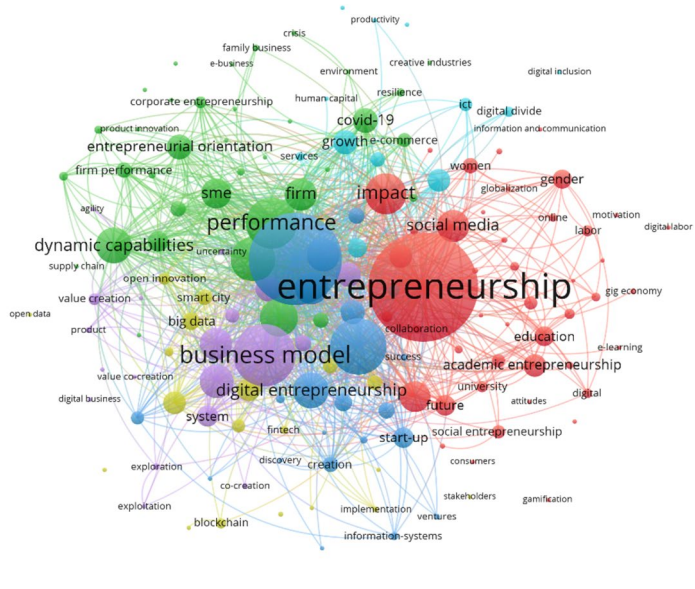


Fig. 2 Keywords co-occurrence map

**Table 3** Top 10 terms related to the analyzed topic extracted from the VOSviewer

No	Term	No. of occurrences	Total link strength
1	Entrepreneurship	759	3069
2	Innovation	625	3031
3	Business model	387	1903
4	Technology	348	1840
5	Performance	311	1780
6	Digitalization	262	1254
7	Impact	238	1267
8	Management	220	1218
9	Dynamic capabilities	204	1316
10	Digital entrepreneurship	203	956

the market process. *Innovation* and *technology* are associated with the blue cluster, where we can also identify *digital entrepreneurship*. Keywords such as *performance* and *business model* provide an analytic perspective on the effect of digital transformations on entrepreneurship, mainly grouped in the green cluster. In addition, the top 10 most frequently related terms include keywords such as *management*, *digitalization*, and *dynamic capabilities*.

For an accurate representation of each cluster, in addition to the top 10 terms related to the topic of digital entrepreneurship, we proceeded to identify the first five terms related to the keywords based on their occurrence. This extraction process, illustrated in Table 4, can help to draw a particular meaning of the clusters. Based on these assumptions, we will proceed to each cluster interpretation.

Digital entrepreneurship, as an integrative framework between entrepreneurial activity and digital transformations, has become a relatively new area for debate. Assuming the complexity of the topic, breaking it down into sub-topics, based on the co-occurrence and the interconnections between the terms, can facilitate the depiction of digital entrepreneurship. The database processing resulted in the identification of six clusters, with 178 relevant terms, that will be analyzed in what follows.

The *first cluster* resulting from the bibliometric analysis, represented in the previous figure in *red*, consists of terms related to the entrepreneurial process, mainly oriented to quantify and analyze the impact of technological evolution on the traditional market. By grouping the research using keyword co-occurrence and total link strength criteria, the most influential keywords of this cluster are *entrepreneurship* and *impact*. Besides them, the previous research studies bring to the fore associated concepts such as *social media*, *digital platforms*, *Internet*, *academic entrepreneurship*, and *future*, featuring a new perspective on entrepreneurial activity, mainly oriented toward beating the challenges of a permanently connected environment. Thus, it can be stated that the boundaries of entrepreneurship are becoming less defined due to the growing prevalence of digital technologies, leading to a rise in “everyday-everyone entrepreneurship,” which refers to the increasing ease and accessibility for individuals of all backgrounds to start and operate their own businesses, often from

**Table 4** Keyword clusters extracted from the VOSviewer

Cluster	The main keywords based on their occurrence	The first five terms related to the keywords based on their occurrence
1 (red)	Entrepreneurship, impact	Social media; digital platform; Internet; academic entrepreneurship; future
2 (green)	Performance, digitalization	Management; dynamic capabilities; firm/SME(s); entrepreneurial orientation; COVID-19
3 (blue)	Innovation, technology	Digital entrepreneurship; knowledge; business; digital technologies; start-up
4 (yellow)	Industry 4.0, entrepreneurial ecosystem	Big data; smart city; challenges; crowdfunding; artificial intelligence
5 (purple)	Business model, strategy	Digital transformation; networks; entrepreneur; system; value creation
6 (turquoise)	Growth, information	Digital economy; market; ICT adoption; institutions; digital divide

home or through online platforms (van Gelderen et al., 2021). Specifically, under the technological transformation, the development of digital platforms shifted the traditional entrepreneurial paradigm, by providing a permanent connection between producers and consumers (Kraus et al., 2019) (Korsgaard et al., 2020). Here, where the exploitation of entrepreneurial opportunities is a platform-based process (Hsieh & Wu, 2019), open innovation and strategy are key pillars (Greul et al., 2018), but their acceptance is conditioned by a future-oriented approach.

In-depth, the red cluster also investigates the impact of *social media* on entrepreneurship. In many cases, social media has accelerated and transformed the entrepreneurial process (Zhao et al., 2023) and has become a marketing tool, a starting point for learning or a network for the ecosystem (Secundo et al., 2020). Similarly, through digital transformation, e-commerce has experienced exponential growth that can contribute to firms' resilience (Costa & Castro, 2022) and to effortless internationalization (Goldman et al., 2020). Thus, according to different researchers, social media can influence digital entrepreneurial intention (Chakraborty & Biswal, 2023). While there are benefits associated with digital entrepreneurship, such as increased access to markets and reduced cost (Braune & Dana, 2022), there are also different disadvantages. An empirical research approach by Nambisan and Baron (2021) carried out on 201 surveys explored the costs of digital entrepreneurship, with a focus on role conflict, stress, and venture performance in digital platform-based ecosystems. An entrepreneurial challenge identified in different case studies refers to the permanent need to be innovative and adaptive to new technologies (Arvidsson & Troels, 2018) and market conditions, as well as the need to balance multiple roles and responsibilities (Braune & Dana, 2022). Consequently, the rapid spread of digital technologies has resulted in the downfall of businesses that failed to adjust to the changing landscape, while simultaneously creating new opportunities for entrepreneurial ventures capable of adapting (Weil & Woerner, 2015). In this context, the development of a new way of handling challenges by using digital technologies played a fundamental role in facilitating different types of entrepreneurship, which can be seen as the next step in market specialization. In this regard, the case of *female entrepreneurship* that has experienced exponential growth in the last years (Ughetto et al., 2019) must be highlighted, also taking into consideration the increasing rate of *internationalization* of their businesses (Pergelova et al., 2018). In practice, the use of ICT and the innovation culture are positively associated with woman entrepreneurship (Jiao et al., 2022). Nonetheless, a similar evolution can be identified in the area of *social entrepreneurship*, where digital platforms have become instruments in the process of building new connections between entities (Zhao et al., 2022). Also, a complementary dimension of this cluster draws attention to an essential duo, education and innovation, associated with another type of entrepreneurship, namely, *academic entrepreneurship*, which can facilitate technology adoption on the market and vice versa (Toniolo et al., 2020) (Oppong et al., 2020). Digital transformation also transforms how knowledge is acquired, especially in the academic environment, by contributing to the development of new skills (Garcez et al., 2022). Furthermore, in another way, it has led to a reconsideration of the structural pillars of academic entrepreneurial activity (Garcez et al., 2021) (Yu & Jiang, 2021). Addressing the requirements of the youngest generation, in general terms, an

adaptive educational system is mandatory, with a digitally supported entrepreneurial education (Secundo et al., 2021). Therefore, the next generation must be prepared for the future by achieving dynamic and digital capabilities (Bharadwaj et al., 2013).

Putting together the main subjects by referring to the analyzed cluster, it can be mentioned that the illustrated approaches cover a large area of research, mainly described as the *sharing economy*, which is inherently connected with digital technologies and their progress, including the boom of digital platforms (Wirtz et al., 2019) (Vallas & Schor, 2020). The unprecedented increase in the sharing economy around the world (Liu et al., 2020), sustained by the spread of the COVID-19 pandemic (Hossain, 2020), causes a society-wide spillover effect, especially due to its characteristics. Thus, it is noteworthy that crowd-based networks help to build a mass-market community, where trust (Hurne et al., 2017) (Czernek et al., 2018) and connectivity are fundamental (Sundararajan, 2016). Besides the theoretical aspects such as typologies and characteristics, the presentation of different case studies was preferred for exemplifying the sharing economy. Sectors such as tourism or transport are the ones that are affected by a “disruptive innovation” (Schumpeter, 1934), which transforms the traditional market process (Zervas et al., 2017) and promotes sustainability (Leung et al., 2019) (Dabbous and Tarhini, 2021). In this context, Airbnb and Uber are the most addressed cases (Geissinger et al., 2018) (Yi et al., 2020).

Overall, the impact of the sharing economy (Daviesa et al., 2017) (Frenken & Schor, 2017) is visible everywhere, from the lifelong learning process (Choi, 2020) to changes in consumer behavior (Lutz & Newlands, 2018). This conceptual framework, focused on digital technologies and entrepreneurship, contributes to developing both interconnections between fields of study (Nambisan et al., 2019) and the emergence of new ones (Eckhardt et al., 2019). Between promises and paradoxes (Acquier et al., 2017) (Martin, 2016), different authors criticized the sharing economy process, mainly for the “flexibility of the legal and economic environment” (Cavalic & Becirovic, 2017) (Altinay & Taheri, 2018). Additionally, the issue of building trust among platform users is significant as it influences partnerships and operations within the sharing economy.

The *green cluster* is mapping the entrepreneurial orientation through a *firm-oriented approach*, adapted to a *dynamic environment*, where every significant event/crisis can conduct a reconfiguration of the existent behaviors (Winston, 2020) Thus, the *digitalization* of traditional business models can be a key direction both in survival and achieving *performance*. The general trend of technological innovation spreading has affected not only the entrepreneurial activity, but also the technological market, which has experienced spectacular growth in recent years (Jafari-Sadeghi et al., 2021). More than this, the *COVID-19 pandemic* has led to a new framework for doing businesses, a framework where the entrepreneurs were forced to adapt for survival (Lungu et al., 2021) by identifying their competitive advantage (Ratten, 2021). The newly created context, with effects on the market and society, was supported by using digital instruments and digital transformation. Thus, the sanitary crisis led, on the one hand, to the emergence of new *entrepreneurial opportunities* in areas such as healthcare, technology, e-commerce, or entertainment (Modgil et al., 2022) and, on the other hand, to the development of an adaptive consumer,

oriented towards online purchasing (Alsolamy, 2022). The challenges were related to building resilient societies, where digital platforms have become an important instrument for providing education or social entrepreneurial activities (Korsgaard et al., 2020). In light of this, the adoption of digital technologies in entrepreneurial activity impacts a firm's performance, a performance where dynamic capabilities and business models serve as key pillars of this disruptive trend (Zhang et al., 2022) (Cenamor et al., 2019). Subsequently, the hypothesis of increasing the performance of the firm using digital technologies and supported by dynamic capabilities was empirically validated (Peng & Tao, 2022) (Ferreira et al., 2018).

A focus on fields such as *management*, *dynamic capabilities*, and *entrepreneurial orientation* highlights the necessity for adaptation. Against this background, the firms created digital innovation units (DIUs) (Hellmich et al., 2021) (Abubakre et al., 2021) in order to stay up to date with digital trends and promote dynamic capabilities (Soluk et al., 2021). Similarly, the suggestion made by practitioners is that dynamism requires a continuous network connection with other actors involved in the market process; in this regard, digital platforms can be seen as solutions to gain a competitive advantage (Li et al., 2017) and, why not, to achieve a healthy ecosystem with adaptable organizations (Teece, 2017). Here, dynamic exchange capabilities co-create and co-capture value for the ecosystem (Siaw & Sarpong, 2021). Starting from these arguments, a broader view of entrepreneurial activity also focuses on the internationalization of businesses. According to different authors, digital transformation has a significant potential for facilitating the firms' *internationalization* (Feliciano-Cestero et al., 2023) and their success in a foreign market (Herve et al., 2020).

All of these aside, entrepreneurial activity remains the driving force of the market process, leading the development of sustainable business models by assuming different typologies of *digital capabilities* (Gao et al., 2022) (Annarelli et al., 2021). In this context, visible changes in the different managerial processes and a reorganization of the strategic perspective are imminent (Warner & Wäger, 2018) (Tahirkheli & Ajigini, 2022), considering the fact that "digital transformation is as much about strategizing as it is about technology" (Volberda et al., 2021). Thus, reshaping entrepreneurial activity through digital transformation determined a snowball effect on (almost) every inter-related field, such as management or strategy, where the reevaluation of traditional business models is dependent on new skills and competencies, based on a learning-centered approach. These competencies, particularly digital communication skills, are included in the area of digital marketing (Lehmann et al., 2022). In other words, digital marketing has become fundamental in developing digital entrepreneurial activities (Amjad, 2022), and it is sustained by the permanent connection to mobile devices/terminals (Felix et al., 2017) (Rauschnabel et al., 2019). In a 4.0 industry, reshaping and integrating marketing digital solutions has become mandatory for managing the actual processes (Ardito et al., 2018).

The *third cluster*, represented in *blue*, emphasizes *innovation* as a pillar of entrepreneurial activity, which is closely associated with the topic of *digital entrepreneurship*. Hence, keywords such as *technology*, *digital technologies*, *start-up(s)*, *opportunity*, and *knowledge* are frequently used when analyzing the field of digital entrepreneurship. Basically, the identification of *new business opportunities* is

intrinsically linked to the digitization process and the transformation it brings to entrepreneurial activities (Richter et al., 2017). Specifically, the impact of ICT transformation in the field of entrepreneurship can be summarized as a *digital dividend* (Galindo-Martin et al., 2019) that helps to increase competition and to boost the implementation of innovation; complementary, the reduction of transaction cost was identified as a benefit (Braune & Dana, 2022).

Overall, *knowledge*, as a topic in entrepreneurial studies, brings to the fore issues such as information asymmetry, the subjective value of information (Hayek, 1945), and of course, knowledge as capital (Lungu, 2022). A knowledge-based entrepreneurial ecosystem was developed through digitalization, where instruments such as artificial intelligence and online platforms have become indispensable (Sahut et al., 2019) but, at the same time, challenges as open-source collaboration can negatively impact entrepreneurial opportunities (Lin & Maruping, 2022). However, assuming a knowledge-based approach, both the existing firms and start-ups have developed a new way of doing businesses (Geissinger et al., 2018), convergent with a dynamic attitude and capabilities (Kraus et al., 2019), digitally oriented. In this regard, a network-centric view suggests a bidirectional relationship between entrepreneurs and digital platforms. On the one hand, in a connected market, digital networks are ways of achieving profits, using existing products and processes, and, on the other hand, the entrepreneurs play a part in the development of platforms (Srinivasan & Venkatraman, 2017). Therefore, through digital tools and dynamic capabilities, a boost in entrepreneurial orientation and knowledge sharing leads to opportunity recognition (Sahut et al., 2019) and new business creation (Cunningham et al., 2019).

Putting together the concepts associated with this cluster, significant aspects in defining the concepts of digital entrepreneurship were identified that were briefly exposed in the introductory section of the present research article. To complete the theoretical framework, different empirical studies provide arguments for supporting that the dynamism of the market process conducts disruptive innovation (Pang & Wang, 2023). In this regard, the opportunities led by the innovation ecosystem can facilitate the increase of the competitive dimensions of entrepreneurial activities (Filho et al., 2023).

The *fourth cluster*, represented in *yellow*, includes terms related to the implications of digital transformation on *entrepreneurial ecosystem*, with a particular focus on *big data*, *smart city*, *artificial intelligence*, and *crowdfunding*. These elements promote the emergence of an entrepreneurial ecosystem and, at the same time, provide the premises for new business growth and the opportunities discovered (Du et al., 2018). Starting from these aspects, there were also identified *challenges* that address entrepreneurial activities in a current transformational environment, dominated by *digitalization process* and *industry 4.0* phenomena, but also important changes in consumer expectations (Leitão et al., 2016), mainly through the technological fusion that reduces the old barriers (Kruger & Steyn, 2021). Due to the Internet's capacity to reduce spatial barriers and the evolution of innovational technologies, we can assume the international dimension of digital entrepreneurship (Ahsan & Musteen, 2021), and the new alternative of crowdfunding, especially for start-ups, that benefit from online crowdfunding by using it to get over geographical limitations and make it easier to create complex networks (Mollick, 2014). Today,



the funding of entrepreneurial activities can be associated with accumulating capital through digital platforms, no matter if it is about social entrepreneurship (Chandna, 2022), woman entrepreneurship (Wang et al., 2022), financial market (Butticè & Vismara, 2021), etc. Oppositely, different authors identified the dependence of digital entrepreneurship on internal funding sources, especially in the early stage (Schueckes & Gutmann, 2021).

Overall, this cluster emphasizes that nowadays, entrepreneurial activity is significantly influenced by digital technologies (Zhai et al., 2023) or *digitally driven* (Sedera et al., 2022), as it was observed in the particular case of artificial intelligence—as an ongoing process—with consequences on business opportunities and, finally, on business models (Marr & Ward, 2019). Thus, in the context of industry 4.0 technologies and their transformative potential, entrepreneurs require a specific set of competencies to navigate the intricacies of this globally interconnected and technology-driven environment (Kruger & Steyn, 2021). Hence, while a significant influence on developing the controversial concept (Trencher, 2019) of a smart city ecosystem (Schiafone et al., 2020), as an aspirational and technology-centered paradigm (Trencher, 2019), was insufficiently exploited in connection with digital entrepreneurship (Kraus et al., 2019), the effects of adopting industry 4.0 related technologies were also identified at the firm's performance level, as well as organizational resilience (Marcucci et al., 2021) and competitiveness (Chan et al., 2018). Particularly, the significant role of artificial intelligence in business performance was observed (Upadhyay et al., 2022). Taking into consideration these aspects, the entrepreneurial ecosystem appears to be a digital one, which is grounded on a macro-environmental approach, beyond the firm level (Spigel, 2015). Here, a general tendency to recover and build more resilient businesses, mainly explained by digitalization (Khlystova et al., 2022), as well as expanding the national businesses outside the national borders, was observed. Overall, digital tools facilitate the formulation of a conceptual framework for entrepreneurship on a global scale (Prashantham et al., 2019), where the supporters of institutions, the co-working space operators, and the niche players are the main actors (Du et al., 2018).

Moving forward to define the *purple cluster (cluster 5)*, the bibliometric approach illustrates that *business model* and *strategy* are core elements in studying the topic of digital transformation's effects on entrepreneurship, supporting the statement that “no sector or organization is immune to the effects of digital transformation” (Rêgo et al., 2022). Hence, it can be stated the dynamic character of the firms and, consequently, of the business models (Cavallo et al., 2023). According to the VOSviewer results, the most addressed keywords are *digital transformation*, *networks*, *entrepreneur*, *system*, and *value creation*. Generally, a spotlight on this cluster highlights the impact of digital transformation on sustainability (George et al., 2020), by using disruptive technologies such as digital twins (Kamble et al., 2022) and developing new skills (Schiuma et al., 2022). Thus, digital skills and capabilities are not solely exploited in one area, but rather their relationship with the general impact, for example, in sustainable management or sustainable strategies (Busulwa et al., 2022).

Taking advantage of digital entrepreneurship to achieve business value (Hattingh et al., 2020), we can assume the possibility of digital transformation leading to digital entrepreneurial activities and vice versa; digital entrepreneurship can also



determine digital transformation (Hull et al., 2007). Subsequently, the process of digital transformation requires the design of a new digitally oriented strategy (Hess et al., 2016). As a result, the higher flexibility offered by digital technologies (Sahut et al., 2019) offers the premises for value creation (Sussan & Acs, 2017) and new sustainable growth business models (Gavrila & Ancillo, 2022) (Gehde et al., 2022). For example, this can be illustrated through Lean Startup Approaches—as agile business models and their applications in entrepreneurial activities. Particularly, essential elements of value architecture, which include value creation, value delivery, and value capture techniques, are seen as the primary focus of early-stage business model innovation for digital firms (Ghezzi & Cavallo, 2020), especially as a result of artificial intelligence (Pfau & Rimpp, 2021) and big data (Zeng & Glaister, 2018) increasing trend. Additionally, the *platformization* as a business value creator was associated with the development of an entrepreneurial ecosystem (Song, 2019). Even if the potential value of the digital entrepreneurial ecosystem (Hsieh & Wu, 2019) was recognized, an insufficient conceptualization of derivate business models (Standing & Mattsson, 2016) and the way in which a company can handle these entrepreneurial opportunities (Anubhav et al., 2022) were observed.

Finally, *the sixth cluster*, represented in *turquoise*, is framing a general debate on *growth* in the digital era, with a particular focus on *information* and *ICT adoption* effects on the traditional market, reshaped in a digital one. This assumption implies that traditional business models may require reconsideration, as digital entrepreneurs are compelled to adjust rapidly for the purpose of coping with market conditions and technological developments, to maintain their competitive advantage in a dynamic market. Fundamentally, the key points of entrepreneurial activities in a sharing economy/digital economy have been changed, whether we consider the processes, institutions, or value creation (Eckhardt et al., 2019). In the case of emerging economies, digital transformation can contribute to economic development (Jawad et al., 2020) through competition (Beltagui et al., 2020). However, it should be stated that the lack of trust in *institutions* could affect the overall activity, generally in countries with a low level of entrepreneurial freedom (Hansen, 2019) (Zemtsov et al., 2022).

Fundamentally, the emergence of technological and institutional transformations, which is frequently associated with the realm of digital entrepreneurship, appears to be more favorable to development within urban agglomerations, where lower transaction costs, a diverse array of stakeholders, access to policymakers, and market heterogeneity prevail. As a result, the critical role of cities in overcoming institutional obstacles to the expansion of digital entrepreneurship and accessibility growth was underlined (Martinez Dy, 2022). These metropolitan areas, which frequently necessitate institutional adjustments to support the continued expansion of digital scale-ups, tend to provide the contextual requirements required for achieving institutional change (Geissinger et al., 2019). Even so, these statements are strongly related to the connectivity issues. In this regard, it was argued the significance of higher connectivity for developing entrepreneurial activity (Audretsch et al., 2015) (Alderete, 2017) is influenced by structural and cultural aspects (Martinez Dy et al., 2018), where a significant advantage was identified at the large firms level (Destefano et al., 2018). Additionally, it was discovered that, through digital entrepreneurship, the *digital divide* and the *discrepancies* between the genders are still persistent (Duffy

& Pruchniewska, 2017), even if the increase in using digital platforms favors the woman entrepreneurial intentions and opportunities (Martinez Dy, 2022).

The digital economy is inherently connected with digital skills and infrastructure. Hence, it can be stated that in dealing with new challenges (Ketchen & Craighead, 2020), a vital role can be attributed to digital skills and the available networks (Afutu-Kotey & Gough, 2022). Starting from these assumptions, the digital discrepancies are visible in terms of implementing digital technologies in the businesses, as Hull et al. (2007) previously observed it, according to which we distinguish between low, intermediate, and highly digitalized businesses. Extending the argument to a large scale, there are various studies and measurements that empirically support the discrepancies between the countries, such as *Digital Economy and Society Index* or *Digital Skills Gap Index*.

Gravitating around *digital entrepreneurship* concept, it can be emphasized its interconnection with a complexity of elements that were exposed using the previous cluster approach. To accomplish the view on the analyzed topic and to yield an integrative conceptual framework that underscores the complex nature of entrepreneurial endeavors in a digital era, we assume as mandatory a spotlight on the most important nodes between keywords, having as a starting point *digital entrepreneurship*, graphically provided in Fig. 3.

Generally, the emergence of digital technologies in entrepreneurial activities postulates the shift in the market process and requires a set of dynamic capabilities

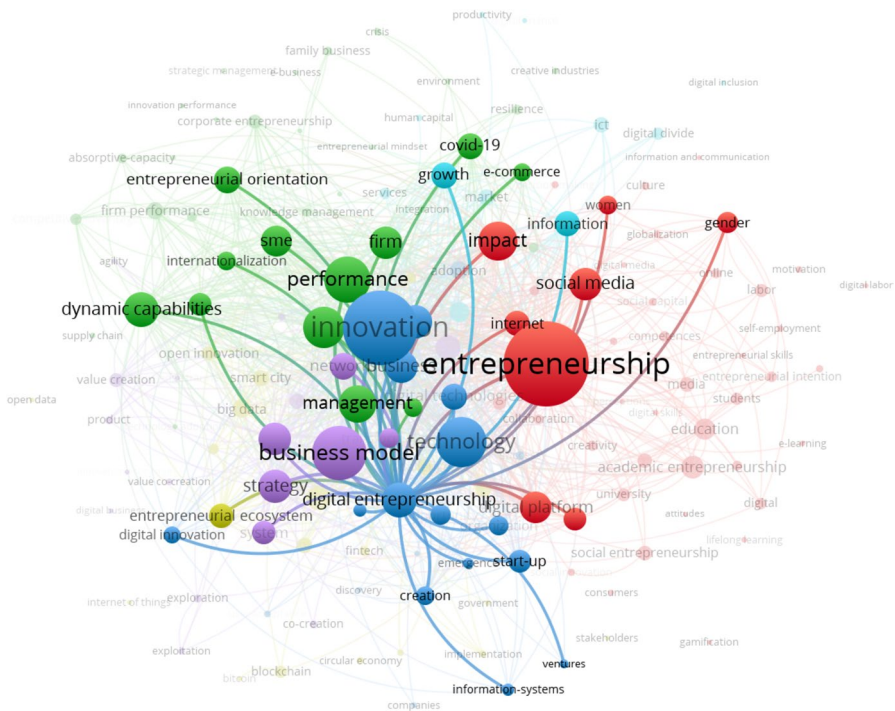


Fig. 3 Digital entrepreneurship connection with related terms

for dealing with the uncertainty associated with this transformation. Under these circumstances, the development of new business models was a spontaneous reaction of the entrepreneurial actors that were constrained to adapt their businesses, including the managerial and strategic perspectives. To support this statement, the internationalization of businesses and the growth of different types of entrepreneurship (i.e., social entrepreneurship, woman entrepreneurship, academic entrepreneurship) are eloquent examples. Specifically, the use of different digital tools, such as digital platforms and social media channels, led to the creation of related start-ups (Geissinger et al., 2021) and the development of sharing economy—as a plethora of business models (Öberg, 2023). These *reactive businesses* (Schlagwein et al., 2019), significantly impelled by the COVID-19 pandemic, proved the spreading of the entrepreneurial orientation in different environments and the impact of innovation and technology on firms' performance (Ferreira et al., 2018). Progressively, the elements composing the digital entrepreneurial ecosystem have arisen; smart city, artificial intelligence, big data, or digital platforms are just some examples that have become associated with this new trend of the transformative market process. This image is fulfilled by the dynamic capabilities and digital skills, as key elements of this new society, where the development of new business models, influenced by digital transformation, is associated with value business creation.

## Conclusions

The emergence of digital technologies transformed not only daily activities, but also entrepreneurship. Subsequently, digital entrepreneurship, as a fast-growing field derivated from changes, combines heterogeneous elements that build a particular ecosystem that integrates both entrepreneurship and digital transformation. The digital entrepreneurial ecosystem entails the use of digital tools and similar instruments to create innovative products and services, driving economic and social development, coming also with its own challenges and opportunities. Starting from these premises, the article discussed digital entrepreneurship as a relatively new area of study, by adopting a bibliometric approach, based on the resources available on the Web of Science database. The methodological endeavor supports the achievement of the proposed goal, i.e., mapping the topic of digital entrepreneurship, using qualitative and quantitative methods.

Based on studying the previous research, there were identified six clusters of relevant terms through bibliometric analysis and explored the interconnections between various fields of study, including the bidirectional relationship between entrepreneurs and digital platforms, as well as the effects of digital transformation on sustainability, emphasizing the impact of digital transformation on entrepreneurial activity and society. Overall, the research brings to the fore the critical role of digital transformation in relation to entrepreneurship, leading to new opportunities and challenges in various fields, as well as the increase in the competitive process, inside and outside the national borders. The complexity of the topic, supported by the various connections between keywords and nodes, requires deep analysis, to provide an accurate picture of digital entrepreneurship. A focus on the analyzed clusters

has explored the impact of digitalization in new types of entrepreneurship (i.e., academic entrepreneurship, female entrepreneurship, social entrepreneurship), as well as the development of new ways of handling challenges through digital technologies, which has played a fundamental role in facilitating entrepreneurial activities. In this regard, the reactive business models and adaptive strategies should be mentioned, together with the growth of dynamic capabilities and digital skills. In an industry 4.0 era, new e-businesses have become a trend for dealing the rapid technological changes. Consequently, artificial intelligence and big data, as a part of the digital entrepreneurial ecosystem, led to new approaches for profits and competition.

Visualizing together the results of the present research, it can be stated that the main contributions are convergent with the established goal and subsequently, with the research objectives. Firstly, the article emphasizes an up-dated image of the digital entrepreneurship topic, by analyzing and presenting the previous academic research, having as a starting point a co-occurrence analysis of the keywords. Simultaneously, this work provides an integrated approach to bridge the gap identified in previous research studies that investigated digital entrepreneurship. Overall, the methodology employed in this research paper combined both quantitative and qualitative methods to provide a comprehensive framework for digital entrepreneurship. Secondly, by clustering the associated keywords, a map of digital entrepreneurship was provided, using VOSviewer software. This facilitates the understanding of the connections between the associated keywords and provides an overview of the most frequent debates identified in the literature. The higher the node or, similarly, the higher the cluster, the more intense the debate on that specific aspect. In our case, it can be stated that a significant attention allocated in the literature was focused on three particular clusters (cluster 1/red, cluster 2/green, and cluster 3/blue) that explored, in general terms, the impact of digital transformation on entrepreneurship.

The limitations of this research primarily relate to the selection of a single database, namely, Web of Science. Thus, the endeavor can be criticized for a partial approach. Building on the limitation, one of the future research directions is to extend the analysis to other databases and to combine different ones (i.e., Scopus), in order to provide a more accurate bibliometric approach. Another identified limitation is related to the Boolean integration, which only included terms related to digital entrepreneurship and excluded similar concepts, such as *e-entrepreneurship* or *technological entrepreneurship*. Based on this, the research can be extended to provide an evolutionary perspective on the digital transformation's impact on entrepreneurial activities, and not only the view on a niche field, known as *digital entrepreneurship*. Complementary, it should be stated that assuming the exponential growth of the topic in recent years and the ascendant trend, the study provides a static picture and not a dynamic overview. In this regard, we are taking into consideration another interrogation of the database(s), assuming the same Boolean query, to comparatively interpret the results, after another growth in terms of efforts focused on studying the topic. Also, measuring the citations of the papers will complete future research.

Particularly, based on the findings, the implications of the research can be translated into the practice, for improving different categories of results. The practitioners can consider the results in order to encourage the development of new areas and

strategies, for increasing the profits from digital entrepreneurship. Based on their implications, grounded on a theoretical understanding of the topic, the knowledge transfer and collaboration of different actors will facilitate the development of the digital entrepreneurial ecosystem. Last, but not least, the policymakers can take into consideration the results, for helping the innovation fostering in different key points of digital entrepreneurship, through appropriate policies.

## Declarations

**Conflict of Interest** The authors declare no competing interests.

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