

Digital Transformation and Business Model in SMEs: a Bibliometric Analysis

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Abstract – Digital transformation (DT) has become a significant subject nowadays. Therefore, it is necessary to understand the link between DT and business models (BM) in small and medium enterprises (SMEs). Through a bibliometric analysis, this work aims to highlight the evolution of research on the influence of DT on SMEs’ business models by identifying the most relevant sources, the most influential authors, and the dominant countries in scientific research. The results show a thematic evolution, triggered by the COVID-19 pandemic, since the number of publications has significantly increased in the recent years, however the scientific collaboration between countries is limited. This work exhibits possible lines for further research, such as delving into a definition of DT. It also contributes to showing a global perspective of research concepts related to DT via bibliometric data.

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I. INTRODUCTION

The COVID-19 pandemic has exposed significant flaws in the current BM and operations of many SMEs [1]. In addition, the pandemic has disturbed regular business activity and has forced all organizations to reconsider their technological investment plans [2].

According to [3], companies' DT alone is not enough; it must be coupled with intelligent technologies to achieve this goal. However, SMEs have scarce time and resources to experiment with their BMs and implement new strategies [4]. Therefore, all managers should consider DT a critical process, and multiple efforts should be allocated to implementing this long-term strategy [5].

High scientific collaboration has been identified through bibliometric indicators in recent DT, BM, and SMEs studies. These studies are essential, as estimations suggest that SMEs represent about 90% of businesses and more than 50% of employment worldwide; formal SMEs contribute up to 40% of national income in emerging economies [6]. Micro, small and medium enterprises play an essential role in the economic development of a country through exports and domestic supplies and by creating employment opportunities [7]. Unfortunately, this segment of companies finds themselves ill-equipped to face these new possibilities regarding production planning and control functions [8].

Bibliometric indicators have proven to be useful tools in the assessment of research performance [9]. Furthermore, it has the potential to provide a cheaper, more objective, and more informative mode of analysis [10]. This study aims to show, through a bibliometric study, the evolution of research on the influence of DT on SMEs' business models. This leads us to the following research questions, what are the most relevant sources? which are the most influential authors? and which are the dominant countries in scientific research in this field.

The paper is organized as follows. In the next section, we provide a literature review, presenting the theoretical background on the subject; followed by a description of the research methodology to collect the data. Bibliometrix was used as a statistical tool for data analysis. After that, we summarize the empirical results from the bibliometric analysis. We then discuss the study's contributions and implications. Finally, we present the research conclusions and future research lines.

II. LITERATURE REVIEW

Since the 1990s, a range of different types and sizes of organizations in almost all industries have placed great emphasis on DT [11]. It shapes profound changes in society, industries, and firms [12]. In essence, DT is not only affecting organizations and governments but also every individual on the planet [13]. According to [14], implementing robust actions to manage societal disruption will enable the firm to better understand and learn about the new world.

The term DT is used today to signify the transformational or disruptive implications of digital technologies for businesses and society [15]. It is an evolutionary process that leverages digital capabilities and technologies [16]. Technology may produce disruptive changes and market turbulence in any industry, organizational inertia becomes a factor that adversely affects transformation [17]. To overcome the inertia, managers must introduce new types of innovation while aggressively extracting resources from legacy processes and organizations [18]. The challenge will consist of providing the necessary training to the company staff, as well as customers and suppliers, regarding the actions involved in a DT process to achieve an adequate level of implementation [2] and innovation. Ref. [19] demonstrates that open innovation helps SMEs overcome organizational inertia by creating new BM.

Although the term DT is frequently used in business research and marketing, scholars disagree on a common definition [11]. Analysis conducted by [20] reveals that circularity, unclear terminology, and the conflation of the concept and its impacts, among other challenges, hinder the conceptual clarity of DT, which suggests that more research is required for a standard definition of DT.

In the last couple of years, DT has revolved the way companies do business, establish relationships with their customers, providers and other stakeholders, and contribute to the innovation of their BM, generating new distribution channels and new ways to create and deliver value to customer segments [12]. DT is multidisciplinary by nature, as it involves changes in strategy, organization, information technology, supply chains, and marketing [21]. DT calls for the renewal and readjustment of BM that challenge the conventional way of doing business [22]. One of the most significant issues for companies is whether or not their BM still fits the market requirements [23]. As mentioned by [24], there are no right or wrong BM, but BM that works in a particular context and those that do not. Further research regarding the impact of DT on BM would be worthwhile [25].

Nowadays, companies, especially SMEs, are facing the new challenge of DT [26]. Large companies position themselves at the frontline of the DT, while SMEs are challenged by resource constraints and missing guidance on realizing the benefits of DT [27] without underestimating that information privacy has become a prime concern for everybody [28]. Moreover, key insights on SMEs reveal that they tend to be less digitalized than larger firms [29]. According to [30], another issue is that some SME's owner-managers do not have the skills or inclination to run a firm of increased size or to manage firm growth effectively. Ref. [31] recommends that future research investigates what employee skills are necessary for the DT of SMEs and recruits a leader who manages the growth in an effective way. According to [12], SMEs' DT remains an under-researched phenomenon; SMEs still represent most firms [32].

Leaders and employees of SMEs must develop an active and resilient stance that enables them to properly manage and identify one of the dangers that comes with DT: cyber risk [33]. According to [34], it is therefore necessary to raise awareness about the importance of cybersecurity and the need for rapid and timely recovery following a potential incident. To build a cybersecurity culture that aligns with Industry 4.0, SMEs and Academia must work together with an interdisciplinary and holistic approach [35].

Industry 4.0 is currently one of the most frequently discussed topics among practitioners and academics [36]. The German government introduced this concept in 2011 as a strategic initiative of the High-Tech Strategy 2020 Action Plan

[37]. It is also known as the Fourth Industrial Revolution [38], which is currently a top priority for many companies, research centers, and universities [33]. Industry 4.0 has become an international byword for intelligent, networked production [39], where people, objects, and organizations are connected to collect data from specific systems and processes and to communicate with each other. This concept lies at the intersection of technology development and application, firm management, industrial innovation, and social advance, among other disciplines [40], which will change the industrial, economic, and social paradigms [41]. Industry 4.0 will help small businesses and startups develop and deliver downstream services [42] and will eventually encourage novel ways of creating BM and value [43].

The increasing pace of advanced technologies modes of operating businesses has shifted from traditional brick and mortar to online platforms [44]. It applies not only to businesses, by using e-participation platforms, but smart cities could also gain feedback and helpful insights from users, thereby enabling more informed decisions and better services to citizens [45]. Furthermore, combining citizen participation and community engagement with digital technologies offers enormous potential for local authorities to better adapt to the rapid technological transition [46].

Bibliometrics has come to play a major role in the measurement and evaluation of research performance [10]. Bibliometric analysis can also help identify thematic areas, journals, and topics to aid the exploration of new opportunities for future research [47]. However, the amount of information contained in these has been seen to be unmanageable [48]. That is why information technology must be used to manage all the data.

Such data can be taken in bulk from only a few proprietary databases [49], like in Web of Science, acknowledged as the oldest citation database with broader coverage of scholarly publications [50], [51], [52]. It is also one of the largest peer-reviewed and authentic indexing and abstracting databases of scientific literature [53]. Alternative options for the presentation of results are offered by various software packages and bibliographic mapping approaches that can be used for visualizing research on a topic or theme [54].

III. METHODS

There are two important aggregates of bibliographic information regarding management and related areas - Clarivate Analytics' Web of Science citation index and Elsevier's Scopus abstract and citation database [49]. We decided to use Web of Science. However, to assure the maximum level of reliability, as [55] recommended, the results were also cross-validated with the Scopus database to confirm the inclusion of all the relevant studies.

The exploration was carried out on July 2024, at the Web of Science Core Collection, following an effective and comprehensive range search to recover the largest number of relevant articles that search in the title, abstract, author keywords, and Keywords Plus, the terms: *digital transformation* (AND) *business model* (AND) *SME**. We retrieved 229 publications from 2007-2024, considering articles and review articles solely. Once this procedure was finalized, we reviewed each one to verify that it complied with the necessary information for the research purpose.

Following [49] we manually scanned the data collected to ensure that no significant publication was left out of our dataset.

To analyze the intellectual structure of the research reported on in this dataset, we conducted a bibliometric analysis [55] that allows a transparent and replicable systematic review of the literature [56]. Moreover, it provides more reliable results in the systematic process of scientific information on a topic, without the risk of neglecting past documents [57]. We used the R programming language and the R package Bibliometrix from [56]. Ref. [54] indicated that Bibliometrix provides a flexible and extensible free environment to conduct research and analysis; besides, it has been used in a growing number of publications.

IV. RESULTS

The articles were analyzed on Bibliometrix to elaborate statistical and graphic investigations capable of summarizing the research, highlighting the Spatio-temporal aspects of the results obtained [57]. We retrieved 229 publications in a 17.5-year time span, published in 138 journals, from 689 authors, and 25.7 average citations per document.

Even though the analysis period started in 2007 -the earliest year Web of Science offers in its primary collection-the first publication on this subject took place in 2013, and the second one in 2016. Nonetheless, a notable publication increase was not observed until 2020, as shown in Fig. 1.

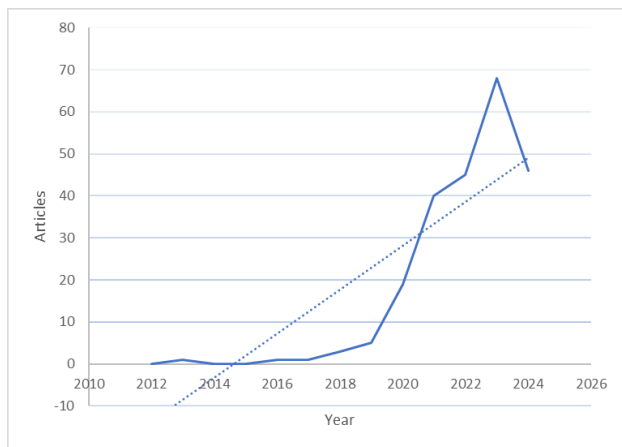


Fig. 1 ANNUAL SCIENTIFIC PRODUCTION

Twenty-eight papers from the Sustainability journal were found in the documentation, as shown in Table I. Scimago Journal Rank defines it as an open-access interdisciplinary, international academic journal on environmental, cultural, economic, and social sustainability. It provides an advanced forum for studies related to sustainability and sustainable development. It is a second-quartile Swiss journal with a research domain on science and technology. However, the most quoted source is the Journal of Business Research, according to Scimago Journal Rank this first-quartile journal aids the application of empirical research to practical situations and theoretical findings to the reality of the business world, which belongs to the first quartile since 2001, under the marketing category.

TABLE I
SOURCE IMPACT

Journal	TC	NP	PY_start
Journal of Business Research	779	5	2021
International Journal of Production Research	591	1	2018
Sustainability	487	28	2018
Information Systems Journal	384	1	2018
Journal of Cleaner Production	239	3	2020
Technological Forecast and Social Change	238	7	2021
Technovation	217	4	2020
Telecommunications Policy	215	1	2019
European Management Journal	200	1	2021
Journal of Knowledge Management	146	1	2022

Note. TC total citations, NP number of publications, PY_start publication year.

Out of the 689 authors in 60 countries, only 36 of them have more than one publication. We noticed Lara Penco, who is a member of the Department of Economics and Business Studies at the University of Genoa, Italy. She is the only author with three publications and has an H index of 21 and 2.202 total citations, according to Google Scholar. The most cited authors are [8], as shown in Fig. 2. According to Taylor & Francis Online, this article has 20.363 views and 677 crossed references. As second most cited authors are Penco Lara and her colleague Giorgia Profumo from the University of Genoa.

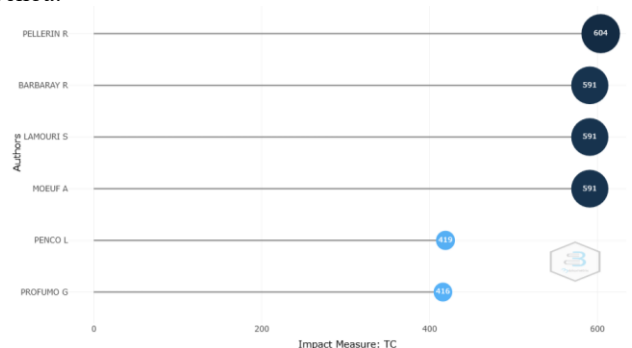


Fig. 2 MOST CITED AUTHORS

Fig. 3 shows the frequency distribution of scientific production, based on [58], who describes the publication

frequency per author in any research field. In this specific case, 94.8% of the distribution concentrates on authors who have written a single paper, so it appears that most authors only publish occasionally [59].

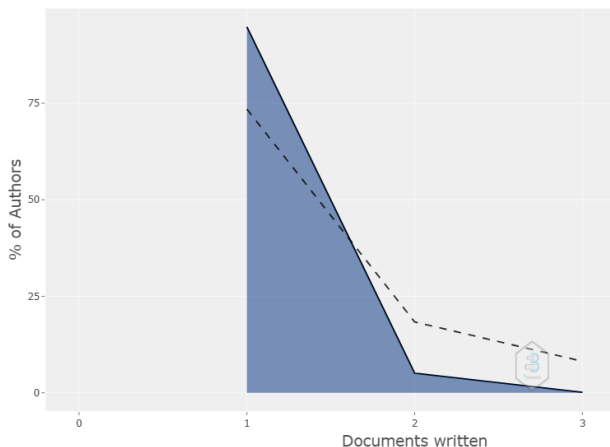


Fig. 3 FREQUENCY DISTRIBUTION OF SCIENTIFIC PRODUCTIVITY

Ref. [60] shows that one of the ways to calculate the country’s scientific productivity is to register the number of research papers published by its researchers. The Scimago Country Rank uses a methodological-informetric viewpoint, analyzing country scientific indicators developed from the information contained in the Scopus database [61]. Table II shows that China, Italy, and Germany are the countries with the highest number of publications. On the other hand, the Scimago Country Rank shows that China takes the third position, Italy eighth, and Germany ranks fifth worldwide, by selecting the thematic area of Business, Management, and Accounting, considering documents published in all categories between 1996 and 2023.

TABLE II
COUNTRY SCIENTIFIC PRODUCTION

Country	Articles	SCP	MCP	MCP Ratio
China	24	14	10	0.42
Italy	18	12	6	0.33
Germany	14	10	4	0.29
France	10	3	7	0.70
Portugal	9	8	1	0.11
United Kingdom	9	3	6	0.67
Czech Rep.	8	6	2	0.25
India	8	3	5	0.62
Spain	8	6	2	0.25
Finland	7	4	3	0.43
Indonesia	7	5	2	0.29

Note. SCP single country publication, MCP multiple country publication

Following [62] we divided articles into two types: (1) single country publications (SCP), in which all authors have the same country affiliation, and such publications represent an intracountry collaboration; and (2) multiple country publications (MCP), in which authors have different country affiliations and such publications represent intercountry

collaboration. 34.4% of publications belong to the MCP category, nevertheless, France and the United Kingdom have a ratio of 0.7 in MCP.

As shown in Fig. 4, France places itself with a higher number of citations, 856. However, the USA has the highest citations per paper on average, with just four papers published some of which are the most cited articles.

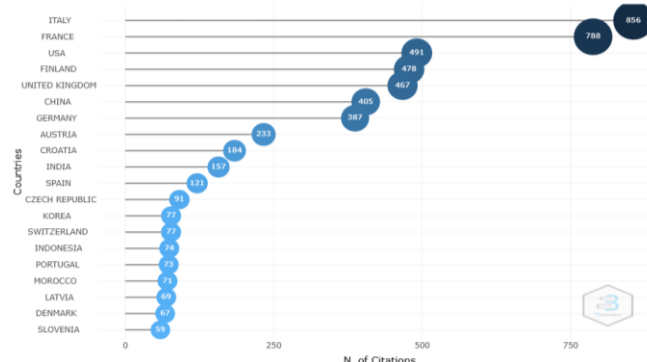


Fig. 4 MOST CITED COUNTRIES

Ref. [63] introduces the quantitative method named "Reference Publication Year Spectroscopy" (RPYS). This method can determine the historical roots of research fields and quantify their impact on current research. RPYS is based on the frequency analysis with which references are cited in the publications for a specific research field regarding the publication years of said references. Fig. 5 shows this spectroscopy, where the origin starts with Joseph Schumpeter, going through Rensis Likert, reaching the frequency peak in 2020 with 1990 cited references. The most cited publication in this RPYS is [20], who presents an agenda for future research on DT.

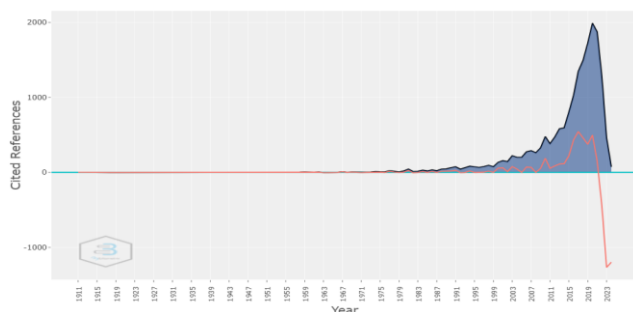


Fig. 5 REFERENCE PUBLICATION YEAR SPECTROSCOPY

By analyzing the bibliometric data collected from the Keyword Plus count, the most relevant words are innovation, followed by performance and management, as shown in Fig. 6. Regarding these three words. Another relevant word is Industry 4.0, a term described by [40] to refer to when people, objects, and organizations are connected to collect data from specific systems and processes and to communicate with each other.



Fig. 6 WORD CLOUD BY KEYWORDS

The thematic evolution during the first seven-year period, as shown in Fig. 7, were critical success factors, innovation, firm performance, and implementation. Then the theme evolved to innovation, management, model, and transformation in the most recent lapse.

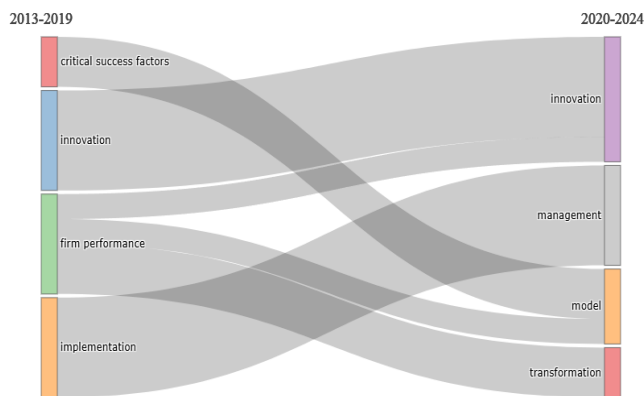


Fig. 7 THEMATIC EVOLUTION

Bibliometric indicators offer several advantages to study research collaboration networks between countries. According to [64], it allows to count scientific publications and to map the thematic evolution to portray variations among countries or regions, exposing their influence in the research field. As shown in Fig. 8, Italy and the United Kingdom lead the main network; the second is led by China, and the third one by Germany and Spain. There is also a smaller Latin American network integrated by Brazil and Chile, that is unlinked to other networks.

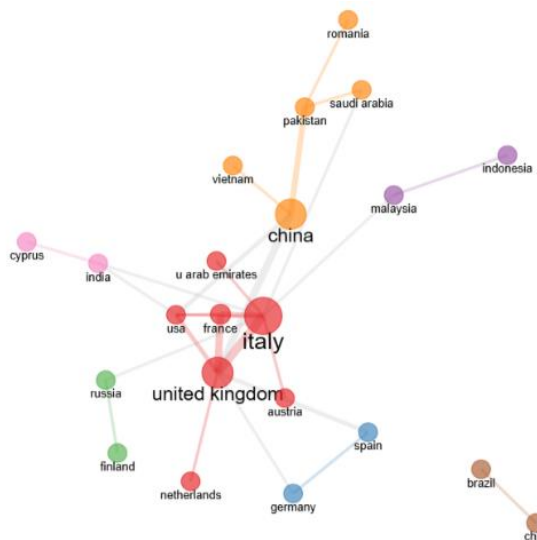


Fig. 8 COLLABORATION NETWORK

V. DISCUSSION

The last two decades have witnessed a DT, not least thanks to universal internet access and new internet applications, that have created new entrepreneurial opportunities. Sensitive to this, many incumbent firms have been keen to explore these opportunities, and doing so requires adapting established business models or even designing new ones [65]. During those decades, many traditional markets have been shaken by the rise of disruptive business models, like the freemium business model [66]. They extract lessons and implications from this paradigmatic change for the theory and practice of business model innovation in social enterprises, particularly relevant to Latin America, where social and environmental disequilibria remain a recurring feat.

Even though these authors point out this DT during the first two decades of the XXI century, it was until 2013 that the first paper where DT, BM, and SMEs converge was published since scientific production was low and unstable until 2019. The years 2020 and 2021 show an exponential increment in scientific production on these topics. Then 2022, 2023, and the first half of 2024 research continues to grow.

This bibliometric analysis demonstrates that since 2019 and particularly in 2020 and 2021, the research topics have evolved towards DT. Nevertheless, the research developed by [1] shows that SMEs have shifted their focus from technology-driven transformation to more socially-driven transformation initiatives. Ref. [14] conducted a study aiming to offer a strategic management response to societal disruptions, posing challenges that are much greater and different than the industry-wide disruptions that businesses have learned to manage. They propose that firms need to develop a sense of identity that transcends these disruptions, using planning techniques and developing platform organizations to formulate

and implement effective strategic responses. DT is a disruptive innovation process in SMEs and threatens their very existence [67].

The rapid growth of scientific production in 2020 and 2021 overlapped with the COVID-19 disruption when SMEs were trying to avoid a total shutdown of their economic activities by introducing digital technologies that were not considered a high priority earlier [1]. COVID-19 has made SMEs increasingly dependent on technology to be competitive and efficient [68]. In developing countries, the demonetization and the COVID-19 pandemic demand businesses with limited or zero online presence to think about the DT of their business [7] therefore emerging nations need to grasp every opportunity for development from DT [44]. The post-pandemic era has amplified the significance of digitalizing organizational practices and encouraging innovation for SMEs [69], economic and social disruption generated by COVID-19 increased research on DT [70] which corresponds with the continuous rise in scientific output during 2022, 2023, and the first half of 2024.

The negative impacts of the pandemic have been reported in all spheres of life and have had economic, political, social, and psychological consequences [71], [72]. The diversity in the impacts is also noted in the sources where knowledge is published. Sustainability journal concentrates more than one-tenth of the scientific publications on the subject of study. These journals excel at different categories: the Journal of Cleaner Production is the most popular choice for publishing papers on sustainable business models, according to the bibliometric analysis conducted by [73].

The sources dispersion phenomenon is also shown in the authors. Frequency distribution in scientific production [58] shows that 94.8% of the authors have written only one article on the subject. 5.1% of the authors have written two articles, and only one author wrote three papers.

With 84.4 citations per year, the most cited document is [8]. They suggest that there is still no evidence of tangible business model transformation in SMEs, but that was before the pandemic. Another frequently cited paper is [3] which concludes that the DT of the companies alone cannot enhance relationship performance and needs to be coupled with smart technologies to achieve this goal. Agreeing with the research of [74], who said previous to the COVID-19 pandemic that it is necessary to transform businesses' operations using digital technologies, to improve customer interaction and collaboration.

According to [60], the single authorship corresponds to 29% of the scientific production, which is a usual practice in humanities and social sciences. However, bibliometric indicators in this study reveal that single authorship represents 8.7% of the total and multiple authorship represents the majority of the contributions, whose potential positive effects are mentioned by [64], e.g., increased productivity, visibility, and research quality.

Although the author's collaboration networks are segregated, some countries' collaboration networks have more

links between them. Ref. [64] mentioned that non-scientific elements, like politics, economics, and social considerations, play an essential role in initiating a scientific international collaboration network. In this analysis, the network led by Italy, which includes France, United Kingdom, USA, all members of the Group of Seven (G7), and other advanced economies like Netherlands, Austria and United Arab Emirates.

VI. CONCLUSION

This bibliometric analysis demonstrates that research where DT, BM, and SMEs converge is scarce and recent. However, during the COVID-19 pandemic related research has increased exponentially and continued to grow in post-pandemic. This matches [64], who claim that scientific collaboration has been linked to increased productivity for authors, institutions, and countries. However, this work has demonstrated that scientific collaboration between countries is limited. Therefore, a collaboration network needs to be multiplied, especially in emergent economy countries, allowing for higher new knowledge production. It could even consider collaboration between companies, as the open business model of [75], a more open and co-creational business model to create, transfer and capture value with other firms. The business model innovation process is necessary for an open business model configuration.

Future research needs to consider deepening a DT definition, further than conceptualizing, bringing a clear vision on the entrepreneurial research path focused on SMEs. A vast body of literature investigates digital maturity, which is relevant to gaining knowledge on the maturity degree of companies. However, it is yet to be investigated on the determining factors for the implementation of DT, and what SMEs' dimensions or domains the research should be developed on. Further research needs to focus on assessing the cyber risk of SMEs and how to properly manage these risks, fostering the growth and innovation of their BM.

Finally, this work is of great interest to scholars and professionals. It exposes lines of research for scholars. To SME professionals, it presents relevant studies to gain a more profound knowledge of DT. This article reveals that the COVID-19 pandemic seems to trigger scientific production on DT. As [4] mentioned before this pandemic, DT was already requiring companies to rethink and innovate their business models.

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