

Article

Digital Entrepreneurship and Sustainability: The State of the Art and Research Agenda

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Abstract: Digital technologies have changed and disrupted the dynamics of the economy and society as a whole, offering new opportunities for entrepreneurs with potential impact on economic, environmental, and social value creation. This paper examines the scientific research on digital entrepreneurship (DE) and sustainability based on data from Scopus database. The main purpose is to identify both the predominant themes and further research opportunities to this topic. This study uses a bibliometric analysis, analyzing and synthesizing research on DE and sustainability, based on a total of 58 publications. Co-word analysis used to identify the conceptual structure reveals three thematic clusters: (1) innovation and entrepreneurship, (2) digital transformation: strategy and business models, and (3) sustainability and sustainable development goals. For each thematic cluster, the most significant contributions are presented. Further, this paper offers a future research agenda and holds significant implications for the theory and practice of the different subtopics of DE and sustainability.

Keywords: digital entrepreneurship; sustainability; bibliometric analysis; Scopus



Citation: Fernandes, Catarina, Rui Pires, and Maria-Ceu Gaspar Alves. 2023. Digital Entrepreneurship and Sustainability: The State of the Art and Research Agenda. *Economies* 11: 3. <https://doi.org/10.3390/economies11010003>

Academic Editors:
Renata Korsakienė,
Laima Jesevičiūtė-Ufartienė and
Neringa Vilkaitė-Vaitonė

Received: 15 November 2022
Revised: 8 December 2022
Accepted: 16 December 2022
Published: 20 December 2022



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1. Introduction

The growth of the digital economy owes its existence largely to the entrepreneurial activity supported by digital technologies (Zaheer et al. 2019). Digital economy is widely recognized as one of the most substantial economic developments since the industrial revolution, characterized by the capability to transform economies, jobs, and even society as a whole, and DE is at the origins of this disruptive revolution (Akpan and Ibidunni 2021; Manea et al. 2021). Digital economy performance is a matter of national strategies for attaining economic development and socioenvironmental growth (Laitsou et al. 2020; Manea et al. 2021).

Given today's technological and digital developments, several distinct industries have been forced to adapt or transform their traditional strategies, procedures, and business models to tackle the digital challenges and seize emerging opportunities (Akpan and Ibidunni 2021; Fernandes et al. 2022; Gavrila and Ancillo 2022; Gregori and Holzmann 2020; Manea et al. 2021; Zaheer et al. 2019). Moreover, the steady advances of digital technologies (e.g., internet of things, artificial intelligence, and big data) have created room for new digital startups. DE, built on the existence or development of the digital ecosystem, has the potential to promote sustainable business (George et al. 2021; Jha et al. 2022; Tim et al. 2021; Tohănean et al. 2020) from the economic, environmental, and social points of view.

The digitalization of businesses creates several opportunities and enables higher levels of sustainability, as confirmed by positive interdependencies among these two megatrends (Lichtenthaler 2021). On the one hand, digital solutions that enable DE improve connectivity and accessibility, lower costs and carbon footprint, and promote the inclusion and

participation of users (Baran and Berkowicz 2021; Gregori and Holzmann 2020; Lichtenthaler 2021). On the other hand, stakeholders' sustainability concerns encourage the adoption of sustainable solutions, such as digital technologies.

In the last years, some literature review studies have been published on DE (e.g., Fernandes et al. 2022; Kraus et al. 2019; Sahut et al. 2021; Zaheer et al. 2019; Zhai et al. 2022), on sustainable entrepreneurship (e.g., Anand et al. 2021), on sustainability (e.g., Niñerola et al. 2019), and on the intersection of entrepreneurship and other topics (e.g., Glinyanova et al. 2021; Hota et al. 2020; Lampe et al. 2020; Santos et al. 2018). However, to the best of our knowledge, there is no integrative bibliometric analysis on DE and sustainability research. Keeping in mind this gap in the academic literature, the main goal of this paper is to examine the scientific research on the topic to help us to understand where it comes from and where it is going. Specifically, we intend to achieve the following aims: (i) to analyze the evolution of the research on DE and sustainability, (ii) to identify the most productive journals and authors, (iii) to identify the most impactful articles in the research topic, (iv) to identify and to synthesize the predominant research themes, and (v) to recommend future research opportunities.

This paper makes some significant contributions to the literature. First, we present a complete assessment of the research on DE and sustainability through a bibliometric analysis, which contributes to the understanding of the knowledge structure of the research topic and helps to identify key knowledge gaps. Second, our paper extends the understanding of the linkage between DE and sustainability in its different dimensions. In this paper, we adopt a broad concept of sustainability, which includes the three interconnected pillars of sustainability: economic (profit), environmental (planet), and social (people) well-being. Finally, we suggest potential directions for further research by proposing a research agenda.

The remainder of this paper is organized into four sections. Section 2 introduces the theoretical background on the topic. Section 3 describes the methodology employed in the study. Section 4 provides the results and discussion and proposes a future research agenda. Finally, Section 5 reports the main conclusions, theoretical and practical implications, and limitations.

2. Theoretical Background

The literature review gives guidance through the academic research dealing with the topics of DE and sustainability by providing a systematized overview on the existing literature.

2.1. Digital Entrepreneurship

Entrepreneurship is commonly viewed as a driver of innovative dynamics and economic growth and entrepreneurs, in the Schumpeterian approach, as "creative destructors". The recent development of digital technologies has strongly influenced the entrepreneurial process (Fernandes et al. 2022; Nambisan 2017; Zhai et al. 2022), both through the digitization and digitalization of existing businesses and the creation of digital firms (Fernandes et al. 2022). Against this background, DE describes the entrepreneurial action enabled by the use of digital technologies (Nambisan 2017; Sussan and Acs 2017; Zhai et al. 2022). In the words of Hull et al. (2007, p. 293), DE "is a subcategory of entrepreneurship in which some or all of what would be physical in a traditional organisation has been digitised", such as digital goods or services and distribution. In turn, the definition of Sahut et al. (2021) is wider, including the role of digital enablers to support all the phases of the process of venture creation (e.g., idea generation and opportunity recognition, and distribution). Accordingly to their view, and contrary to Hull et al. (2007), DE cannot be reduced to a subcategory of entrepreneurship but, rather, as advocated by Le Dinh et al. (2018, p. 1), DE is "the reconciliation of traditional entrepreneurship with the new way of creating and doing business in the digital era". Table 1 contains a summary of alternative definitions of DE.

Table 1. Definitions of digital entrepreneurship.

Source	Definition
Hull et al. (2007, p. 293)	“Digital entrepreneurship is a subcategory of entrepreneurship in which some or all of what would be physical in a traditional organisation has been digitised”. data
Kraus et al. (2019, p. 354)	“In general, any entrepreneurial activity that transfers an asset, service or major part of the business into digital can be characterised as digital entrepreneurship”.
Le Dinh et al. (2018, p. 1)	“Digital entrepreneurship is defined as the reconciliation of traditional entrepreneurship with the new way of creating and doing business in the digital era”.
Nambisan (2017, p. 1029)	Digital entrepreneurship as the “intersection of digital technologies and entrepreneurship”.
Sahut et al. (2021, p. 1162)	“DE as the process of entrepreneurial creation of digital value through the use of various socio-technical digital enablers to support effective acquisition, processing, distribution, and consumption of digital information”.
Sussan and Acs (2017, p. 66)	“Digital entrepreneurship (. . .) includes any agent that is engaged in any sort of venture be it commercial, social, government, or corporate that uses digital technologies. (. . .) In other words, they are performing activities that need digital engagement but may not in themselves be digital (. . .)”.

Based on the definitions, one can note that DE has several differences compared to traditional entrepreneurship. According to Hull et al. (2007, p. 292) “one major difference between digital entrepreneurship and traditional entrepreneurship is how they market”. Products, marketing activities, and workplace are differentiation criteria commonly pointed out by the literature (Hull et al. 2007; Kraus et al. 2019). Additionally, in some studies, other differences can be found, such as personal characteristics of entrepreneurs (Colombo and Delmastro 2001), evolution patterns of business models (König et al. 2019), and how the regulatory environment influences entrepreneurial activity (Dong 2019; Steininger et al. 2022). Regulators across different countries have to deal with different challenges, such as data privacy and security. It is truly challenging “to protect digital products and digital knowledge through intellectual property rights and other forms of protection such as secrecy. This can create a problem for digital start-ups to raise capital from banks and other traditional providers of corporate finance” (Steininger et al. 2022, p. 6). With most digital firms operating globally, country-specific regulation is an important source of risk (Kraus et al. 2019).

Digital technologies are not only opening up interesting innovation opportunities for entrepreneurs, but also creating new challenges (Fernandes et al. 2022; Kraus et al. 2019; Sahut et al. 2021; Zhai et al. 2022). The “digital” offers significant potential for previously excluded groups, contributing to democratizing entrepreneurship through, for instance, the promotion of gender equality (Zhai et al. 2022). Digital ecosystems, where firms, customers, and other stakeholders interact with each other, allow entrepreneurs to access a considerable amount of relevant data, for business improvement (i.e., business exploitation) and new business development (i.e., business exploration) to create and capture value (Kraus et al. 2019; Sussan and Acs 2017). Value creation increasingly takes place through the production and easy access of digital information (Sahut et al. 2021).

Digital technologies also give consumers the possibility to influence product design, production, and delivery (Zhai et al. 2022). Consumers are no longer just passive recipients but can actively participate in this process, enabling entrepreneurs to customize their offerings. DE creates new business opportunities for promoting sustainability by developing and using new digital technologies, which “support the development of value propositions

that blend environmental, social, and economic value” (Gregori and Holzmann 2020, p. 2). A growing awareness of environmental and social issues means that entrepreneurship should consider the impact of business activities on current and future economic (e.g., long-term profitability), environmental (better use of natural resources), and social (e.g., local community development) well-being.

2.2. Sustainability

Sustainability has become a significant issue in all aspects of human and organizational routines. The notion of sustainability incorporates the integration of economic, environmental, and social purposes (Anand et al. 2021; Manea et al. 2021). In business, sustainability implies finding solutions and making decisions grounded on the relationships among profit, planet, and people (3 Ps). Sustainable business models go beyond simple financial profit, including also environmental and social values and goals. Entrepreneurs are now seen as agents of change who are committed to seeking a balance between the three pillars of sustainability.

Economic sustainability is linked to the resource efficiency in order to reach profitability in the long term (Niñerola et al. 2019). Environmental sustainability implies that natural resources should be managed at a sustainable rate (e.g., material saving, decrease energy consumption, and increase waste recycling), as these are scarce and generally nonrenewable (Niñerola et al. 2019). Finally, social sustainability embraces social capital, equality of opportunities, community development, improvement of living conditions, and social responsibility (Eizenberg and Jabareen 2017; Niñerola et al. 2019).

By launching the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), the United Nations Member States, and, thus, the world community in general, reiterated its commitment to sustainability. SDGs, embracing a wide range of economic, environmental, and social issues, pose new and important challenges for all actors in society (civil society, governments, and the private sector), but both researchers and practitioners recognize the particular impact on businesses. Firms must adjust their strategies and operations not only to achieve SDGs, but also to respond to the demand of environmentally and socially conscious clients.

2.3. Digital Entrepreneurship and Sustainability

The development and use of digital technologies create new opportunities for entrepreneurs (Fernandes et al. 2022), enabling new businesses’ development and business improvement that ensure economic, environmental, and social sustainability (Baran and Berkowicz 2021; George et al. 2021; Gregori and Holzmann 2020; Jha et al. 2022; Tim et al. 2021; Tohănean et al. 2020). That is, these technologies support digitization, digitalization, and digital transformation, which breaks with the past and leads to new sustainable growth business models (Gavrila and Ancillo 2022).

Therefore, DE plays a major role in contributing towards sustainability as it not only creates financial value, but also enhances resource optimization and promotes social inclusion and fighting poverty through digital technologies (Manea et al. 2021; Srivastava and Shainesh 2015). For instance, the association of digital technologies with the circular economy into DE enables the achievement of the sustainable development goal related to the responsible consumption and production, that is, resource optimization by reducing the need to use new resources (Manea et al. 2021). DE holds potential for helping to make entrepreneurship more inclusive. Underserved societal segments could be more likely to benefit from certain attributes of digital technologies for business creation and growth, including the wider access to global markets offered by the internet (McAdam et al. 2020; Srivastava and Shainesh 2015; Tim et al. 2021). Moreover, smart city initiatives, which mainly follow sustainable and/or digital orientations to enhance performance city and citizens’ well-being, may provide a propitious climate for green and/or digital entrepreneurs (Manjon et al. 2022).

3. Methodology

We followed a bibliometric analysis approach, as outlined by Zupic and Čater (2015) and Donthu et al. (2021), to achieve the aim of structuring extant research on DE and sustainability. Similar studies on the intersection of entrepreneurship and other topics used the same approach (e.g., Anand et al. 2021; Glinyanova et al. 2021; Hota et al. 2020; Lampe et al. 2020; Santos et al. 2018). This approach includes the following four main steps: (1) to define the research design (delimitate the main purpose and scope of the study), (2) to choose the method of bibliometric analysis (based on the main goal defined in step one), (3) to collect the data for bibliometric analysis (select the appropriate database and specify the search query), and (4) to run the bibliometric analysis, report and disseminate the review findings.

In the first step, we defined the main purpose of the study, that is, identified both the predominant themes and future research opportunities on DE and sustainability. Accordingly, in the second step, we decided to analyze the productivity of journals and authors, the impact of publications, and use as a bibliometric method the co-word analysis, which is interpreted as a representation of the conceptual structure of the research field (Donthu et al. 2021; Fernandes and Pires 2021; Zupic and Čater 2015). Co-word analysis uses an advanced content analysis technique to investigate the relationships between terms/words in a set of documents (Callon et al. 1983) and to delimit the boundaries of scientific areas (Castriotto et al. 2019). “The idea underlying the method is that when words frequently co-occur in documents, it means that the concepts behind those words are closely related” (Zupic and Čater 2015, p. 435). Because words’ co-occurrence reveals which words are jointly mentioned, it shows patterns and trends in the field of study. Co-word analysis was conducted using the VOSviewer 1.6.18 software.

The bibliographic data were collected from Elsevier’s Scopus database, which is widely used in systematic literature reviews and bibliometric analyses (e.g., Anand et al. 2021; Niñerola et al. 2019; Fernandes and Pires 2021). Moreover, Scopus database has a larger publications coverage in this field of research than Web of Science database (e.g., Mongeon and Paul-Hus 2016). Figure 1 shows the process of data collection following the PRISMA flowchart (Page et al. 2021).

The search was performed on 11 April 2022, using as keywords “digital*” OR “digitization” AND “entrepreneur*” AND “sustainab*” in three alternative fields: title, abstract, and keywords. These keywords were defined based on previous studies (e.g., Anand et al. 2021; Fernandes et al. 2022; Kraus et al. 2019). We used an asterisk for our search to ensure we did not leave out any publications of interest, since an asterisk can substitute for the absence of a character, a single character, or multiple characters in a word. For instance, “entrepreneur*” can be entrepreneur, entrepreneurs, entrepreneurial, and entrepreneurship. We also used the symbol “\$” to substitute different characters. Thus, “digitization” can be digitization and digitisation. In this step, the query search resulted in 431 publications. Then, according to the previous literature, we limited the sample to articles written in English and published in international journals (Anand et al. 2021; Kraus et al. 2019, 2020). No start date was specified, enabling the search engine to detect the earliest articles in the research field. As we are in 2022, we limited our search to articles published (online) up to 2021. This reduced the number of publications to 191 articles.

Finally, the three authors of the study applied separately the previously defined criteria. All articles’ title, abstract, and keywords were analyzed and, when necessary, the full text read. The articles selected by each of those authors were subsequently compared and discussed. As a result, 133 articles not specifically related to the research were removed. Thus, the final sample includes 58 articles that appeared appropriate for structuring the research on DE and sustainability.

In the next step, the 58 articles eligible for the bibliometric analysis were analyzed. In the next section, we synthesize the data (performance analysis) and highlight the important issues (main research streams) related to DE and sustainability.

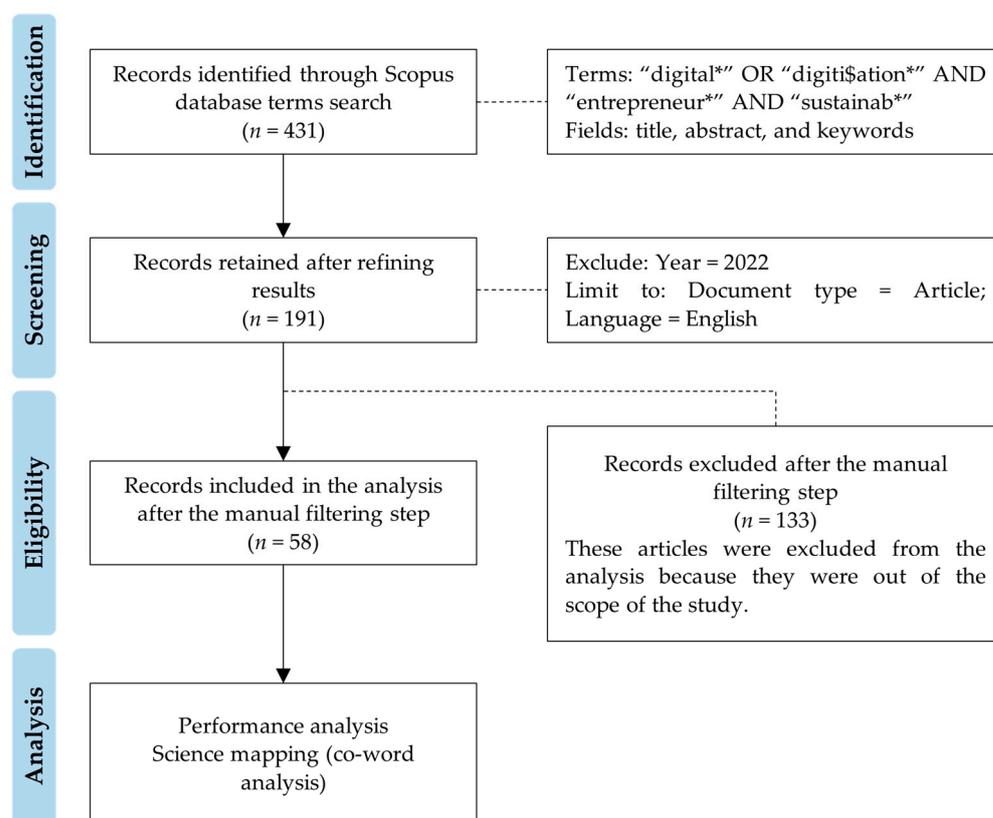


Figure 1. Process of data collection and analysis (PRISMA flowchart).

4. Results and Discussion

The results and discussion section is structured as follows. Firstly, we present the characterization of the sample of articles that make up this investigation (performance analysis). To this end, the chronological evolution of the publications, the most publishing journals, authors, and cited articles, and the authors' keywords most quoted are provided and analyzed. Next, the main research streams on DE and sustainability are presented.

4.1. Performance Analysis

Figure 2 displays the number of articles published on DE and sustainability between 2012 and 2021. The growing interest in this research field began to develop over the last decade, with some evident progress after 2018, suggesting that this subject has been gaining popularity in the academic community in the last years. In fact, the scientific literature on DE is recent (Fernandes et al. 2022) and, thus, the same is true regarding DE and sustainability. As can be seen in Figure 2, 2021 was the most productive year, with 25 articles.

The 58 articles were published in 46 journals. Table 2 presents only the journals with two or more articles. Sustainability appears as the most productive journal (nine articles).

The dataset includes 155 authors for 58 articles. No author stands out from the rest because all of them have the same number of articles (i.e., one article). One possible explanation for this finding is that the topic under analysis is very recent, although attracting increasing attention.

Table 3 shows the 11 articles with the highest number of citations. Seven of them were published in the last three years. Srivastava and Shainesh (2015) stands out with 139 citations, followed by Angelidou et al. (2018) (102 citations) and Gössling and Hall (2019) (80 citations).

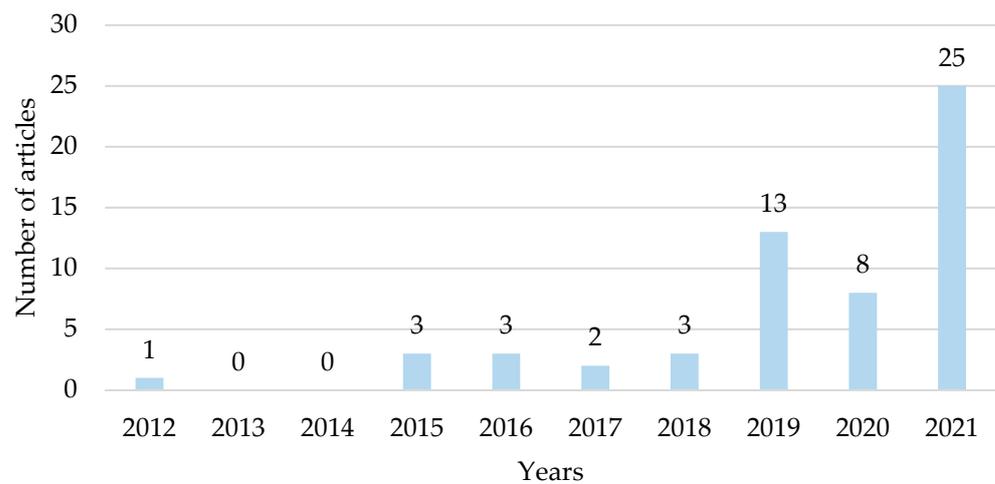


Figure 2. Evolution and quantification of the articles ($n = 58$).

Table 2. Most publishing journals (two or more articles).

Journal Title	Number of Articles
Sustainability	9
Amfiteatru Economic	2
British Food Journal	2
Journal of Media Business Media	2
Thunderbird International Business Review	2

Table 3. Most cited articles on DE and sustainability.

Authors (Year)	Title	Journal	TC	AC
Srivastava and Shainesh (2015)	Bridging the service divide through digitally enabled service innovations: Evidence from Indian healthcare service providers	MIS Quarterly: Management Information Systems	139	17.38
Angelidou et al. (2018)	Enhancing sustainable urban development through smart city applications	Journal of Science and Technology Policy Management	102	20.40
Gössling and Hall (2019)	Sharing versus collaborative economy: How to align ICT developments and the SDGs in tourism?	Journal of Sustainable Tourism	80	20.00
Naldi and Picard (2012)	“Let’s start an online news site”: Opportunities, resources, strategy, and formational myopia in startups	Journal of Media Business Studies	51	4.64
Richter et al. (2015)	The Smart City as an opportunity for entrepreneurship	International Journal of Entrepreneurial Venturing	39	4.88
Bican and Brem (2020)	Digital business model, digital transformation, digital entrepreneurship: Is there a sustainable “digital”?	Sustainability	37	12.33
George et al. (2021)	Digital sustainability and entrepreneurship: How digital innovations are helping tackle climate change and sustainable development	Entrepreneurship: Theory and Practice	34	17.00
De Bernardi et al. (2019)	Online and on-site interactions within alternative food networks: Sustainability impact of knowledge-sharing practices	Sustainability	31	7.75
Akhter (2017)	Unlocking digital entrepreneurship through technical business process	Entrepreneurship and Sustainability Issues	25	4.17
Gregori and Holzmann (2020)	Digital sustainable entrepreneurship: A business model perspective on embedding digital technologies for social and environmental value creation	Journal of Cleaner Production	20	6.67
Bjørn and Boulus-Rødje (2018)	Infrastructural inaccessibility: Tech entrepreneurs in occupied Palestine	ACM Transactions on Computer-Human Interaction	20	4.00

TC = total number of citations; AC = average number of citations by year.

Srivastava and Shainesh (2015) extend the digital divide perspective (goods-centric view) to that of a service divide (service-centric view) in order to understand the role of information and communication technologies (ICT) in facilitating equitable development. Specifically, they examine the development of sustainable telemedicine healthcare service delivery models for the rural population in India, stressing the use of digital technologies by social entrepreneurs to serve disadvantaged segments of the population. Angelidou et al. (2018) also make a relevant contribution to the literature by investigating how digital technologies, in particular ICT, used in smart city applications, enable environmental sustainability. These technologies are critical not only to create smart sustainable cities, but also to support entrepreneurship in digital services and development of data-driven applications. In turn, Gössling and Hall (2019) investigate the sustainability dimensions of the sharing economy in the accommodation sector, underlining the role of ICT (in particular, digital platforms) to transform business models and create new opportunities for entrepreneurship.

Figure 3 shows the frequently occurring words in the author keywords of the articles analyzed, indicating the thematic focus in these studies. The most prevalent keywords are entrepreneurship, sustainability, digital entrepreneurship, innovation, sustainable development goals, and digital technology.



Figure 3. Word cloud of the authors' keywords.

4.2. Main Research Streams on DE and Sustainability

Using the VOSviewer software and the co-word analysis, the conceptual structure of the research on DE and sustainability was obtained. The network visualization is presented in Figure 4. Colors show clusters of keywords that are related to each other. Keywords located near each other exhibit a high co-occurrence frequency in articles, and keywords further apart depict low co-occurrence frequency. Each cluster represents a research stream in DE and sustainability. The size of the circle depends on the number of occurrences the keywords have. In this way, large circles represent keywords that have more occurrences.

Based on the analysis of the network diagram and through an interpretative analysis of the authors' keywords included in each cluster, three research streams were identified: (1) innovation and entrepreneurship, (2) digital transformation: strategy and business models, and (3) sustainability and sustainable development goals. It can be observed that the clusters of authors' keywords are linked with each other, reinforcing that research themes should not be addressed as being mutually exclusive. This is particularly evident when the topic is recent and, therefore, the research focuses on a limited number of keywords. One should expect that, with increasing studies on DE and sustainability, the research concentrates in specific subtopics and the clusters are more delimited.

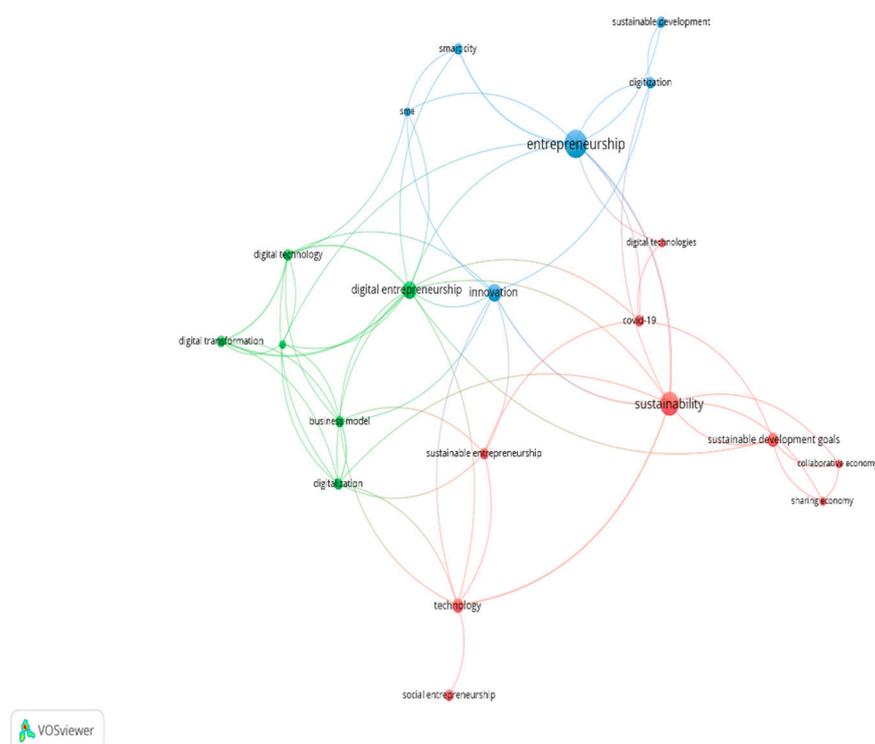


Figure 4. Global thematic network in DE and sustainability research based on keywords co-occurrence analysis.

4.2.1. Cluster 1 (Blue Cluster): Innovation and Entrepreneurship

The blue cluster includes a set of articles that relates entrepreneurship and innovation based on a reinterpretation of the (traditional) Schumpeterian approach, where the development is driven by entrepreneurial innovation. This “new” approach, prompted by the current context, shapes the concepts of development and entrepreneurship/entrepreneur by specifically focusing on sustainable development (in economic, environmental, and social dimensions) and digitization of the entrepreneurial process, respectively. The articles address this subtopic in two different perspectives: governmental level (public sector, in particular, smart cities) (Angelidou et al. 2018; Manjon et al. 2022; Richter et al. 2015) and firm level (private sector, in particular, small and medium enterprises) (Akpan and Ibidunni 2021; Irimiás and Mitev 2020).

Digitization, meaning the automation of processes through ICT or the integration of ICT with existing tasks, being the first step in the process of the digital transformation, is considered to be an efficient means to support sustainable economic, environmental, and social development. “ICT for sustainability” plays a relevant role in urban and business contexts (Akpan and Ibidunni 2021; Angelidou et al. 2018).

Rapid adoption of technological solutions by different actors involved in the process of innovation is a critical factor that influences the speed and quality of the “smartization” of cities (Angelidou et al. 2018; Gitelman et al. 2020), and, in turn, it contributes to the sustainable urban development (e.g., smart energy or energy efficiency, smart city infrastructure, and smart road traffic management) (Angelidou et al. 2018; Gitelman et al. 2020; Richter et al. 2015). Therefore, smart cities represent an opportunity for entrepreneurship, in particular, for technology entrepreneurship, since, on the one hand, they create a climate conducive to the creation of new solutions and, on the other hand, technology entrepreneurs focus on the creation of breakthrough innovations that change the existing markets (Gitelman et al. 2020; Manjon et al. 2022; Richter et al. 2015).

Within a firm, sustainable development often requires changes in strategy and structure. Into the small business context, scholars have highlighted the digitization and technology adoption as a strategic competitive factor for survival and growth (Akpan and

Ibidunni 2021). However, SME's resources (e.g., knowledge and funding) are frequently limited (Irimiás and Mitev 2020; Ochinanwata et al. 2021) and, thus, the ability to innovate through the use of ICT, which enhances the efficient use of resources and waste reduction and supports sustainable development, is often constrained (Irimiás and Mitev 2020).

4.2.2. Cluster 2 (Green Cluster): Digital Transformation: Strategy and Business Models

The green cluster comprises articles that focus on the two steps of the process of digital transformation beyond digitization, that is, digitalization and digital transformation. These three steps represent different levels of adoption and use of digital technologies, digital transformation being the one that embraces the most profound changes and implications (Bican and Brem 2020). The articles investigate how organizations integrate these digital technologies within their strategies and operations and employ them to develop new digital business models, highlighting, also, the potential contribution of digital business models for sustainability (e.g., Gregori and Holzmann 2020; Karimi and Walter 2021; Tohänean et al. 2020). Digital technologies provide several (digital and sustainable) entrepreneurial opportunities, which Gregori and Holzmann (2020) label as “digital sustainable entrepreneurship”.

Digitalization occurs when digital technologies and digital data are adopted and used to introduce changes in the way businesses are carried out (e.g., improving businesses and transforming business processes) and revenues are created (Bican and Brem 2020; Gregori and Holzmann 2020; Tohänean et al. 2020). In turn, digital transformation, representing the integration of digital technologies within all aspects and operations of the organizations, which influences value proposition, value creation, and value capture, may lead to improved or new (digital) business models with sustainable potential (Gregori and Holzmann 2020). Digital transformation results not only from the interplay between digital technology and digital innovation, but is also influenced by the organization, its digital readiness, and external collaborations to promote the digital transformation (Bican and Brem 2020).

Nowadays, technological and digital transformation is a strategic decision that successful organizations need to make to be particularly well placed in the current digital economy and industry 4.0 (Akpan and Ibidunni 2021). Organizations that do not quickly develop and implement digital transformation strategies are unlikely to keep pace and compete in this new reality (Akhter 2017; Tohänean et al. 2020). Through digital transformation, current and more closed business models can be renewed to develop more open and platform-based business models to capture external opportunities. The combination of diverse digital technologies in these new business models allows creation of spaces for community integration, engagement in co-creation activities, and integration of an increasingly diverse set of stakeholders going beyond customers and suppliers (Gregori and Holzmann 2020). Moreover, digital technologies enable the transformation of current business models into digital business models towards a sustainable and circular economy (Bican and Brem 2020; Manea et al. 2021).

4.2.3. Cluster 3 (Red Cluster): Sustainability and Sustainable Development Goals

The red cluster contains a set of articles that highlights the key role of digital technologies in offering new possibilities for sustainable business practices, grounded on the balance between economic, environmental, and social sustainability, and, thus, substantially contributing to achieve SDGs (e.g., sustainable economic growth, sustainable production and consumption, gender equality, and clean water and sanitation) (Bican and Brem 2020; George et al. 2021; Gregori and Holzmann 2020; Tim et al. 2021). Digital technologies in business activities not only bring better use of scarce resources, but also provide opportunities for sustainable innovations. In other words, the integration of digital technologies with entrepreneurship results in sustainable entrepreneurship and in the development of innovative business models (Gössling and Hall 2019; Gregori and Holzmann 2020; Jha et al. 2022), supporting the transition from the linear economy to a circular economy (Manea et al. 2021).

Articles in this cluster show that entrepreneurial agents are using digital technologies to tackle critical sustainability challenges (George et al. 2021).

In this context, much of the literature relates the sharing economy, which is increasingly being replaced by the collaborative economy, to the sustainability and SDGs (Gössling and Hall 2019), stressing its role in employment generation and dematerialization, as well as in enabling the use of underutilized and redundant resources and a more efficient utilization (e.g., reduction in water and energy use) (Gössling and Hall 2019; Jha et al. 2022). “At its core, the sharing economy is about sharing of idle assets, usually via tech platforms, in ways that produce economic, environmental, social and practical benefits” (Jha et al. 2022, p. 518). Digital platforms have turned into the most important pillars in the sharing economy (Gössling and Hall 2019; Jha et al. 2022), viewed as living labs for sustainable entrepreneurship and innovation (Baran and Berkowicz 2021). During the COVID-19 crisis, the importance of the sharing economy in managing business efficiency was evidenced by the research (Jha et al. 2022). Moreover, the pandemic crisis has led to the need to rethink and redefine the concept of sustainability to include human wealth.

4.3. Future Research Directions

The results reveal some gaps in the literature and provide some potential opportunities for further research. First, although the literature stresses the contribution of smart cities to sustainable development, clearly reflected in the SDGs (Goal 11, “make cities and human settlements inclusive, safe, resilient and sustainable”), and, thus, the particular relevance of public policies, the role of collaboration across different stakeholders to achieve SDGs remains underdeveloped. Further research should examine how public–private partnerships contribute to the implementation of sustainable projects and SDGs. Additionally, considering the urgency of addressing climate change, with harmful effects to the society in general, more investigation is needed to better understand the impact of smart cities in combating/mitigating climate change and promoting inclusive economic growth.

Second, while the need for “digital” is currently beyond an optional decision for business agents and SMEs are the backbone of most world economies, in particular, in less developed and emerging economies, they face several obstacles in implementing digital technologies (e.g., limited human and financial resources) in the entrepreneurial process. Future research should investigate efficient solutions to overcome the hurdles of access to digital resources by SMEs. Many challenges continue to hamper the adoption of digital technologies by SMEs, which are critical to create sustainable competitive advantages and compete locally and globally.

Third, even though the existing research argues for the integration of economic, environmental, and social issues to achieve enduring development and highlights the role of DE in generating business for enhancing sustainability, there are still gaps in the literature on the balance and incorporation of all the dimensions of sustainability in the business process and models. Further research should investigate how firms and specific sectors/industries strike a balance in maintaining economic, environmental, and social sustainability, especially entrepreneurial actors that intend to generate socioenvironmental value through financially viable business models, and well-being of all stakeholders in the ecosystem, how they integrate SDGs in their operations, processes, and value chains and how these influence the ability to compete with the other players in the local and global markets. Such research may be timely in the post-COVID-19 pandemic crisis, as there is increased need for business reconversion and adaptation towards more sustainable strategies and business models.

5. Conclusions, Implications, and Limitations

This paper intended to identify and synthesize both the predominant themes and further research opportunities on DE and sustainability. In accordance, we performed a bibliometric analysis of 58 articles indexed to Scopus database. The results of the performance analysis allow us to achieve the research goals (i), (ii), and (iii), reporting the

evolution of the publications, the most prolific journals and authors, as well as the most influential articles. Additionally, we present the conceptual structure of the research on DE and sustainability using the co-word analysis method, which allowed us to synthesize research trends in the field (paper's goal (iv)). Finally, we provide an agenda for future research on DE and sustainability (paper's goal (v)).

Over the past two decades, the topic under analysis received increased attention in research, especially since 2018. Sustainability is the journal that published more articles on DE and sustainability. No author stands out with a much higher production than the rest. The most cited article, with 139 citations, is entitled "Bridging the service divide through digitally enabled service innovations: Evidence from Indian healthcare service providers" and was co-authored by [Srivastava and Shainesh \(2015\)](#).

The results of the clusters analysis (science mapping) indicate the existence of three research streams (not mutually exclusive) on DE and sustainability that we label as follows: (1) innovation and entrepreneurship, (2) digital transformation: strategy and business models, and (3) sustainability and sustainable development goals. Our analysis shows that the topics addressed in the different identified clusters are inter-related.

The findings of this study have relevant theoretical and practical implications. From the theoretical point of view, this study was the first, to the best of our knowledge, to perform a bibliometric analysis to understand the link between DE and sustainability, contributing to the theoretical body of entrepreneurship in general and DE in particular and how it impacts on economic and socioenvironmental value creation. The knowledge provided by this study is expected to enable researchers to be involved in this field and/or focus their research more effectively.

From the practical point of view, this paper offers important insights for practitioners, entrepreneurs, and public actors. It helps to understand the complex and dynamic nature of entrepreneurship in a digital world and provides knowledge on how digital technologies can be embedded not only in the definition and development of digital sustainable business models, but also in the implementation of public policies in distinct domains, such as transportation, energy, public lighting, and waste management and, in general, in intelligent engineering infrastructure in cities. Government, industry, and universities need to collaborate to maximize societal and individual effects of DE and its outcomes.

As with every piece of research, our paper is not without limitations. Our study focuses only on scientific articles, excluding other types of scientific publications, such as conference papers, books, or book chapters. Although they could be included in future studies, this represents a big challenge and may affect the standards of scientific quality. On the one hand, the homogeneity of the sample is compromised. On the other hand, these types of publications may not be subject to the double-blind peer review system. Moreover, they may afterwards be published in the form of academic articles, thus introducing the potential for repetition, which could distort the results. A second limitation is associated with the application of the bibliometric method by itself, which can lead to the elimination of research topics with marginal importance.

Author Contributions: Conceptualization, C.F. and R.P.; methodology, C.F. and R.P.; software, C.F. and R.P.; validation, C.F., R.P. and M.-C.G.A.; formal analysis, C.F. and R.P.; investigation, C.F. and R.P.; resources, C.F. and R.P.; data curation, C.F., R.P. and M.-C.G.A.; writing—original draft preparation, C.F. and R.P.; writing—review and editing, C.F., R.P. and M.-C.G.A.; visualization, C.F. and R.P.; supervision, C.F., R.P. and M.-C.G.A.; project administration, C.F.; funding acquisition, C.F. and M.-C.G.A. All authors have read and agreed to the published version of the manuscript.

Funding: The research of the author Catarina Fernandes was supported by National Funds through the FCT (Portuguese Foundation for Science and Technology), I.P., within the scope of the project Ref. UIDB/04105/2020. The research of the author Maria-Ceu G. Alves was supported by National Funds through the FCT, I.P., within the scope of the project Ref. UIDB/04630/2020.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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