

Digital Entrepreneurship: Global maps and trends of research

Design/methodology/approach: The bibliometric analysis was applied to offer a technological review on digital entrepreneurship. Seven hundred and four publications and their 34083 references from Web of Science (WoS) were retrieved as the sample set. Basic characteristics of publications, including the most influential documents, authors, journals, and countries, etc. were obtained. Then, co-citation and co-occurrence analyses were conducted to sketch the contours of the structure and evolution of digital entrepreneurship.

Purpose: Digital technologies, such as big data and artificial intelligence, significantly impact entrepreneurial activities worldwide. However, research on entrepreneurial activities enabled by digital technologies is fragmented, divergent, and delayed. This study aims to provide a structured review of digital entrepreneurship to identify status, hotspots, knowledge structure, dynamic trends, and future developments in this field.

Findings: Digital entrepreneurship (DE) has attracted increasing attention in the past three decades, especially after 2013. There are dozens of countries, hundreds of journals, and more than 1,000 authors that have contributed to this field. Based on keyword co-occurrence clustering and co-citation clustering, we proposed a 3E (empower, evolution, and ecosystem) framework of digital entrepreneurship to facilitate an interdisciplinary dialogue for evidence-based policymaking and practice. In the future, researchers need to pay more attention to theoretical research and study digital entrepreneurship from a holistic and dynamic perspective with consideration to the negative impact of digital technology on entrepreneurial activities.

Originality/value: The current study draws an outline of the global advance on digital entrepreneurship research. It presents an opportunity to comprehensively understand the contemporary achievements, the march of knowledge, and the logical vention underlying academic developments as well as foundations for policy-making.

Keywords: Digital entrepreneurship; Bibliometrics; Research hotspots; Knowledge mapping

1. Introduction

Humankind has entered a new era of digital technology revolution, and almost all countries in the world have realized that this digital transformation has been the main source of new economic and social developments (Shrader *et al.*, 2000; Pergelova *et al.*, 2019; Sang *et al.*, 2020; Zhang *et al.*, 2020; Anumba *et al.*, 2021). Digital entrepreneurship (DE), the entrepreneurial action enabled by digital technologies, is naturally ubiquitous among global corporate giants as well as countless emerging start-ups (Hull *et al.*, 2007; Zaheer *et al.*, 2019). The booming development of DE has not only significantly shaped the trajectory of industries and markets, but has also turned into a powerful driving force for social evolution (Lin *et al.*, 2020; Nambisan *et al.*, 2019; Tang and Meng, 2020). It has brought fundamental changes in economic growth patterns, industrial layouts, entrepreneurial models, and lifestyles of human beings (Zaheer *et al.*, 2019).

Because of its rapid growth, DE has brought enormous opportunities for academic research. Rosenbaum and Cronin (1993) discovered that visionary entrepreneurs began to use the information superhighway for entrepreneurial activities. Following this seminal study, research on DE has expanded to include various related topics in business and management fields, such as factors affecting DE (Hair *et al.*, 2012; Scuotto and Morellato, 2013; Ziyae *et al.*, 2014; Alderete, 2015, Hansen, 2019), DE models (Hull *et al.*, 2007), entrepreneurial opportunity identification (Hafezieh *et al.*, 2011), market orientation (Hair *et al.*, 2012), network infrastructures (Alderete, 2015), and digital entrepreneurship ecosystems (DEE) (Li *et al.*, 2017; Stam and Spigel, 2018).

Although trends emerge and fade, there is still a lack of consensus on this topic. Scholars recognize that DE has the following three distinct characteristics (Kollmann *et al.*, 2009; Klotz *et al.*, 2013; Farani *et al.*, 2017; Giones and Brem, 2017): (1) Entrepreneurs combine digital technology with marketing, operations, communication, and other aspects of an enterprise; (2) The core business of startups needs to be closely related to digital technology; and (3) The enterprise generates strategic directions and business models based on digital technology. Without digital technologies such as the internet companies will not be able to survive.

Based on these characteristics, many early digital startups have developed into very successful companies, such as Amazon (an e-commerce company), Google (a search engine company), Facebook and Twitter (social media companies), and Microsoft (an operating system company). Although large companies have occupied a lot of market share in the digital industry, emerging new technologies have brought opportunities for startups. The internet of things (IoT), artificial intelligence (AI), big data analysis, and blockchain fields have created room for new digital startups to generate new digital technologies in the future (Pergelova et al., 2019; Hu et al., 2020; Tian et al., 2020; Wang et al., 2021). For example, these technologies enable more efficient functions in logistics operations (Feng and Ye, 2021). However, disciplinary boundaries in this rapidly developing field have erected an invisible wall between researchers and a large part of the existing literature. Research on entrepreneurial activities enabled by digital technologies is fragmented, divergent, and delayed. This study aims to provide a structured review of digital entrepreneurship to identify status, hotspots, knowledge structure, dynamic trends, and future developments in this field.

To adopt a broader perspective and address the need for more research on the topic (Hasnain *et al.*, 2019; Kraus *et al.*, 2019), this study aims to systematize the scientific achievements related to DE by providing scholars with a holistic overview of the fragmented literature available, and by proposing possible future research streams. These findings would help policymakers and practicing managers to effectively promote or embrace DE. With this, a bibliometric analysis was conducted to answer the following research questions (RQ):

RQ1: What was the past research framework of the digital entrepreneurship?

RQ2: What is the current research framework for digital entrepreneurship?

RQ3: What will be the future research framework of digital entrepreneurship?

Bibliometrics can reveal the law of scientific literature development and its distribution, the development history of a specific field, current research hotspots, and future development trends (Merigo *et al.*, 2015). Based on the results of bibliometric analysis and scientific mapping, several indicators were considered to identify the most

influential documents, authors, journals, and countries. Thus, a model framework for DE was created.

The results of the bibliometric analysis showed that the literature related to DE began more than 20 years ago and has shown an increasing growth trend in the past decade. Although several countries worldwide have paid attention to this field, the influence of the United States is far greater than theirs. However, the United States has a relatively low willingness to cooperate with other countries. Consequently, other countries are encouraged to study this field and strengthen international cooperation. Most articles were completed by multiple authors, but cooperation and networking among them were rarely formed. For example, more than 60% of the journals focusing on business and management fields also involve broader research directions, such as computer technology.

In addition, the results of science mapping enabled the identification of structures. The conceptual structure was analyzed through keyword co-occurrences and literature co-citations, which identified three thematic clusters: empowerment, evolution, and ecosystem. The influential literature and essential research directions introduced DE research topics and possible future research directions. Although a lot of studies on DE have been conducted, there are still some issues that need more attention from the academic community: (1) paying attention to integrity and dynamic evolution will help carry out future research; (2) the negative impact of digital technology on entrepreneurship needs to be considered; (3) advanced theoretical development is confronting urgent calls.

The rest of this study is organized as follows: Section 2 describes the adopted methodology; Section 3 presents the results of the bibliometric analysis; Section 4 discusses the results of science mapping; Section 5 contains the discussion; and Section 6 reports the conclusion.

2. Methodology

The inspiration for employing bibliometric analysis stems from Chen (2004). Its large-scale quantitative assessment of published documents could offer a panoramic vision of scientific communication, knowledge structure, and evolutionary trajectory in

a particular research field (Yuan *et al.*, 2021). As a technology-based review, bibliometrics can introduce systematic, transparent, and reproducible findings based on the statistical measurement of science, scientists, and scientific activity. Compared with typical author-scoped reviews, this method can provide more reliable and objective results (Broadus, 1987) For example, some of the significant achievements have been made in fields of management, family business, and sharing economy (Kraus *et al.*, 2020; Mas-Tur *et al.*, 2020; Rovelli *et al.*, 2021).

In this study, we used bibliometrics to analyze global advances in DE research. Academic research on this subject has been conducted for more than 20 years, resulting in a significant number of relevant publications. Despite numerous publications, there is still a distinct fragmented knowledge pattern (Briner and Denyer, 2012). For example, benefits and disadvantages always coexist, the negative impacts of digital technology on entrepreneurship need to be considered. Furthermore, the march toward marrying remarkable practice with theoretical advancement is articulated with the hope of greater attention. Therefore, a synthetic overview is needed to coherently sort out the literature, and provide an agreed terminology and direction for prospective progress (Rousseau, 2012). By collecting and screening a large amount of comprehensive information, we aim to discover the development trends and research topics from the most prolific institutions and authors of DE research. We aim to present an opportunity to understand the knowledge and logic of DE evolution in a global context, which is essential to future policymaking.

2.1 Data collection

High-quality and comprehensive data are the key to obtaining reliable analysis results (Carvalho *et al.*, 2013). Web of Science (WoS) from Clarivate Analytics is one of the world's largest scientific databases, containing more than 15,000 international academic journals and over 90 million documents. Its core collection covers publication in various domains, including the Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), Arts Humanities Citation Index (A&HCI), and Emerging Sources Citation Index (ESCI). Because of these advantages, the WoS Core Collection was selected as the original database for this study.

Given the varying concepts in different disciplines, it was not surprising that “digital entrepreneurship” had diverse expressions. Collecting relevant publications without narrowing down the search raised some challenges. Therefore, we deliberately designed our search strategy. First, we used “digital” and “entrepreneurship” as the primary search formulas to ensure the relevance and comprehensiveness of the data. As there was no consensus in the early academic circles, there were multiple studies in the same field that used different words to denote digital entrepreneurship, such as “internet entrepreneurship,” and “digital startup.” Then, we added “internet,” “cyber,” “startup,” and other keywords to cover the existing research of digital entrepreneurship more comprehensively. Finally, to avoid the loss of generality, the supplementary search formula was as follows: “digit* start up,” “digit* startup,” “cyber entrepreneur*,” “internet entrepreneur*,” “internet startup,” “internet startup,” “online entrepreneur*,” “online start up,” “online startup,” “e-entrepreneurship,” “e-startup,” “digit* venture,” “internet establish,” “internet venture,” or “big data entrepreneur*.”

Between January 1, 1985, and March 8, 2021, which was the period of data acquisition, 723 publications and 34,802 references were retrieved as the sample set. More detailed information of the retrieved publications, such as authors, institutions, periodicals, keywords, abstracts, and citations, were also structured for further analysis (Rousseau, 2012).

2.2 Selecting articles for the database

Before the final data analysis, it was necessary to pretreat the retrieved data. There were two criteria for data pretreatment in this study: (1) meta-synthesis and (2) relevance and authority.

The meta-synthesis method of Tranfield *et al.* (2003) was first applied in the medical field, and was also later widely used in business and management literature reviews. Massaro *et al.* (2016) developed a structured literature review (SLR) and provided researchers with 10 SLR steps as follows:

1. Write a literature review protocol.
2. Define the questions that the literature review sets out to answer.
3. Determine the type of study and conduct a comprehensive literature search.
4. Measure article impact.

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5. Define an analytical framework.
 6. Establish literature review reliability.
 7. Test literature review validity.
 8. Code data using the developed framework.
 9. Develop insights and criticize them by analyzing the dataset.
 10. Develop future research paths and questions.

While having a structure is advocated, the implementation of an SLR is flexible. SLRs provide an approach that can help academics discover under-investigated topics and methods, and develop new knowledge areas and research approaches.

Data relevance and authority are well-regarded by Zaheer *et al.* (2019). Relevance means that the article must be related to DE. In this study, some articles were excluded due to a lack of direct relevance. Authority means that the selected article must cite a reliable source. For example, consider *Dual Cage High Power Induction Motor with Direct Start-up: Design and FEM Analysis*. This title includes “start-up,” but the paper presents an investigation on the design of high-power induction motor with special constraints (Livadaru *et al.*, 2013). Such articles have nothing to do with DE; therefore, similar articles were not covered in the dataset. Based on these two criteria, the final dataset comprised of 704 scholarly articles and 34,083 references.

3. Bibliometric analysis

Literature is the carrier of human knowledge and has the function of cognition and storage of knowledge. In 1969, after The British intelligence scientist Alan Britchard put forward the term "Bibliometrics", It has attracted increasing attention from researchers. There are many research methods of bibliometrics, compared with traditional literature review, professional bibliometrics tool has the characteristics of large literature volume, long practice span and visualization results from multiple dimensions. Bibliometrics has be widely applied in the research of various disciplines, such as transportation (Najmi *et al.*, 2017), public administration (Curry *et al.*, 2018), solar cells (Yeo *et al.*, 2020). Karus et al. have made a systematic literature review in entrepreneurship research (Karus *et al.*, 2020) and digital transformation in healthcare (Kraus *et al.*, 2021). This study adopts the bibliometrix *R* package as an analytical tool.

The package supports a recommended workflow to perform bibliometric analyses and is widely used in the ever-changing science domain (Aria and Cuccurullo, 2017).

A total of 704 scholarly articles were published between 1999 and 2021 across 401 journals. Among the articles' disciplines, *business* and *management* accounted for more than 60%, followed by *information science*, *computer science*, *economics*, and *environmental studies*. There were 1,674 authors in 704 scholarly articles, with an average of 2.38 authors per publication. The top three authors with the highest number of relevant publications were Kraus, Ghezzi, and Cavallo. The top three institutions with the highest number of relevant publications were Renmin University of China, University of Texas in Austin, Texas, and Politecnico di Milano in Italy. Countries like China, United States, and Italy, where these institutions are located, are also influential countries where research on digital entrepreneurship is relatively active.

3.1 Time evolution of articles

Fifty articles were published between 1999 and 2013. Research on digital entrepreneurship has entered a stage of rapid development since 2014, with a total of 654 articles published, averaging a compound annual growth rate (CAGR) of more than 50%. The number of articles published since 2014 accounts for more than 90% of the total number of articles on DE. Using 2013 as the boundary, this study divided the evolution of articles into two time slices: 1999–2013 and 2014–2021 and discussed the influential articles and research content of each time slice. This study was performed to provide a more comprehensive picture of the different topics that scholars have studied over the years and to determine the path for future research. Figure 1 shows the number of articles published each year on DE.

<Insert Figure 1>

Figures 2 and 3 show thematic maps of 1999-2013 and 2014-2021, which were determined based on centrality (drawn on the X-axis) and density (drawn on the Y-axis). Centrality measures the degree of relevance of a theme to other themes, while density measures the level of agglomeration within the theme (Forliano *et al.*, 2021). For example, the upper-right quadrant contains themes with high centrality and density, in which the theme develops well on its own and influences the other themes.

<Insert Figure 2>

<Insert Figure 3>

3.1.1 Time slice 1: 1999–2013

In the early days of DE studies, researchers observed that digital technology has a particular impact on entrepreneurial activities; therefore, they conducted research mainly on this phenomenon. Figure 2 shows the main research directions of the articles in this period, including behavior, innovation, knowledge, economy, and strategy.

It can be seen from the thematic map that the research themes in this period were concentrated in the first and fourth quadrants, with a relatively high centrality, thereby indicating that the themes have a strong correlation with other themes. However, with dynamic and institutional entrepreneurship, it had a high-density level, thereby indicating that the themes have a high intra-cluster cohesion.

Early research on digital entrepreneurship suggests that scholar mainly focused on combining digital technology and existing business activities. For example, towards the end of the 20th century, many companies have not yet widely accepted e-commerce. A startup company still faces several obstacles when selling software products to other companies. It must adjust its strategy, develop after-sales support, enter international market, and increase customer awareness (Leidner, 1999). The economic development of the region, where the startup company is located, is also an essential factor that affects the company's growth. Differences in telecommunication services and infrastructure have an extraordinary impact on local digital startups (Guillen and Suarez, 2001; Roper and Grimes, 2005; Kleman, 2006; Tsai *et al.*, 2008). Social control, authoritative sources, and community barriers also impose some constraints on some digital entrepreneurs (Campbell *et al.*, 2011). Business incubators engaged in digital technology can strengthen the connection between entrepreneurs, suppliers, and customers, thereby helping startups grow (Carayannis *et al.*, 2005).

Dynamic capability and innovation are characteristics that digital enterprises must possess. In the digital age, market barriers have become fragile, and market changes have accelerated. The digital revolution requires companies to dynamically adjust their core competencies (McGrath, 2013). Digital-based startups must use new technologies

to adapt to the rapidly changing business environment (Siu, 2002). They must also have the agility to win against competition, thereby heavily relying on information technology, process, knowledge, and communication technology to improve agility (Sambamurthy *et al.*, 2003).

Startups also need to adapt to new knowledge and behavior. Digital technology can be used to optimize a company's internal workflow and cooperation with other companies. Digital technology can help startups improve their performance by creating new workflows, such as electronic contracts (Chiu *et al.*, 2002; Kollmann, 2006). The development of communication technology has also produced new forms of entrepreneurship in which virtual teams have increasingly become the competitive advantage of successful startups (Matlay and Westhead, 2005). From the perspective of entrepreneurs themselves, the interaction between entrepreneurs and international experience creates a social capital that has positive effects on digital companies (Batjargal, 2007).

3.1.2 Time slice 2: 2014–2021

Society's demand for digital technology continues to grow. Since 2010, new technologies such as big data, AI, and blockchain have rapidly developed and penetrated entrepreneurial activities. Since 2014, the number of researchers focusing on digital entrepreneurship has been increasing rapidly. During this period, in addition to addressing previous research directions, researchers have expanded several new research fields, such as social networks, digital entrepreneurship ecosystems (DEE), blockchain, and digital entrepreneurship theories. Figure 3 shows the themes of this period, such as education, growth, perspective, performance, innovation, entrepreneurship, and absorptive capability, while Figure 4 shows the evolution of these themes in the two time slices.

<Insert Figure 4>

As shown in Figures 3 and 4, the themes in time slice 1 have developed in recent years. More research on the first quadrant indicate that the internal cohesion of the main themes has improved and that themes have become more mature with the inclusion of innovation, performance, and entrepreneurship. Disruptive innovation caused by digital

technology can affect the business environment, reduce the difficulty of starting a business (Dy *et al.*, 2017), and make traditional companies feel threatened (Ansari *et al.*, 2016). The improvement of digital infrastructure can also enable startups to grow rapidly through the following mechanisms: data-driven, instant release, and rapid conversion (Huang *et al.*, 2017). Several new business models have also been developed to help companies improve their performance levels, such as sharing economy (Richter *et al.*, 2017), gig economy (Burtch *et al.*, 2018), peer-to-peer (P2P) networking (Gossling and Hall, 2019), and lean entrepreneurship (Ghezzi and Cavallo, 2020). Social networks can provide business value to small and medium-sized enterprises (SMEs) (Scuotto *et al.*, 2017), help entrepreneurs accumulate social capital (Smith *et al.*, 2017), improve the quality of corporate information, and increase customer trust (Fischer and Reuber, 2014). Blockchain technology can help entrepreneurs raise funds and communicate with customers. It has triggered a new wave of entrepreneurship, bringing new opportunities for innovation and entrepreneurship (Hernandez *et al.*, 2017; Chen, 2018; Zhang *et al.*, 2020).

However, the third quadrant has some emerging themes and research directions that need to be further developed by scholars, such as absorb-capacity, perspective, and impact. Knowledge has become the cornerstone of innovation, and corporate absorb-capacity is one of the elements that enhance corporate innovation and help companies improve their performance (Scuotto *et al.*, 2017). Several scholars have studied digital entrepreneurship and its impact on different perspectives such as ecosystems, platforms, and theories. The digital entrepreneurial ecosystem can be formed by integrating digital and entrepreneurial ecosystems. The digital entrepreneurial ecosystem framework consists of four concepts: digital infrastructure, digital user citizenship, digital entrepreneurship, and the digital industry (Sussan and Acs, 2017). Digital platforms can enhance SMEs' business and management capabilities, thereby helping them achieve digital transformation (Li *et al.*, 2018; Nambisan *et al.*, 2019). Most of the research on DE focuses on practical issues. Some scholars have conducted theoretical research related to digital entrepreneurship. However, new digital technologies have changed the nature of the entrepreneurial process and its results by providing a method to deal with its inherent uncertainty (Nambisan, 2017). The rapid development of digitalization

has begun to subvert existing entrepreneurial theories. Theoretical recommendations, in the form of four new theoretical logics or elements: dynamic adjustment, social cognition, technical enlightenment, and coordination and cooperation, may help to provide a more accurate explanation of the digital world's innovation process and its results (Nambisian *et al.*, 2018).

3.2 Author

Productivity and impact are two important indicators for evaluating authors' academic influences in related fields (Forliano *et al.*, 2020). This study evaluates an author's productivity by the number of articles published and the author's impact by the number of citations. Figure 4 shows the 20 most influential authors, while Table 1 lists the five authors with the most published articles and the most citations (repetitions removed), based on their h-index and g-index, these two indexes represent the author's influence in academia.

Most of the authors started to publish their first articles on DE after 2013. Only Kollmann paid attention to DE in time slice 1. Kollmann (2006) believed that electronic information technology can largely support enterprises' communication processes. He also believed that, in the future, e-entrepreneurship will be established to realize the development and innovation of communication networks (Kollmann, 2006). Sambamurthy, the most cited author, discussed the critical role of agility in modern business environment, and how firms rely on information technologies, process, knowledge, and communication technologies to enhance their agility (Sambamurthy *et al.*, 2003). Kraus, the author with the most significant number of articles, paid attention to the field of digital entrepreneurship since 2015. He has studied smart city (Richter *et al.*, 2015) and sharing economy (Richter *et al.*, 2017) with his collaborators, and has sorted out related research on digital entrepreneurship (Kraus *et al.*, 2019). Another scholar, Nambisan, focused on the theoretical research of digital entrepreneurship and proposed the theoretical framework of digital entrepreneurship (Nambisan, 2017). His research witnessed a rapid increase in the past three years and had brought attention to digital technology's impact on traditional theories of entrepreneurship. Reading key articles before starting DE research can help researchers master the development

process and research direction of DE. The effective research of key authors can also greatly promote DE.

<Insert Table 1>

<Insert Figure 5>

<Insert Figure 6>

<Insert Figure 7>

Figures 6 and 7 show the cooperation network between the authors and the distribution of science authors. In DE, the cooperation among authors is relatively low, while primary authors tend to complete science independently of the study. Simultaneously, only a few authors have published three or more articles which indicates that most of the authors' research on digital entrepreneurship is still in its early stages.

3.3 *Articles and journals*

Table 2 lists the top 10 articles with the highest local citations. Local citations are the number of times an article has been cited by other articles in the dataset, thereby representing the article's importance in digital entrepreneurship. As presented in Table 2, Nambisan's two articles are very influential in digital entrepreneurship. Digital technologies herald a new era in entrepreneurship, in which the boundaries between the process of entrepreneurship and its results are more blurred. Hence, entrepreneurship agency will be more broadly defined (Nambisan, 2017). There is a critical need to theorize novels on digital innovation management (Nambisan *et al.*, 2018). Sussan and Acs (2017) proposed the digital entrepreneurship ecosystem (DEE) conceptual framework, which includes: (1) digital infrastructure governance, (2) digital user citizenship, (3) digital entrepreneurship, and (4) digital marketplace. This was one of the first articles that focused on DEE. Simultaneously, the concept of digital technology entrepreneurship was also proposed (Giones and Brem, 2017). The large number of citations indicates that these papers occupy a very important position in DE, and some studies have even created a new research direction. Reading these articles is a must for every academic who studies digital entrepreneurship.

<Insert Table 2>

Articles on digital entrepreneurship have been published in a wide variety of journals. Over the years, steady advancements have been made on this topic. In Table 3, the 10 most relevant journals ordered by several publications were presented to describe the journals' impact.

Sustainability is the journal that publishes the most articles in terms of productivity. *Technological Forecasting and Social Change* ranks second, with the highest h-index and g-index, thereby indicating that it has an essential position in digital entrepreneurship. Most journals started to focus on DE in 2014. *Journal of Strategic Information Systems* and *Small Business Economics* began to publish articles in 1999 and 2001, respectively. With the number of articles relatively increasing, there is continuous attention to this field.

Technological Forecasting and Social Change focus on documents related to society, the environment, and technology. *Sustainability* focuses on green and sustainable development. *Small Business Economics* focuses on a wide range of fields, including small and medium-sized enterprises, innovation and entrepreneurship, public policy, and other directions. The focus of journals with high volume of publication in DE is quite different. This indicates that digital entrepreneurship involves a wide range of fields and research direction with comprehensive characteristics. However, in general, it still focuses on business and management.

<Insert Table 3>

3.4 Institutions and regions

Table 4 lists the 10 countries that have published the most articles. The United States has the most significant number of articles published in DE, with the highest number of total citations and average article citations. United Kingdom is a distant second to the United States, indicating that the United States is the absolute leader in DE.

<Insert Table 4>

Since only less than 10% of single-authored documents exist, collaboration becomes a critical aspect for authors who are studying digital entrepreneurship. However, the most prolific country is ironically the least likely country to engage in international cooperation. Single-country publications (SCP) represent the number of

publications written by authors from the same country, while multi-country publications (MCP) represent the number of publications written by authors from different countries. Moreover, MCP ratio is the ratio of MCP to SCP. It represents the willingness and level of a country to participate in international DE cooperation. Figure 8 shows the cooperative relationships among countries. Although the MCP ratio of the United States is low, it still has a significant number of articles, and also occupies an important position in international cooperation. The most active regions for international cooperation are the United States, Europe, China, and Australia. As a new research field, DE is highly related to the level of economic development and the research on DE has mainly been concentrated in developed countries.

<Insert Figure 8>

<Insert Table 5>

3.5 Keywords

Table 5 lists the 20 most frequently used keywords in the database, and the year when these keywords first appeared. The core of research in DE is “entrepreneurship,” in addition, the three keywords that appear most frequently are “innovation,” “performance,” and “technology.” They first appeared in the early 21st century. These keywords have received attention in the research direction of traditional entrepreneurial field. It is worth noting that “digital entrepreneurship,” “digital transformation,” and “digitalization” have only begun to appear in recent years. This shows that the research on DE was initially based on traditional research on entrepreneurship, with digital technology as part of its research content. In recent years, DE has begun to appear as an independent research field, with keywords appearing more frequently. Scholars have realized that digital entrepreneurship has many unique aspects, and it is necessary to study it as an independent direction rather than the branch direction of previous entrepreneurial research.

4. Science mapping

Science mapping is an important research method in bibliometrics (van Eck and Waltman, 2010). It is a spatial representation of how disciplines, fields, specialties, and individual documents or authors are related to one another (Small, 1999). It focuses on

monitoring a scientific field and delimits research areas to determine its cognitive structure and evolution (Noyons *et al.*, 1999; Cobo *et al.*, 2012). Scholars often use co-occurrence analysis and co-citation analysis to study a specific discipline's dynamic development (Small, 1973; Callon *et al.*, 1983; van Eck and Waltman, 2014).

4.1 Keyword co-occurrence and co-citation network

Keywords are the highly condensed core content of a paper. According to the basic principles of co-occurrence analysis, if a specific keyword repeatedly appears in a research field, it means that the word is a research hotspot in this field. Suppose two keywords appear in the same document. In that case, it indicates that the two words have a certain degree of relevance, and the research topic they represent has attracted the attention of researchers. This study uses keyword plus as the unit of analysis for co-occurrence analysis, in which 35 nodes were obtained by adopting the Louvain cluster algorithm and the association strength normalization (van Eck and Waltman, 2009). Figure 9 shows the keyword plus co-occurrence network and a total of 3 main clusters that have been formed.

The concept of “co-citation” was first proposed in 1973 by Henry Small, an American intelligence scientist. Co-citation refers to two documents being cited at the same time by another document. The number of times that two papers are jointly cited is called the co-citation intensity. The greater the co-citation intensity, the closer is the relationship between the two papers. Through literature co-citation analysis, meaningful knowledge connections can be reflected in the research field. Figure 10 uses the article's citation information and draws the paper's co-citation network on 35 main articles.

<Insert Figure 9>

<Insert Figure 10>

4.2 Empower, evolution and ecosystem

It is apparent that there are many research directions in DE, such as innovation, performance, management, and ecosystems. According to the results of visualization analysis and literature research, DE research can be divided into three dimensions: empower, evolution, and ecosystem.

4.2.1 Empower

Empower refers to the digital technology in the entrepreneurial practice that helps entrepreneurs and startups achieve their entrepreneurial goals. The current literature in this cluster mainly focused on topics related to impact, firms, e-commerce, internet, growth, information, adoption, and strategies. In the digital age, everyone has the opportunity to create their brand, and the threshold for entrepreneurship has been dramatically reduced. At the same time, it also provides new financing channels for startups, thereby helping entrepreneurs start their businesses (Zavolokia *et al.*, 2016). With digital technology support, companies can use digital technology to improve internal and external processes and integrate them into new business models that adapt to changing markets while maintaining competitive advantage and market share (Tohanean *et al.*, 2019; Bouncken *et al.*, 2021). Through e-commerce websites, startups can introduce consumer reviews as a platform for brand promotion, and start image entrepreneurship to build brand reputation (Kuehn, 2016). Digital technology then provides a new direction for academic entrepreneurship, in which academic institutions are changing from traditional teaching roles to entrepreneurial roles. Scholars' enthusiasm for creating academic spin-offs (ASOs) has increased (Galati *et al.*, 2020), which led to digital academic entrepreneurship creating a virtual space that can interact with companies and universities. This has improved the communication efficiency of both parties (Linzalone *et al.*, 2020). With the support of digital technology, digital academic entrepreneurship has evolved from network cooperation among individuals to a broader ecosystem (Toniolo *et al.*, 2020).

The digital space provides a space for more individuals to showcase themselves and introduce themselves as new competitors in the existing industry. In this environment, startups need more specialized capabilities to remain competitive. At the spatial level, broadband technology solves the connection problem, reduces the inequality caused by enterprises' geographical location (Haefinr and Stemberg, 2020), improves the geographical disadvantages of rural areas, and helps develop entrepreneurial enterprises in rural areas (Anderson *et al.*, 2016). Digital technology can help marketing and e-commerce activities (Donnelly *et al.*, 2015), gender equality (Rajahonka and Vilman, 2019), and corporate internationalization (Dillon *et al.*, 2020).

Informal investors of corporate venture capitalists (CVCs) have played a significant role in exploring breakthrough opportunities, using organizational assets, and looking for distinctive innovations (Rossi *et al.*, 2020). With digital technology significantly reducing communication costs, startups will also have more opportunities in the international market, with a number of successful startups gaining sufficient knowledge. According to Qunones *et al.* (2020), it is easier for companies to integrate into the global economy. The higher the degree of digitization of the enterprise, the more pronounced is its entrepreneurial orientation. Thus, the more successful it will be to make strategic decisions in the international market (Herve *et al.*, 2020).

4.2.2 Evolution

Evolution is a new entrepreneurial opportunity and organizational form, resulting from exponential technology of entrepreneurs and startups. The current literature in this cluster mainly focused on topics related to performance, perspective, management, business model, social media, information technology, education, gender, framework, determinants, capabilities, and creation. Digital technologies have transformed the nature of entrepreneurial processes and outcomes by dealing with its inherent uncertainty (Nambisan, 2017). Digital technologies have inherently changed entrepreneurial processes and outcomes, thereby fully mobilizing external resources, increasing the interaction between entrepreneurial enterprises and stakeholders, and generating more opportunities (Delirmann *et al.*, 2020). In the digital age, it is challenging to separate entrepreneurial activities from social networks (Wang *et al.*, 2017), in which experienced entrepreneurs had more advantages in applying digital technology tools (Mack *et al.*, 2017). For example, social media can be used as a tool to help individuals realize their brand, help them obtain employment in the freelance labor market, and help them realize social value (Fulton, 2015; Gandini, 2016). Social media also gives consumers the ability to influence product design and production in which consumers are no longer just passive recipients but can participate in product design and production in the digital community. Digital technology also plays a positive role in achieving gender equality. Female entrepreneurs are more likely to succeed in digital entrepreneurship than ever before (Dy *et al.*, 2017; Pergelova *et al.*, 2019).

Service innovation can create new business models that may completely change the industry sector, thus forming the basis for classifying different service innovations. Digital technology has always been a critical driver and component of the service business model innovation (Lusch and Nambisan, 2015). It is becoming a very active part of service innovation, thereby enabling the service innovation process to ensure the stability and efficiency of the innovation process. Companies can use digital technologies to improve internal and external processes and integrate them into new business models (Bouncken *et al.*, 2021). They can also adapt to changing markets, while maintaining competitive advantage and market share. However, they require flexible management methods and rapid decision-making skills (Tohanean *et al.*, 2020). Learning entrepreneurial methods in digital entrepreneurship can be used as an agile method of business model innovation (Ghezzi and Cavallo, 2019). Learning entrepreneurship can also help digital startups reduce uncertainty in the entrepreneurial process and significantly reduce costs (Carroll and Casselman, 2020). Digital technology makes startups more flexible and provides unique advantages in business model innovation. In addition, new services and business models of financial technology can lead to many new startups.

4.2.3 Ecosystem

Ecosystem refers to a group of interdependent subjects in an environment that promotes the occurrence of entrepreneurial activities through cooperation (Stam and Spigel, 2018). The current literature in this cluster mainly focused on topics related to entrepreneurship, innovation, technology, competition, networks, ecosystem, future, platform, industry, systems, firm, dynamic, and dynamic capabilities. Digital platforms are becoming increasingly important in creating and obtaining value (Nambisan *et al.*, 2018). A variety of digital platforms are aimed at providing innovation to entrepreneurs to meet their entrepreneurship development and commercialization needs (Hsieh and Wu, 2019). Digital entrepreneurship changes the entrepreneurial system's structure, aims, and network, thus ultimately affecting the level and scale of the innovation (Satalkina and Steiner, 2020). Digital innovation in an innovation-driven entrepreneurial ecosystem and the active cooperation of various stakeholders related to entrepreneurship promote digital entrepreneurship development (Li *et al.*, 2017). For

traditional companies, building dynamic digital transformation capabilities has become an essential means of enhancing customer experience and building new business models (Warner and Wager, 2019).

There are still some political struggles and exclusions. For example, Etsy, a digital platform for creative small businesses, provides meaningful and fulfilling work for startups. Digital cultural production, such as fashion and beauty, enables some women to generate value and get paid in their fields (Duffy, 2016). Digital platforms can help many free developers protect their intellectual property (Miric *et al.*, 2019) and help create new opportunities (Ricart *et al.*, 2020). However, digital businesses also require jointly promoting government agencies, developers, civil, and other stakeholders.

5. Discussion

In the development of emerging digital technologies (e.g., AI, big data, cloud computing, and mobile communication), traditional research related to entrepreneurship find it difficult to keep pace with the times. By reviewing research in the field of digital entrepreneurship, this study demonstrates that there is a massive difference between digital entrepreneurship and traditional entrepreneurship. Digital technology has completely changed the traditional entrepreneurship model and has led to significant challenges to traditional entrepreneurship theories. Digital entrepreneurs use digital technology as the primary means of communication within and among organizations, having a high degree of virtualization and networking characteristics in the organizational management model. Most of the studies are based on existing digital entrepreneurship practices, which are mostly case studies, but with certain lags. Because of low marginal cost of digital technology expansion, digital technology in entrepreneurial practice has been very extensive. However, there is still a large gap between academic research and entrepreneurial practices. Several individuals and companies involved in digital entrepreneurship lack the guidance of authoritative theories. Although the topic has expanded in recent years due to various special issues and solicitation of papers, publications are still fragmented. This proves the need for systematic work, such as the work proposed in this article, and the need for more studies in the future.

Technology produces information faster than we can receive and digest it. With the application and deepening of digital technology, the environment of nonlinear development presents greater turbulence and unpredictability (Petani and Mengis, 2020; Troise and Camilleri, 2021). In this case, digital entrepreneurship needs more scholarly attention. This research can help scholars and practitioners study this topic and provide a comprehensive overview of the scientific literature produced to date. At the same time, policymakers and practitioners can find valuable benchmarks to promote DE. According to the bibliometric analysis results, the next step will be based on the shortcomings of existing research and the development of digital entrepreneurship avenues that will provide scholars with suggestions on the direction of continuing to study DE in the future.

First, paying attention to integrity and dynamic evolution will help carry out the following research steps. Existing studies are mainly carried out from a single aspect, such as e-sales (Parvinen *et al.*, 2015), digital marketing (Wang, 2020), and FinTech (Gomber *et al.*, 2018), etc. The changes resulting from digital technology in marketing, finance, and other aspects of entrepreneurial enterprises cannot be ignored. However, in the digital economy era, entrepreneurial activities involve a lot of participants and resources, thereby influencing each other to produce complex relationships and form a complex system. It is worth noting that DE can also be combined with other fields to produce new digital entrepreneurship types, such as digital academic entrepreneurship. Academic institutions are transforming from a traditional teaching role to an entrepreneurial role. Digital academic entrepreneurship can establish a virtual space that can interact with enterprises and universities, thereby improving the communication efficiency of both sides (Linzone *et al.*, 2020). The digital entrepreneurial ecosystem is a combination of elements within a region that supports the development and growth of innovative startups who are pursuing new opportunities presented by digital technologies (Sussan and Acs, 2017; Du *et al.*, 2018; Elia *et al.*, 2020). With the support of digital technology, digital academic entrepreneurship has developed from network cooperation among individuals to a broader ecosystem (Toniolo *et al.*, 2020).

Second, the negative impact of digital technology on entrepreneurship needs to be considered. Benefits and disadvantages always coexist. Digital technology has provided considerable benefits to the rapid development of entrepreneurship, but some disadvantages cannot be ignored. Unfortunately, in the context of the growth of the digital economy, many problems in DE have been temporarily ignored. While digital technology can improve the efficiency of resource utilization, it can also create legal and ethical problems that hinder the development of startups. Benefitting from low marginal cost and network effect, digital platforms can easily form dominance in the industry. In this case, a large digital platform that has, to some extent, mastered making the rules poses a threat to startups (Nambisan *et al.*, 2018). For example, after Apple changed its privacy policy, many companies whose primary business is analyzing users' data were affected. Apart from reducing marginal costs and helping startups develop markets, digital technology also enabled piracy of the enterprises' intellectual property products at a lower cost, especially in music, literature, and film. This will severely undermine the creative enthusiasm of content creators. Currently, laws and regulations related to digital entrepreneurship are flawed. Many digital enterprises collect valuable information to improve the effectiveness of an advertising push, at the expense of privacy being violated (Gozman and Willcocks, 2019). Although information in the digital age has expanded, enterprises still easily forge identities and cheat users through false publicity (Smith *et al.*, 2017). This reduces users' trust in digital startups and is not conducive to the healthy development of society and economy.

Finally, theoretical research requires more attention. Most of the existing research focuses on the practical level, but only a few theoretical research are related to DE. It should also be acknowledged that digital technology also brings challenges to traditional entrepreneurship theories, such as dynamic capabilities perspective, institutional theory, network theory, opportunity discovery theory, and opportunity creation theory.

The dynamic capability perspective focuses on how enterprises integrate internal and external resources and capabilities to adapt to the complex external environment, in which enterprises are the subject of integrating internal and external resources to create value (Amit and Han, 2017). In the digital economy, enterprises also need to

interact with multiple subjects, such as users and the government, to create value together (Amit and Han, 2017; Nambisan, 2017, Lin *et al.*, 2021). Institutional theory emphasizes on the role of active subjects in creating value (Ansari and Philips, 2011). In the digital era, consumers play a crucial role in creating value through user-generated content (Smith *et al.*, 2012). Network theory states that although the substantial relationship value is higher, maintaining strong relations will also incur higher costs, and with digital technology, the enterprise can spend less to maintain a strong relationship (Smith *et al.*, 2017). Opportunity discovery theory emphasizes the role of entrepreneurs and their experience in opportunity development (Alvarez and Barney, 2007) It is believed that the entrepreneurial process is linear and phased (Korsgaard, 2011). Under the influence of digital technology, the participants of the entrepreneurial process are collectivized (Nambisan *et al.*, 2018), and the role of data analysis in opportunity development is emphasized. The entrepreneurial process also becomes nonlinear, and the boundary of the stage becomes more unclear (Nambisan, 2017). According to the theory of opportunity creation, entrepreneurs' actions create entrepreneurial opportunities (Alvarez and Barney, 2007), while digital technology provide many entrepreneurial opportunities to society. At the same time, digital technology also promotes the interaction between individuals and the environment, which further increases the number of entrepreneurial opportunities (Giudice and Straub, 2011; Amit and Han, 2017; Gozman and Willcocks, 2019, Sun *et al.*, 2021).

A series of questions has been provided as reference for researchers in deciding future research direction (Zaheer *et al.*, 2019). Table 6 summarizes the agenda for future research based on the 3E framework. This agenda is not exhaustive, but it offers some interesting research questions that deserve attention in the future and might be useful in identifying additional questions.

<Insert Table 6>

6. Conclusion

Over the past three decades, the development of DE has attracted a sudden attention worldwide, especially since 2014. There are dozens of countries, hundreds of journals, and more than 1,000 authors that have contributed to development of DE.

These numbers will continue to proliferate in the foreseeable future. By employing bibliometrics analysis and science mapping, we were able to analyze authors, journals, institutions, countries, co-citations, and co-occurrences and summarize the development stage, research framework, and future global DE trends. The 3E (empower, evolution, and ecosystem) framework can be used in studying DE, however, research directions such as holistic perspectives, disadvantages, and theories still needs to be considered in the future.

This study has some limitations. First, although the WoS-based database can improve the quality of the literature, some articles may also be overlooked. Second, the use of different indicators and drawing methods will have an impact on the results. Scholars interested in this field can further optimize these aspects. Digital entrepreneurship is a relatively new field, and its impact requires further academic attention.

Reference

- Alderete, T. L., Autran, C., Brekke, B. E., Knight, R., Bode, L., Goran, M. I., and Fields, D. A. (2015), "Associations between human milk oligosaccharides and infant body composition in the first 6 mo of life", *The American Journal of Clinical Nutrition*, Vol. 102 No. 6, pp. 1381-1388. <https://doi.org/10.3945/ajcn.115.115451>
- Alvarez, S. A., and Barney, J. B. (2007), "Discovery and creation: Alternative theories of entrepreneurial action", *Strategic Entrepreneurship Journal*, Vol. 1 No. 1-2, pp. 11-26. <https://doi.org/10.1002/sej.4>
- Amit, R., and Han, X. (2017), "Value creation through novel resource configurations in a digitally enabled world", *Strategic Entrepreneurship Journal*, Vol. 11 No. 3, pp. 228-242. <https://doi.org/10.1002/sej.1256>
- Anderson, A. R., Wallace, C., and Townsend, L. (2016), "Great expectations or small country living? Enabling small rural creative businesses with ICT", *Sociologia Ruralis*, Vol. 56 No. 3, pp. 450-468. <https://doi.org/10.1111/soru.12104>
- Ansari, S., and Phillips, N. (2011), "Text me! New consumer practices and change in organizational fields", *Organization Science*, Vol. 22 No. 6, pp. 1579-1599. <https://doi.org/10.1287/orsc.1100.0595>
- Ansari, S., Garud, R., and Kumaraswamy, A. (2016), "The disruptor's dilemma: TiVo and the US television ecosystem", *Strategic Management Journal*, Vol. 37 No. 9, pp. 1829-1853. <https://doi.org/10.1002/smj.2442>
- Anumba, C. J., Akanmu, A., Yuan, X., and Kan, C. (2021), "Cyber—physical systems development for construction applications", *Frontiers of Engineering Management*, Vol. 8 No. 1, pp. 72-87. <https://doi.org/10.1007/s42524-020-0130-4>
- Aria, M., and Cuccurullo, C. (2017), "Bibliometrix: An R-tool for comprehensive science mapping analysis", *Journal of Informetrics*, Vol. 11 No. 4, pp. 959-975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Batjargal, B. (2007), "Internet entrepreneurship: Social capital, human capital, and performance of Internet ventures in China.", *Research Policy*, Vol. 36 No. 5, pp. 605-618. <https://doi.org/10.1016/j.respol.2006.09.029>
- Bouncken, R. B., Kraus, S., and Roig-Tierno, N. (2021), "Knowledge-and innovation-based business models for future growth: digitalized business models and portfolio considerations", *Review of Managerial Science*, Vol. 15 No. 1, pp. 1-14. <https://doi.org/10.1007/s11846-019-00333-8>
- Briner, R. B., and Denyer, D. (2012), "Systematic review and evidence synthesis as a practice and scholarship tool", *Handbook of Evidence-Based Management: Companies, Classrooms and Research*, pp. 112-129. <https://doi.org/10.1093/oxfordhb/9780199763986.013.0007>
- Broadus, R. N. (1987), "Toward a definition of bibliometrics", *Scientometrics*, Vol. 12 No. 5, pp. 373-379. <https://doi.org/10.1007/BF02016680>
- Burtch, G., Ghose, A., and Wattal, S. (2013), "An empirical examination of the antecedents and consequences of contribution patterns in crowd-funded markets", *Information Systems Research*, Vol. 24 No. 3, pp. 499-519. <https://doi.org/10.1287/isre.1120.0468>
- Campbell, H. A., and Golan, O. (2011), "Creating digital enclaves: Negotiation of the internet among bounded religious communities", *Media, Culture and Society*, Vol. 33 No. 5, pp. 709-724. <https://doi.org/10.1177/0163443711404464>

-
- Carayannis, E. G., and Von Zedtwitz, M. (2005), "Architecting gloCal (global–local), real-virtual incubator networks (G-RVINs) as catalysts and accelerators of entrepreneurship in transitioning and developing economies: lessons learned and best practices from current development and business incubation practices", *Technovation*, Vol. 25 No. 2, pp. 95-110.
[https://doi.org/10.1016/S0166-4972\(03\)00072-5](https://doi.org/10.1016/S0166-4972(03)00072-5)
- Carvalho, M. M., Fleury, A., and Lopes, A. P. (2013), "An overview of the literature on technology roadmapping (TRM): Contributions and trends", *Technological Forecasting and Social Change*, Vol. 80 No. 7, pp. 1418-1437.
<https://doi.org/10.1016/j.techfore.2012.11.008>
- Chen, C. (2004), "Searching for intellectual turning points: Progressive knowledge domain visualization", *Proceedings of the National Academy of Sciences*, Vol. 101 No. 1, pp. 5303-5310. <https://doi.org/10.1073/pnas.0307513100>
- Chen, Y. (2018), "Blockchain tokens and the potential democratization of entrepreneurship and innovation", *Business Horizons*, Vol. 61 No. 4, pp. 567-575. <https://doi.org/10.1016/j.bushor.2018.03.006>
- Chiu, D. K., Karlapalem, K., Li, Q., and Kafeza, E. (2002), "Workflow view based e-contracts in a cross-organizational e-services environment", *Distributed and Parallel Databases*, Vol. 12 No. 2, pp. 193-216.
<https://doi.org/10.1023/A:1016503218569>
- Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., and Herrera, F. (2012), "SciMAT: A new science mapping analysis software tool", *Journal of the American Society for Information Science and Technology*, Vol. 63 No. 8, pp. 1609-1630. <https://doi.org/10.1002/asi.22688>
- Del Giudice, M., and Straub, D. (2011), "Editor's comments: IT and entrepreneurship: an on-again, off-again love affair or a marriage?", *MIS Quarterly*, Vol. 35 No. 4, pp. iii-viii. <https://dl.acm.org/citation.cfm?id=2208941>
- Dellermann, D., Lipusch, N., Ebel, P., and Leimeister, J. M. (2020), "The potential of collective intelligence and crowdsourcing for opportunity creation", *International Journal of Entrepreneurial Venturing*, Vol. 12 No. 2, pp. 183-207.
<https://doi.org/10.1504/IJEV.2020.105569>
- Dillon, S. M., Glavas, C., and Mathews, S. (2020), "Digitally immersive, international entrepreneurial experiences", *International Business Review*, Vol. 29 No. 6, pp. 101739. <https://doi.org/10.1016/j.ibusrev.2020.101739>
- Donnelly, C., Simmons, G., Armstrong, G., and Fearn, A. (2015), "Digital loyalty card 'big data' and small business marketing: Formal versus informal or complementary?", *International Small Business Journal*, Vol. 33 No. 4, pp. 422-442. <https://doi.org/10.1177/0266242613502691>
- Du, W., Pan, S. L., Zhou, N., and Ouyang, T. (2018), "From a marketplace of electronics to a digital entrepreneurial ecosystem (DEE): The emergence of a meta-organization in Zhongguancun, China", *Information Systems Journal*, Vol. 28 No. 6, pp. 1158-1175. <https://doi.org/10.1111/isj.12176>
- Duffy, B. E. (2016), "The romance of work: Gender and aspirational labour in the digital culture industries", *International Journal of Cultural Studies*, Vol. 19 No. 4, pp. 441-457. <https://doi.org/10.1177/1367877915572186>
- Dy, A. M., Marlow, S., and Martin, L. (2017), "A web of opportunity or the same old story? Women digital entrepreneurs and intersectionality theory", *Human Relations*, Vol. 70 No. 3, pp. 286-311.
<https://doi.org/10.1177/0018726716650730>

-
- Eck, N. J. V., and Waltman, L. (2009), "How to normalize cooccurrence data? An analysis of some well-known similarity measures", *Journal of the American Society for Information Science and Technology*, Vol. 60 No. 8, pp. 1635-1651. <https://doi.org/10.1002/asi.21075>
- Elia, G., Margherita, A., and Passiante, G. (2020), "Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process", *Technological Forecasting and Social Change*, No. 150, Art no. 119791. <https://doi.org/10.1016/j.techfore.2019.119791>
- Farani, A. Y., Karimi, S., and Motaghd, M. (2017), "The role of entrepreneurial knowledge as a competence in shaping Iranian students' career intentions to start a new digital business", *European Journal of Training and Development*. <https://doi.org/10.1108/EJTD-07-2016-0054>
- Feng, B., and Ye, Q. (2021), "Operations management of smart logistics: A literature review and future research", *Frontiers of Engineering Management*, Vol. 8 No.3, pp. 344–355. <https://doi.org/10.1007/s42524-021-0156-2>
- Fischer, E., and Reuber, A. R. (2014), "Online entrepreneurial communication: Mitigating uncertainty and increasing differentiation via Twitter", *Journal of Business Venturing*, Vol.29 No.4, pp.565-583. <https://doi.org/10.1016/j.jbusvent.2014.02.004>
- Forliano, C., De Bernardi, P., and Yahiaoui, D. (2021), "Entrepreneurial universities: A bibliometric analysis within the business and management domains", *Technological Forecasting and Social Change*, No. 165, Art no. 120522. <https://doi.org/10.1016/j.techfore.2020.120522>
- Fulton, J. (2015), "Are you a journalist? New media entrepreneurs and journalists in the digital space", *Javnost-The Public*, Vol. 22 No. 4, pp. 362-374. <https://doi.org/10.1080/13183222.2015.1091624>
- Galati, F., Bigliardi, B., Passaro, R., and Quinto, I. (2020), "Why do academics become entrepreneurs? How do their motivations evolve? Results from an empirical study", *International Journal of Entrepreneurial Behavior and Research*, Vol. 26 No. 7, pp. 1477-1503. https://doi.org/10.1007/978-3-319-61949-1_21
- Gandini, A. (2016), "Digital work: Self-branding and social capital in the freelance knowledge economy", *Marketing Theory*, Vol. 16 No. 1, pp. 123-141. <https://doi.org/10.1177/1470593115607942>
- Ghezzi, A., and Cavallo, A. (2020), "Agile business model innovation in digital entrepreneurship: Lean startup approaches", *Journal of Business Research*, No. 110, pp. 519-537. <https://doi.org/10.1016/j.jbusres.2018.06.013>
- Giones, F., and Brem, A. (2017), "Digital technology entrepreneurship: A definition and research agenda", *Technology Innovation Management Review*, Vol. 7 No. 5, pp. 44-51. <https://ssrn.com/abstract=2984542>
- Gomber, P., Kauffman, R. J., Parker, C., and Weber, B. W. (2018), "On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in financial services", *Journal of Management Information Systems*, Vol. 35 No. 1, pp. 220-265. <https://doi.org/10.1080/07421222.2018.1440766>
- Gössling, S., and Michael Hall, C. (2019), "Sharing versus collaborative economy: how to align ICT developments and the SDGs in tourism?", *Journal of Sustainable Tourism*, Vol. 27 No. 1, pp. 74-96. <https://doi.org/10.1080/09669582.2018.1560455>
- Gozman, D., and Willcocks, L. (2019), "The emerging cloud dilemma: Balancing innovation with cross-border privacy and outsourcing regulations", *Journal of*

-
- Business Research*, No.97, pp.235-256. <https://doi.org/10.1016/j.jbusres.2018.06.006>
- Guillén, M. F., and Suárez, S. L. (2001), “Developing the internet: entrepreneurship and public policy in Ireland, Singapore, Argentina, and Spain”, *Telecommunications Policy*, Vol. 25 No. 5, pp. 349-371. [https://doi.org/10.1016/S0308-5961\(01\)00009-X](https://doi.org/10.1016/S0308-5961(01)00009-X)
- Haefner, L., and Sternberg, R. (2020), “Spatial implications of digitization: State of the field and research agenda”, *Geography Compass*, Vol. 14 No. 12, Art no. e12544. <https://doi.org/10.1111/gec3.12544>
- Hafezieh, N., Akhavan, P., and Eshraghian, F. (2011), “Exploration of process and competitive factors of entrepreneurship in digital space: A multiple case study in Iran”, *Education, Business and Society: Contemporary Middle Eastern Issues*, Vol. 4 No. 4, pp. 267-279. <https://doi.org/10.1108/17537981111190051>
- Hair, J. F., Sarstedt, M., Pieper, T. M., and Ringle, C. M. (2012), “The use of partial least squares structural equation modeling in strategic management research: a review of past practices and recommendations for future applications”, *Long Range Planning*, Vol.45 No.5, pp.320-340. <https://doi.org/10.1016/j.lrp.2012.09.008>
- Hansen, B. (2019), “The digital revolution—digital entrepreneurship and transformation in Beijing”, *Small Enterprise Research*, Vol. 26 No. 1, pp. 36-54. <https://doi.org/10.1080/13215906.2019.1570321>
- Hernández-Carrión, C., Camarero-Izquierdo, C., and Gutiérrez-Cillán, J. (2017), “Entrepreneurs' social capital and the economic performance of small businesses: The moderating role of competitive intensity and entrepreneurs' experience”, *Strategic Entrepreneurship Journal*, Vol.11 No.1, pp.61-89. <https://doi.org/10.1002/sej.1228>
- Hsieh, Y. J., and Wu, Y. J. (2019), “Entrepreneurship through the platform strategy in the digital era: Insights and research opportunities”, *Computers in Human Behavior*, Vol. 95, pp. 315-323. <https://doi.org/10.1016/j.chb.2018.03.033>
- Huang, J., Henfridsson, O., Liu, M. J., and Newell, S. (2017), “Growing on steroids: Rapidly scaling the user base of digital ventures through digital innovation”, *MIS Quarterly*, Vol. 41 No. 1, pp. 301-314. <https://doi.org/10.1287/orsc.2013.0883>
- Hull, C. E. K., Hung, Y. T. C., Hair, N., Perotti, V., and DeMartino, R. (2007), “Taking advantage of digital opportunities: a typology of digital entrepreneurship”, *International Journal of Networking and Virtual Organisations*, Vol. 4 No. 3, pp. 290-303. <https://doi.org/10.1504/IJNVO.2007.015166>
- Hu, X., Sun, L., Zhou, Y., and Ruan, J. (2020), “Review of operational management in intelligent agriculture based on the Internet of Things”, *Frontiers of Engineering Management*, Vol. 7 No. 3, pp. 309-322. <https://doi.org/10.1007/s42524-020-0107-3>
- Klotz, A.C., Hmieleski, K.M., Bradley, B.H., and Busenitz, L.W. (2013), “New venture teams: a review of the literature and roadmap for future research”, *Journal of Management*, Vol. 40 No.1, pp. 226–255. <https://doi.org/10.1177/0149206313493325>
- Kollmann, T. (2006), “What is e-entrepreneurship? fundamentals of company founding in the net economy”, *International Journal of Technology Management*, Vol. 33 No. 4, pp. 322. <https://doi.org/10.4337/9781781951828>

-
- Korsgaard, S., and Anderson, A. R. (2011), "Enacting entrepreneurship as social value creation", *International Small Business Journal*, Vol. 29 No. 2, pp. 135-151. <https://doi.org/10.1177/0266242610391936>
- Kraus, S., Breier, M., & Dasí-Rodríguez, S. (2020). The art of crafting a systematic literature review in entrepreneurship research. *International Entrepreneurship and Management Journal*, Vol.16 No.3, pp. 1023-1042. <https://doi.org/10.1007/s11365-020-00635-4>
- Kraus, S., Li, H., Kang, Q., Westhead, P. and Tiberius, V. (2020), "The sharing economy: A bibliometric analysis of the state-of-the-art", *International Journal of Entrepreneurial Behavior and Research*, Vol. 26 No. 8, pp. 1769-1786. <https://doi.org/10.1108/IJEBr-06-2020-0438>
- Kraus, S., Palmer, C., Kailer, N., Kallinger, F. L., and Spitzer, J. (2018), "Digital entrepreneurship: A research agenda on new business models for the twenty-first century", *International Journal of Entrepreneurial Behavior and Research*, Vol. 25 No. 2, pp. 353-375. <https://doi.org/10.1108/ijebr-06-2018-0425>
- Kraus, S., Roig-Tierno, N., and Bouncken, R. B. (2019), "Digital innovation and venturing: An introduction into the digitalization of entrepreneurship", *Review of Managerial Science*, Vol. 13, pp. 519-528. <https://doi.org/10.1007/s11846-019-00333-8>
- Kraus, S., Schiavone, F., Pluzhnikova, A., & Invernizzi, A. C. (2021). Digital transformation in healthcare: Analyzing the current state-of-research. *Journal of Business Research*, No.123, pp.557-567. <https://doi.org/10.1016/j.jbusres.2020.10.030>
- Kuehn, K. M. (2016), "Branding the self on Yelp: Consumer reviewing as image entrepreneurship", *Social Media and Society*, Vol. 2 No. 4, Art no. 2056305116678895. <https://doi.org/10.1177/2056305116678895>
- Leidner, D. E. (1999), "Virtual partnerships in support of electronic commerce: the case of TCIS", *The Journal of Strategic Information Systems*, Vol. 8 No. 1, pp. 105-117. [https://doi.org/10.1016/S0963-8687\(99\)00012-8](https://doi.org/10.1016/S0963-8687(99)00012-8)
- Li, L., Su, F., Zhang, W., and Mao, J. Y. (2018), "Digital transformation by SME entrepreneurs: A capability perspective", *Information Systems Journal*, Vol. 28 No. 6, pp. 1129-1157. <https://doi.org/10.1111/isj.12153>
- Li, W., Du, W., and Yin, J. (2017), "Digital entrepreneurship ecosystem as a new form of organizing: the case of Zhongguancun", *Frontiers of Business Research in China*, Vol. 11 No. 1, pp. 5. <https://doi.org/10.1186/s11782-017-0004-8>
- Lin, H., Chen, L., Yu, M., Li, C., Lampel, J., and Jiang, W. (2021). "Too little or too much of good things? The horizontal S-curve hypothesis of green business strategy on firm performance", *Technological Forecasting and Social Change*, Vol. 172, Art no. 121051. <https://doi.org/10.1016/j.techfore.2021.121051>
- Lin, H., Zeng, S., Liu, H., and Li, C. (2020), "Bridging the gaps or fecklessness? A moderated mediating examination of intermediaries' effects on corporate innovation", *Technovation*, Vol. 94, Art no. 102018. <https://doi.org/10.1016/j.technovation.2018.02.006>
- Linzone, R., Schiuma, G., and Ammirato, S. (2020), "Connecting universities with entrepreneurship through digital learning platform: functional requirements and education-based knowledge exchange activities", *International Journal of Entrepreneurial Behavior and Research*, Vol. 26 No. 7, pp. 1526-1545. <https://doi.org/10.1108/IJEBr-07-2019-0434>
- Livadaru, L., Simion, A., Munteanu, A., Cojan, M., and Dabija, O. (2013), "Dual cage high power induction motor with direct start-up. Design and FEM

-
- analysis”, *Advances in Electrical and Computer Engineering*, Vol. 13 No. 2, pp. 55-59. <https://doi.org/10.4316/AECE.2013.02009>
- Lusch, R. F., and Nambisan, S. (2015), “Service innovation”, *MIS Quarterly*, Vol. 39 No. 1, pp. 155-176. <https://www.jstor.org/stable/26628345>
- Mack, E. A., Marie-Pierre, L., and Redican, K. (2017), “Entrepreneurs’ use of internet and social media applications”, *Telecommunications Policy*, Vo. 41 No. 2, pp. 120-139. <https://doi.org/10.1016/j.telpol.2016.12.001>
- Massaro, M., Dumay, J. and Guthrie, J. (2016), “On the shoulders of giants: undertaking a structured literature review in accounting”, *Accounting, Auditing and Accountability Journal*, Vol. 29 No. 5, pp. 767-801. <https://doi.org/10.1108/AAAJ-01-2015-1939>
- Mas-Tur, A., Kraus, S., Brandtner, M., Ewert, R., and Kürsten, W. (2020), “Advances in management research: A bibliometric overview of the review of managerial science”, *Review of Managerial Science*, Vol. 14 No. 5, pp. 933-958. <https://doi.org/10.1007/s11846-020-00406-z>
- Matlay, H., and Westhead, P. (2005), “Virtual teams and the rise of e-entrepreneurship in Europe”, *International Small Business Journal*, Vol. 23 No. 3, pp. 279-302. <https://doi.org/10.1177/0266242605052074>
- McGrath, R. G. (2013), “Transient advantage”, *Harvard Business Review*, Vol. 91 No. 6, pp. 62-70.
- Merigó, J. M., Gil-Lafuente, A. M., and Yager, R. R. (2015), “An overview of fuzzy research with bibliometric indicators”, *Applied Soft Computing*, Vol. 27, pp. 420-433. <https://doi.org/10.1016/j.asoc.2014.10.035>
- Miric, M., Boudreau, K. J., and Jeppesen, L. B. (2019), “Protecting their digital assets: The use of formal and informal appropriability strategies by App developers”, *Research Policy*, Vol. 48 No. 8, Art no. 103738. <https://doi.org/10.1016/j.respol.2019.01.012>
- Nambisan, S. (2017), “Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship”, *Entrepreneurship Theory and Practice*, Vol. 41 No. 6, pp. 1029-1055. <https://doi.org/10.1111/etap.12254>
- Nambisan, S., Siegel, D., and Kenney, M. (2018), “On open innovation, platforms, and entrepreneurship”, *Strategic Entrepreneurship Journal*, Vol. 12 No. 3, pp. 354-368. <https://doi.org/10.1002/sej.1300>
- Nambisan, S., Wright, M., and Feldman, M. (2019), “The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes”, *Research Policy*, Vol. 48 No. 8, Art no. 103773. <https://doi.org/10.1016/j.respol.2019.03.018>
- Noyons, E. C., Moed, H. F., and Luwel, M. (1999), “Combining mapping and citation analysis for evaluative bibliometric purposes: A bibliometric study”, *Journal of the American Society for Information Science*, Vol. 50 No. 2, pp. 115-131. [https://doi.org/10.1002/\(SICI\)1097-4571\(1999\)50:2<115::AID-ASIS3.0.CO;2-J](https://doi.org/10.1002/(SICI)1097-4571(1999)50:2<115::AID-ASIS3.0.CO;2-J)
- Parvinen, P., Oinas-Kukkonen, H., and Kaptein, M. (2015), “E-selling: A new avenue of research for service design and online engagement”, *Electronic Commerce Research and Applications*, Vol. 14 No. 4, pp. 214-221. <https://doi.org/10.1016/j.elerap.2014.10.007>
- Pergelova, A., Manolova, T., Simeonova-Ganeva, R., and Yordanova, D. (2019), “Democratizing entrepreneurship? Digital technologies and the internationalization of female-led SMEs”, *Journal of Small Business Management*, Vol. 57 No. 1, pp. 14-39. <https://doi.org/10.1111/jsbm.12494>

-
- Quinones, G., Heeks, R., & Nicholson, B. (2021), “Embeddedness of digital start-ups in development contexts: field experience from Latin America”, *Information Technology for Development*, Vol. 27 No. 2, pp. 171-190.
<https://doi.org/10.1080/02681102.2020.1779638>
- Rajahonka, M., and Villman, K. (2019), “Women managers and entrepreneurs and digitalization: On the verge of a new era or a nervous breakdown?”, *Technology Innovation Management Review*, Vol. 9 No. 6, pp. 14-24.
<https://doi.org/10.22215/timreview/1246>
- Ricart, J. E., Snihur, Y., Carrasco-Farré, C., & Berrone, P. (2020), “Grassroots resistance to digital platforms and relational business model design to overcome it: A conceptual framework”, *Strategy Science*, Vol. 5 No. 3, pp. 271-291.
<https://doi.org/10.1287/stsc.2020.0104>
- Richter, C., Kraus, S., and Syrjä, P. (2015), “The shareconomy as a precursor for digital entrepreneurship business models”, *International Journal of Entrepreneurship and Small Business*, Vol. 25 No.1, pp. 18-35.
<https://doi.org/10.1504/IJESB.2015.068773>
- Richter, C., Kraus, S., Brem, A., Durst, S., and Giselbrecht, C. (2017), “Digital entrepreneurship: Innovative business models for the sharing economy”, *Creativity and Innovation Management*, Vol. 26 No. 3, pp. 300-310.
<https://doi.org/10.1111/caim.12227>
- Roper, S., and Grimes, S. (2005), “Wireless valley, silicon wadi and digital island—helsinki, tel aviv and dublin and the ICT global production network”, *Geoforum*, Vol. 36 No. 3, pp. 297-313.
<https://doi.org/10.1016/j.geoforum.2004.07.003>
- Rovelli, P., Ferasso, M., De Massis, A., and Kraus, S. (2021), “Thirty years of research in family business journals: Status quo and future directions”, *Journal of Family Business Strategy*, Art no. 100422.
<https://doi.org/10.1016/j.jfbs.2021.100422>
- Rosenbaum, H.; Cronin, B. (1993), “Digital entrepreneurship: Doing business on the information superhighway”, *International Journal of Information Management*, Vol. 13 No. 6, pp. 461-463. [https://doi.org/10.1016/0268-4012\(93\)90062-9](https://doi.org/10.1016/0268-4012(93)90062-9)
- Rossi, M., Festa, G., Devalle, A., and Mueller, J. (2020), “When corporations get disruptive, the disruptive get corporate: Financing disruptive technologies through corporate venture capital”, *Journal of Business Research*, Vol. 118, pp. 378-388. <https://doi.org/10.1016/j.jbusres.2020.07.004>
- Rousseau, R. (2012), “Comments on a hirsch-type index of co-author partnership ability”, *Scientometrics*, Vol.91 No.1, pp. 309-310.
<https://doi.org/10.1007/s11192-011-0606-4>
- Sambamurthy, V., Bharadwaj, A., and Grover, V. (2003), “Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms”, *MIS Quarterly*, Vol. 27 No. 2, pp. 237-263.
<https://doi.org/10.1016/j.respol.2005.07.002>
- Sang, L., Yu, M., Lin, H., Zhang, Z., and Jin, R. (2021), “Big data, technology capability and construction project quality: A cross-level investigation”, *Engineering, Construction and Architectural Management*, Vol. 28 No.3, pp. 706-727. <https://doi.org/10.1108/ECAM-02-2020-0135>
- Satalkina, L., and Steiner, G. (2020), “Digital entrepreneurship and its role in innovation systems: A systematic literature review as a basis for future research avenues for sustainable transitions”, *Sustainability*, Vol. 12 No.7, Art no. 2764.
<https://doi.org/10.3390/su12104018>

-
- Scuotto, V., and Morellato, M. (2013), "Entrepreneurial knowledge and digital competence: Keys for a success of student entrepreneurship", *Journal of the Knowledge Economy*, Vol. 4 No. 3, pp. 293-303. <https://doi.org/10.1007/s13132-013-0155-6>
- Scuotto, V., Del Giudice, M., and Carayannis, E. G. (2017), "The effect of social networking sites and absorptive capacity on SMES' innovation performance", *Journal of Technology Transfer*, Vol. 42 No. 2, pp. 409-424. <https://doi.org/10.1007/s10961-016-9517-0>
- Shrader, R. C., Oviatt, B. M., and McDougall, P. P. (2000), "How new ventures exploit trade-offs among international risk factors: Lessons for the accelerated internationalization of the 21st century", *Academy of Management Journal*, Vol. 43 No. 6, pp. 1227-1247. <https://doi.org/10.5465/1556347>
- Siu, W. S. (2002), "Marketing activities and performance: A comparison of the internet-based and traditional small firms in Taiwan", *Industrial Marketing Management*, Vol. 31 No. 2, pp. 177-188. [https://doi.org/10.1016/S0019-8501\(01\)00176-6](https://doi.org/10.1016/S0019-8501(01)00176-6)
- Small, H. (1973), "Co-citation in the scientific literature: A new measure of the relationship between two documents", *Journal of the American Society for Information Science*, Vol. 24 No.4, pp. 265-269. <https://doi.org/10.1002/asi.4630240406>
- Small, H. (1999), "A passage through science: Crossing disciplinary boundaries", *Library Trends*, Vol. 48, No. 1, pp. 72-108. http://www.ideals.illinois.edu/bitstream/handle/2142/8259/librarytrendsv48i1lg_opt.pdf?sequence=1
- Smith, A. N., Fischer, E., and Yongjian, C. (2012), "How does brand-related user-generated content differ across YouTube, Facebook, and Twitter?", *Journal of Interactive Marketing*, Vol. 26 No. 2, pp. 102-113. <https://doi.org/10.1016/j.intmar.2012.01.002>
- Smith, C., Smith, J. B., and Shaw, E. (2017), "Embracing digital networks: Entrepreneurs' social capital online", *Journal of Business Venturing*, Vol. 32 No. 1, pp. 18-34. <https://doi.org/10.1016/j.jbusvent.2016.10.003>
- Spigel, B., and Harrison, R. (2018), "Toward a process theory of entrepreneurial ecosystems", *Strategic Entrepreneurship Journal*, Vol. 12 No.1, pp. 151-168. <https://doi.org/10.1002/sej.1268>
- Sun, D., Zeng, S., Lin, H., Yu, M., and Wang, L. (2021). "Is Green the Virtue of Humility? The Influence of Humble CEOs on Corporate Green Innovation in China", *IEEE Transactions on Engineering Management*, forthcoming, <https://10.1109/TEM.2021.3106952>
- Sussan, F., and Acs, Z. J. (2017), "The digital entrepreneurial ecosystem", *Small Business Economics*, Vol. 49 No. 1, pp. 55-73. <https://doi.org/10.1007/s11187-017-9867-5>
- Tang, L., and Meng, Y. (2021), "Data analytics and optimization for smart industry", *Frontiers of Engineering Management*, Vol. 8 No. 2, pp. 157-171. <https://doi.org/10.1007/s42524-020-0126-0>
- Tian, Y., Lu, Z., Adriaens, P., Minchin, R. E., Caithness, A., and Woo, J. (2020), "Finance infrastructure through blockchain-based tokenization", *Frontiers of Engineering Management*, Vol. 7 No. 4, pp. 485-499. <https://doi.org/10.1007/s42524-020-0140-2>
- Tohănean, D., Buzatu, A. I., Baba, C. A., and Georgescu, B. (2020), "Business model innovation through the use of digital technologies: Managing risks and creating

-
- sustainability”, *Amfiteatru Economic*, Vol. 22 No. 55, pp. 758-774.
<https://doi.org/10.24818/EA/2020/55/758>
- Toniolo, K., Masiero, E., Massaro, M. and Bagnoli, C. (2020), “A grounded theory study for digital academic entrepreneurship”, *International Journal of Entrepreneurial Behavior and Research*, Vol. 26 No. 7, pp. 1567-1587.
<https://doi.org/10.1108/IJEBR-06-2019-0402>
- Tranfield, D., Denyer, D., and Smart, P. (2003), “Towards a methodology for developing evidence-informed management knowledge by means of systematic review”, *British Journal of Management*, Vol. 14 No. 3, pp. 207-222.
<https://doi.org/10.1111/1467-8551.00375>
- Tsai, H. H., Lee, H. Y., and Yu, H. C. (2008), “Developing the digital content industry in Taiwan”, *Review of Policy Research*, Vol. 25 No. 2, pp. 169-188.
<https://doi.org/10.1111/j.1541-1338.2007.00317.x>
- Van Eck, N. J., and Waltman, L. (2010), “Software survey: VOSviewer, a computer program for bibliometric mapping”, *Scientometrics*, Vol. 84 No. 2, pp. 523-538.
<https://doi.org/10.1007/s11192-009-0146-3>
- Van Eck, N. J., and Waltman, L. (2014), “Visualizing bibliometric networks”, *Measuring Scholarly Impact*, Vol. 13, pp. 285-320.
https://doi.org/10.1007/978-3-319-10377-8_13
- Wang, F. (2020), “Digital marketing capabilities in international firms: a relational perspective”, *International Marketing Review*, Vol. 37 No. 3, pp. 559-577.
<https://doi.org/10.1108/IMR-04-2018-0128>
- Wang, F., Mack, E. A., and Maciejewski, R. (2017), “Analyzing entrepreneurial social networks with big data”, *Annals of the American Association of Geographers*, Vol. 107 No. 1, pp. 130-150.
<https://doi.org/10.1080/24694452.2016.1222263>
- Wang, K., Jiang, Z., Peng, B., and Jing, H. (2021), “Servitization of manufacturing in the new ICTs era: A survey on operations management”, *Frontiers of Engineering Management*, Vol. 8 No. 2, pp. 223-235.
<https://doi.org/10.1007/s42524-020-0103-7>
- Warner, K. S., and Wäger, M. (2019), “Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal”, *Long Range Planning*, Vol. 52 No. 3, pp. 326-349. <https://doi.org/10.1016/j.lrp.2018.12.001>
- Yuan, M., Lin, H., Wu, H., Yu, M., Tu, J., and Lü, Y. (2021), “Community engagement in public health: a bibliometric mapping of global research”, *Archives of Public Health*, Vol. 79, Art no. 6.
<https://doi.org/10.1186/s13690-021-00525-3>
- Zaheer, H., Breyer, Y., and Dumay, J. (2019), “Digital entrepreneurship: An interdisciplinary structured literature review and research agenda”, *Technological Forecasting and Social Change*, Vol. 148, Art no. 119735.
<https://doi.org/10.1016/j.techfore.2019.119735>
- Zavolokina, L., Dolata, M., and Schwabe, G. (2016), “The FinTech phenomenon: antecedents of financial innovation perceived by the popular press”, *Financial Innovation*, Vol. 2, Art no. 16. <https://doi.org/10.1186/s40854-016-0036-7>
- Zhang, Z., Yuan, Z., Ni, G., Lin, H., and Lu, Y. (2020), “The quality traceability system for prefabricated buildings using blockchain: An integrated framework”, *Frontiers of Engineering Management*, Vol. 7 No. 4, pp. 528-546.
<https://doi.org/10.1007/s42524-020-0127-z>
- Ziyae, B., Sajadi, S. M., and Mobaraki, M. H. (2014), “The deployment and internationalization speed of e-business in the digital entrepreneurship

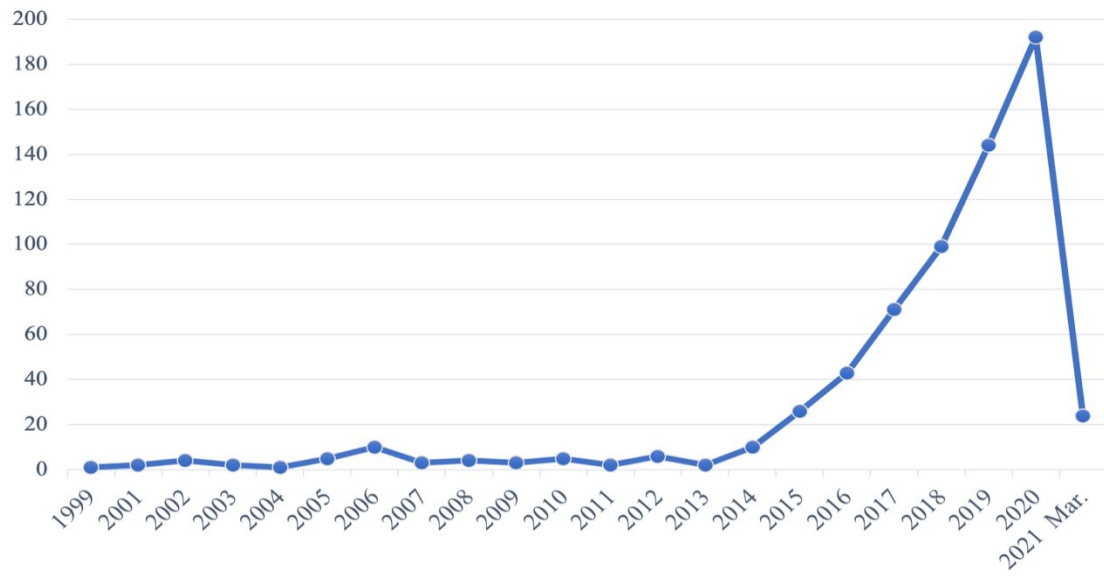


Figure 1 Number of published articles

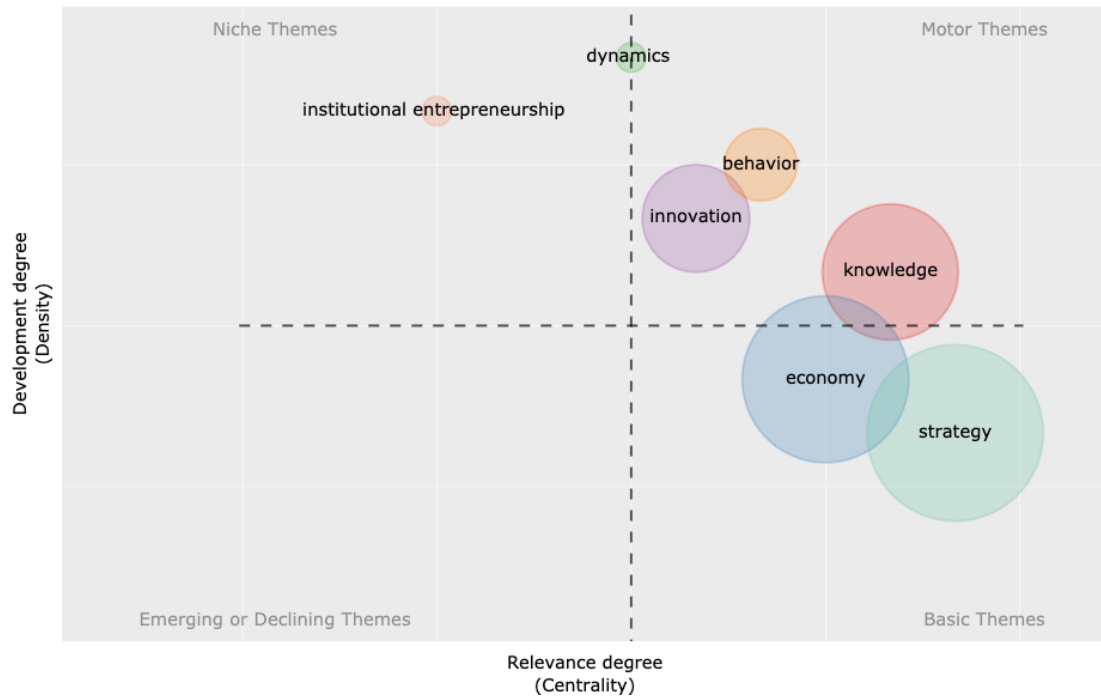


Figure 2 Thematic evolution of the topic: Time slice 1 (1999–2013)

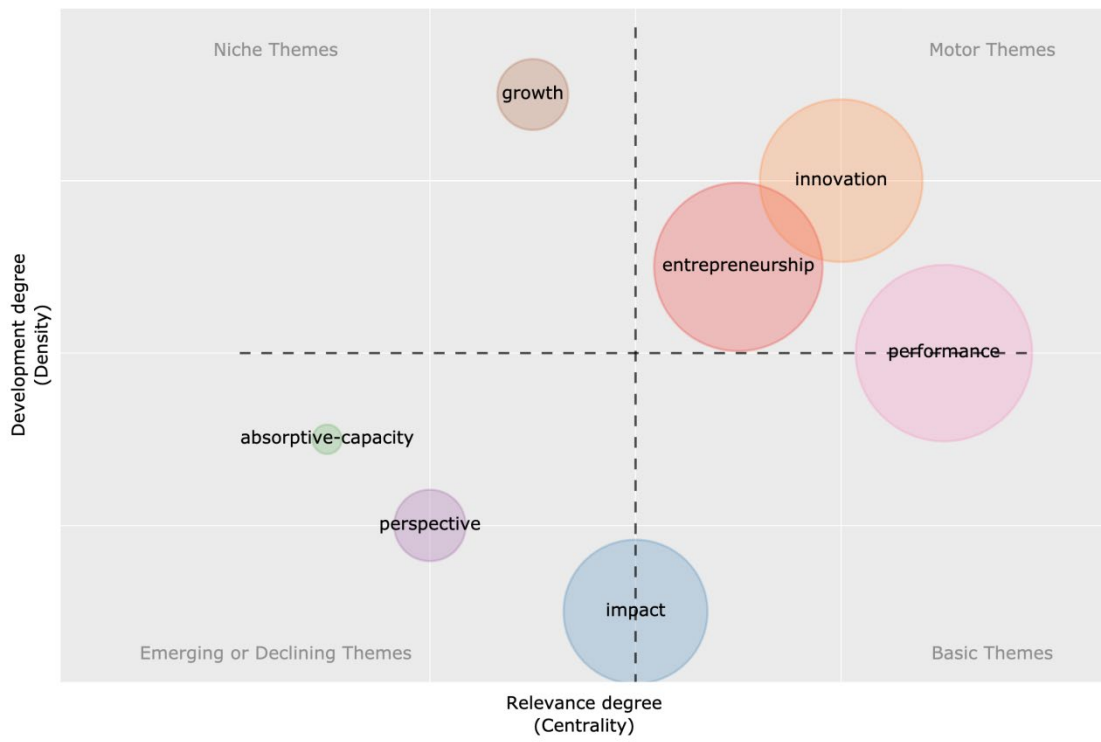


Figure 3 Thematic evolution of the topic: Time slice 2 (2014–2021 Mar.)

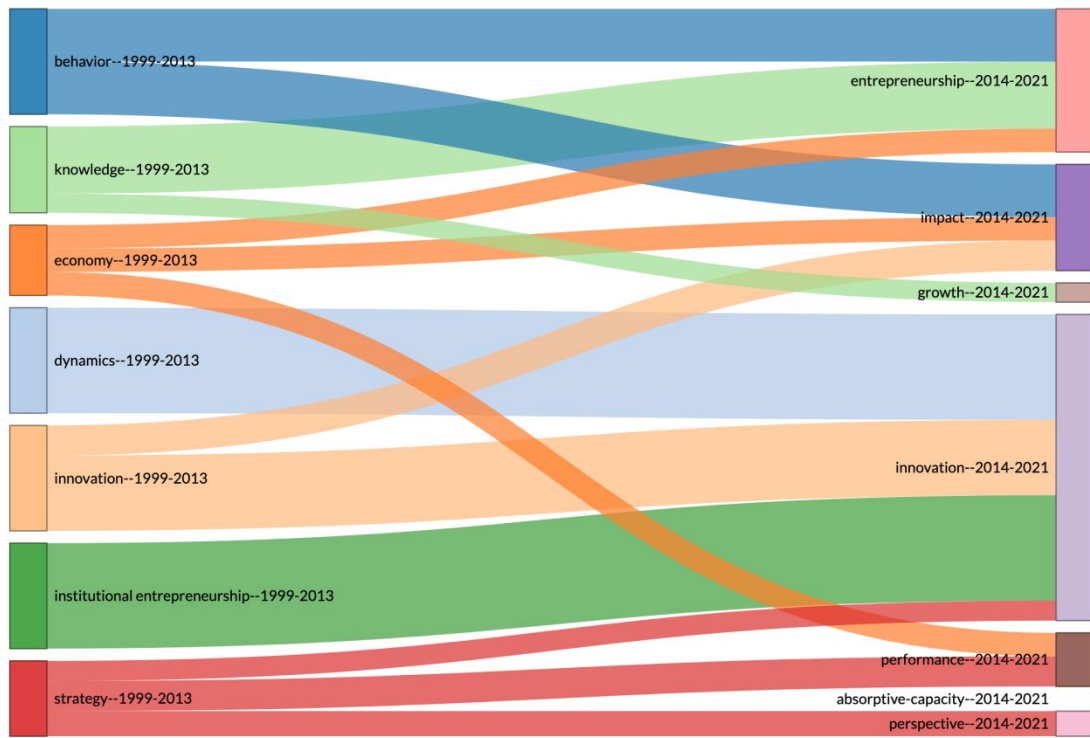


Figure 4 Thematic evolution of time slices

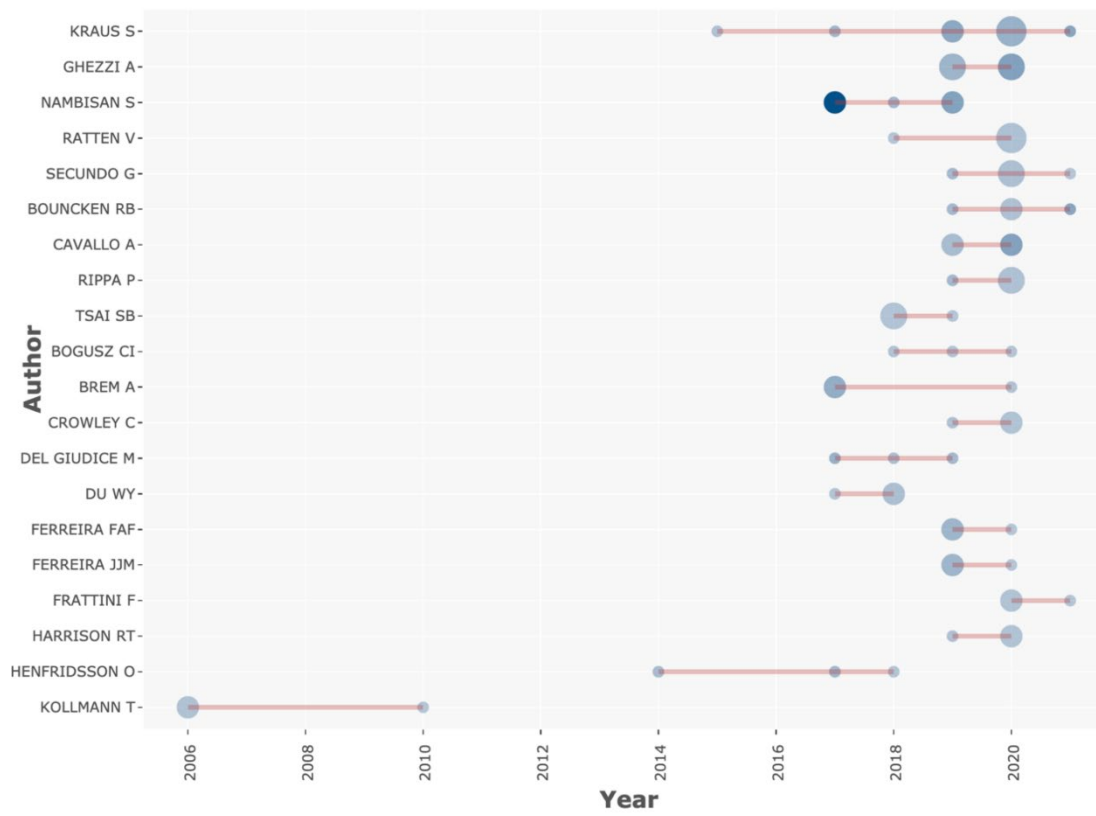


Figure 5 Top authors' production over time

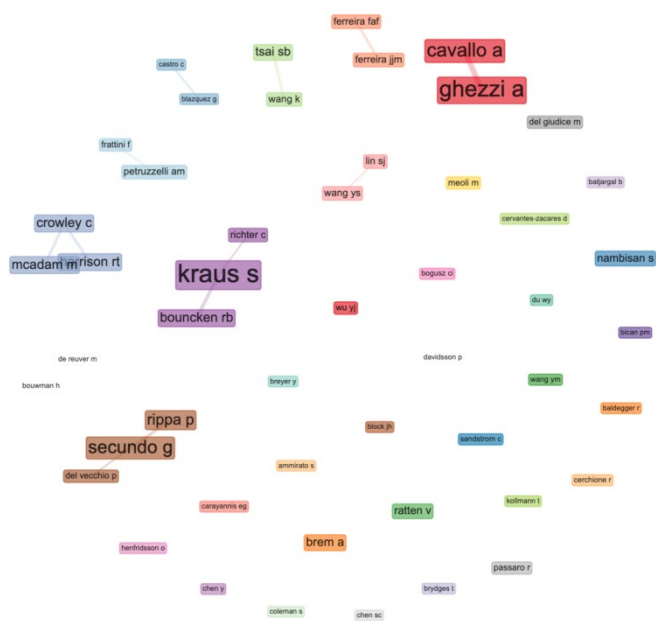


Figure 6 The social structure of the dataset

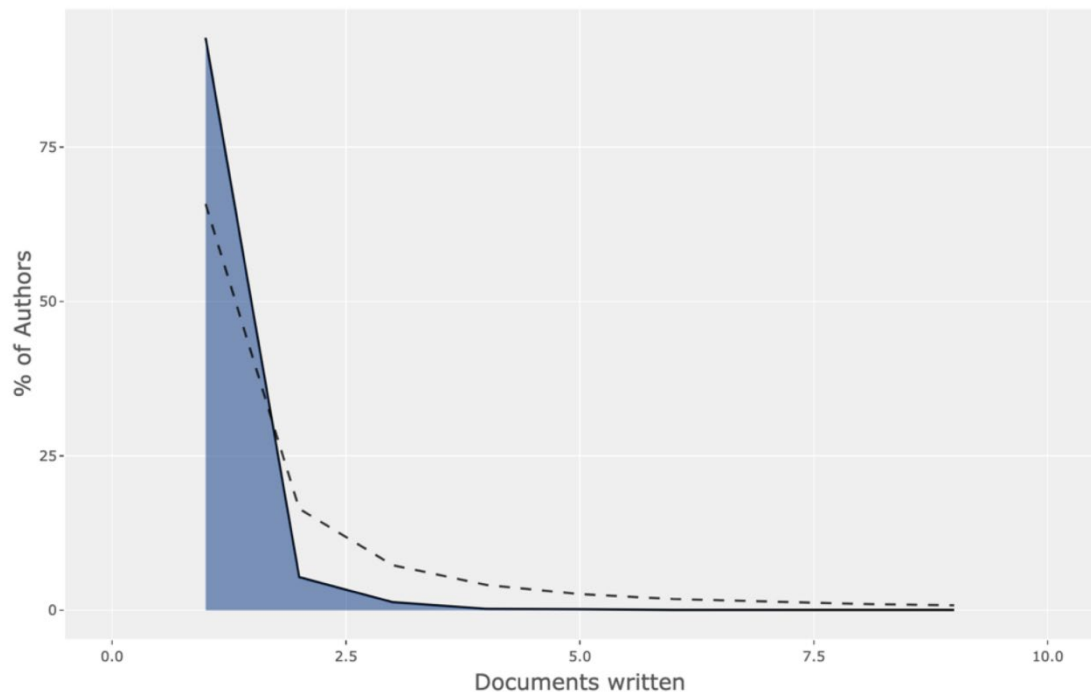


Figure 7 The frequency distribution of scientific productivity

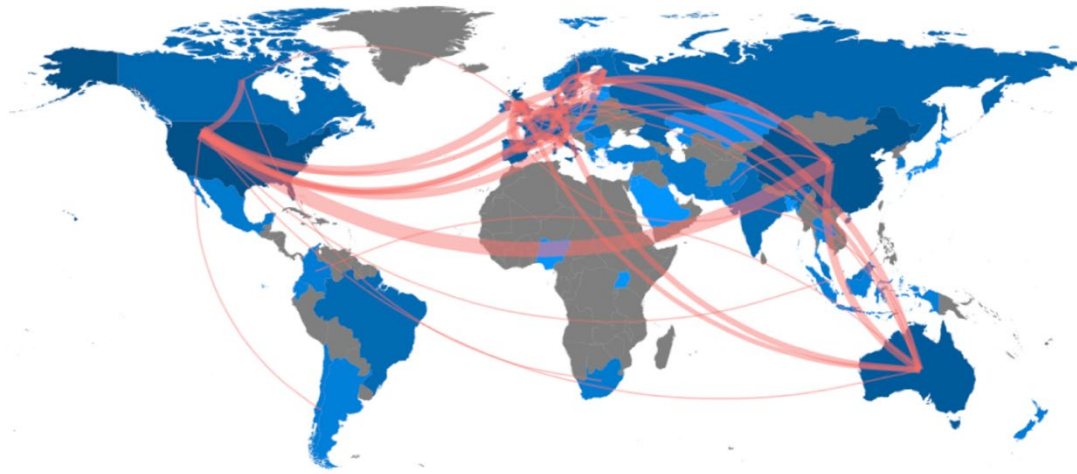


Figure 8 Country collaboration map

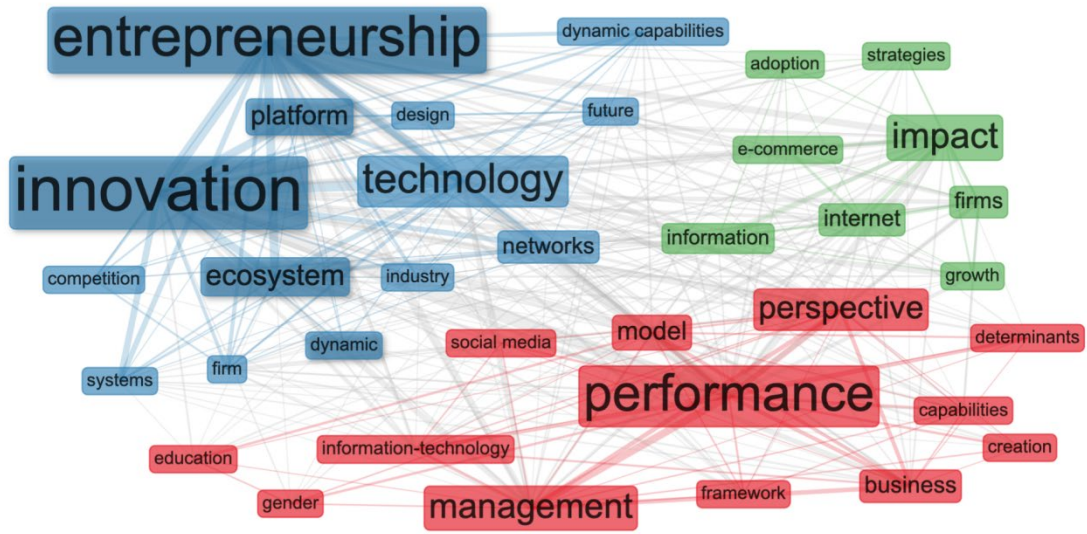


Figure 9 Keyword plus co-occurrence network

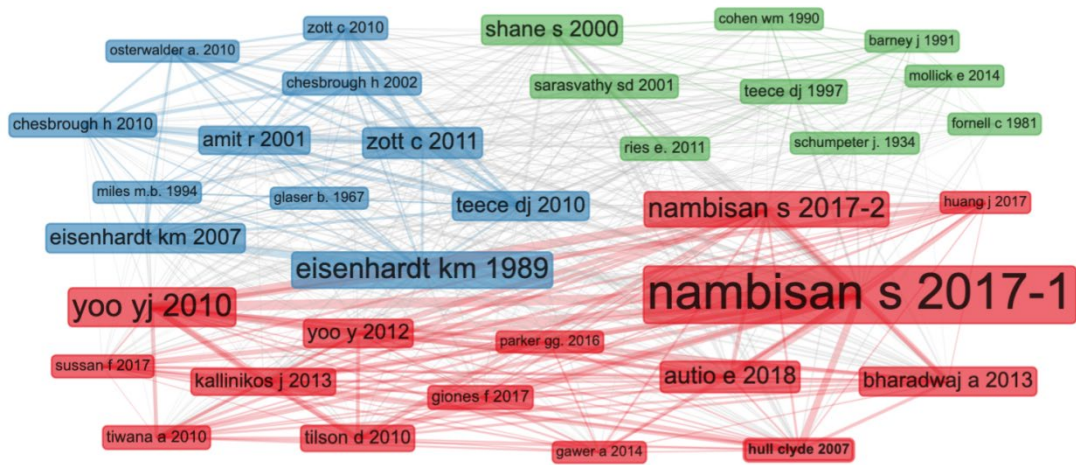


Figure 10 Papers co-citation network

Table 1 Main author

Author	Number of artical	h-index	g-index	Number of citations
Kraus	9	7	9	190
Ghezzi	8	5	8	96
Cavallo	6	4	6	77
Nambisan S	5	5	5	559
Ratten	5	2	2	9
Sambamurthy V	1	1	1	1165
Li L	2	2	2	245
Carayannis Eg	2	2	2	207

Table 2 Citation analysis of the 10 most relevant documents in the dataset

Paper	Local Citations	Total Citations	LC/TC Ratio (%)	TC per Year
Nambisan S, 2017, Entrepreneurship Theory and Practice	111	203	54.68%	40.6
Nambisan S, 2017, MIS Quarterly	44	238	18.49%	47.6
Sussan F, 2017, Small Business Economics	27	68	39.71%	13.6
Giones F, 2017, Technology Innovation Management Review	27	37	72.97%	7.4
Huang J, 2017, MIS Quarterly	20	54	37.04%	10.8
Kraus S, 2019, International Journal of Entrepreneurial Behavior and Research	20	39	51.28%	13
Von Briel F, 2018, Entrepreneurship Theory and Practice	19	37	51.35%	9.25
Sambamurthy V, 2003, MIS Quarterly	17	1165	1.46%	61.32
Richter C, 2017, Creativity and Innovation Management	17	51	33.33%	10.2
Dy Am, 2017, Hum Relations	16	58	27.59%	11.6

Table 3 The 10 most relevant journals

Journal	N. of publications	h-index	g-index	m-index	TC	PY-start
Sustainability	24	4	6	0.667	49	2016
Technological Forecasting and Social Change	22	10	19	1.25	380	2014
International Journal of Entrepreneurial Behavior and Research	16	3	5	0.6	39	2017
Small Business Economics	13	4	11	0	133	2001
Journal of Business Research	12	7	12	1.75	149	2018
Technology Innovation Management Review	10	3	8	0.6	66	2017
Information Systems Journal	9	6	9	0	133	2016
Journal of Strategic Information Systems	9	6	8	0.261	64	1999
International Entrepreneurship and Management Journal	8	4	5	0	35	2018
Research Policy	7	6	7	0.4	331	2007

Table 4 The top 10 countries ordered by the total number of articles

Country	Articles	MCP Ratio	TC	Average Article Citations
America	90	0.1667	3678	40.867
Britain	70	0.3571	798	11.4
China	65	0.3385	356	5.477
Italy	50	0.3	278	5.56
Australia	42	0.3571	244	5.81
Germany	40	0.25	293	7.325
Spain	34	0.1765	153	4.5
Russia	24	0.0417	52	2.167
France	24	0.5833	239	9.958
Sweden	21	0.3333	162	7.714

Table 5 Number of keyword occurrences and first public year

Keywords	Count	First public year
entrepreneurship	245	2001
innovation	169	2001
performance	89	2001
technology	85	2002
digital entrepreneurship	59	2015
strategy	59	2002
management	55	2002
firm	54	2007
impact	54	2006
perspective	48	2003
model	46	2014
knowledge	44	2008
internet	41	2005
network	40	2007
business model	36	2016
social media	34	2014
information technology	32	2012
business	31	2016
digital transformation	29	2014
digitalization	29	2018
information	28	2006

Table 6 Selected questions for future research in DE

Direction	Question for future research
Empower	How do gender, experience, and major of a digital entrepreneur affect the startup process
	What role does digital technology play in entrepreneurship
	How does digital technology affect startup success
	How can entrepreneurs better use digital technology to start a business
	How to use digital technology to improve user goodwill
	What is the impact of digital entrepreneurship on entrepreneurship education
	How do entrepreneurs step up their ideas in the digital age
	What opportunities and challenges does digital technology bring to the marketing work of enterprises
	Compared with traditional enterprises, what kind of financing methods do digital enterprises need
	What are the main factors influencing the success of digital startups at different stages
Evolution	What lessons can digital enterprises offer other startups? Such as enterprise boundary and so on
	In the start-up phase, it is easier for digital businesses to grow faster
	How does the rapid iteration of digital technology help lean startups
	What are the unique advantages of digital enterprises in the process of internationalization
	What are the differences between a digital enterprise and a traditional enterprise
	What challenges does digital enterprise bring to traditional entrepreneurship theories
	How to adjust the existing legal and financing models to better help the development of digital enterprises
	What criteria should we use to measure the success of a digital enterprise
	What are the links and differences between industrial parks, business incubators and digital entrepreneurship ecosystems
	How can the various actors in the digital entrepreneurial ecosystem effectively communicate information
Ecosystem	What can governments do to boost the digital entrepreneurship ecosystem
	What benefits can a well-functioning digital start-up ecosystem bring to the local community
	What is the unique role of eBay, Uber and other platform companies in the digital start-up ecosystem
	How does government regulation affect the development of digital enterprises
	What requirements does the rapid development of digital enterprises put forward for government and legal supervision
	How do network effects help digital businesses grow exponentially