Evolution and Trends in SME Digitization Research: A Bibliometric Analysis

Paul Sarango-Lalangui[1], Jhon Rodríguez[1], Karla Tapia Carreño[1], Boris Galarza[1]

Abstract: This research aims to determine the evolution and development of SME digitization research trends published in leading scientific journals. The data analyzed comprised 650 research publications indexed in the Web of Science platform. The data is processed and analyzed using R Bibliometric to examine SME digitization. The results showed that the number of publications on SME digitization had increased significantly. Then, most of the types of papers discussing SME digitization are articles in scientific journals. The main findings are that SME digitization research focuses on information technologies, archive digitization, digital transformation, innovation, industry 4.0, technology, sustainable development, covid-19, sustainability, and public policy.

Keywords: Digitization; SMEs; Bibliometrics; R Biblioshiny

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Introduction

Digitization is the increased digital or computer technology adoption by an organization, industry, or country (Brennen, 2016). This concept appeared in a 1971 essay in the North American Review, written by Robert Wachal, and, since then, has been massively explored. Some researchers use the terms "digitization" and "digitization" interchangeably. However, "digitalization" refers to how various sectors of social life are reconstructed due to the move from analog to digital technologies in people's relationships. It is about the material process of converting analog information into digital offerings (Child et al., 2017).

Small and medium-sized enterprises (SMEs) have always been categorized as economic engines and significant employers across industries and countries (Child et al., 2017). Furthermore, although they receive perhaps, less attention than they deserve compared to larger firms, their attributes, role, and style have always intrigued business researchers (Leonidou et al., 2018). However, SMEs have seen their identity and position vis-à-vis larger firms and customers change dramatically during the IT revolution over the past two decades (Kriemadis 2018).

SMEs, in this decade, was partly weakened in the face of competition from large companies but also strengthened with competencies and opportunities to make operations and reach customers unimaginable in other times (Pavic et al. 2007). Autio (2017) distinguishes SMEs' adoption of digital technologies into two types. The pioneers contributing to digital transformation and the followers must adapt to new technologies. Companies can sell online through their platforms (websites or social networks) or existing e-marketplaces (such as Alibaba or Facebook) (Deng, 2019; Kim, 2020).

The literature suggests that digitization has been more than a stimulant for firms (Bouwman et al., 2019); it is a changing context in which new technologies emerge and new capabilities are required (Dumcius, 2019). Employment in general, as well as new working conditions and training for employees (Imgrund et al. 2018), to enhance their abilities and prospects in the labor market (Lergner et al. 2017), are just a few examples of how the digitalization of companies can contribute to economic growth (Bresciani et al., 2013). With changing market dynamics and the increasing impact of digitization (Lergner et al. 2017), companies tend to increasingly invest in digital technology (North et al. 2019) to achieve innovation and gain competitive advantage (Thrassou et al. 2018b).

Some disadvantages of using their websites are that a company's website may suffer from limited online traffic and be able to attract only a limited number of users (Dumcius, 2019). In addition, the costs of maintaining and setting up standalone websites are high. In addition, using digital platforms also has advantages for SMEs (Morgan-Thomas, 2009, p. 267). The fact that these platforms bring together an infinite number of companies and customers from all over the world allows companies to understand better the preferences of their competitors and customers and, consequently, to develop new products efficiently. Also, communication and display services help companies effectively promote and communicate their value propositions to customers worldwide. Another advantage of digital platforms is the low maintenance cost and the regular online traffic. However, when using these tools, SMEs face more competition and have less control (Kim, 2020).

Small and medium-sized enterprises (SMEs) play a crucial role in global economic growth as major employers and innovators. In the digital age, SMEs must adapt to new technologies to remain competitive

(1) Department of Business Science, Universidad Técnica Particular de Loja (UTPL), Loja 11-01-608, Ecuador
Corresponding author: posarango@utpl.edu.ec

(Dellarocas, 2003). Digital transformation offers SMEs opportunities for improved efficiency, customer engagement, and innovative business models (Loebbecke, 2015). However, challenges such as limited resources, digital skills gaps, and cybersecurity concerns persist (Anderson, 2011). By adopting digital technologies and platforms, SMEs can gain a competitive edge, access global markets, and better understand customer preferences. Research on SME digitization continues to evolve, addressing digital transformation, technology adoption, digital competencies, and infrastructure access (Vendrell-Herrero, 2017).

This research aims to identify the studies that have had the most significant impact on SME digitization research, examine the changes, recognize the updated literature, and explore the state of the art. The literature review discusses the effects of digitalization on businesses, including the difficulties SMEs face in implementing a digital strategy and how digitalization might help them reach global markets. The research questions for this review are to achieve the objective of shedding light on SME digitization.

- *How is the chronological development of the topic characterized (publications over time)?*
- *Which are the most relevant journals on SME digitization (according to the number of articles published and the number of citations)?*
- *Which are the most influential authors on the topic (according to two indicators: the number of articles published on SME digitization and the number of citations per article)?*
- *What are the most relevant articles on the topic?*

The chronological literature analysis of the Web of Science-Social Sciences Citation Index (WoS-SSCI) database, up to February 2022, provides new insights not previously reviewed, such as the most influential journals, authors, and articles. As a result, 650 articles were retrieved, published in 397 journals, and written by 1912 authors affiliated with 122 institutions from 85 countries.

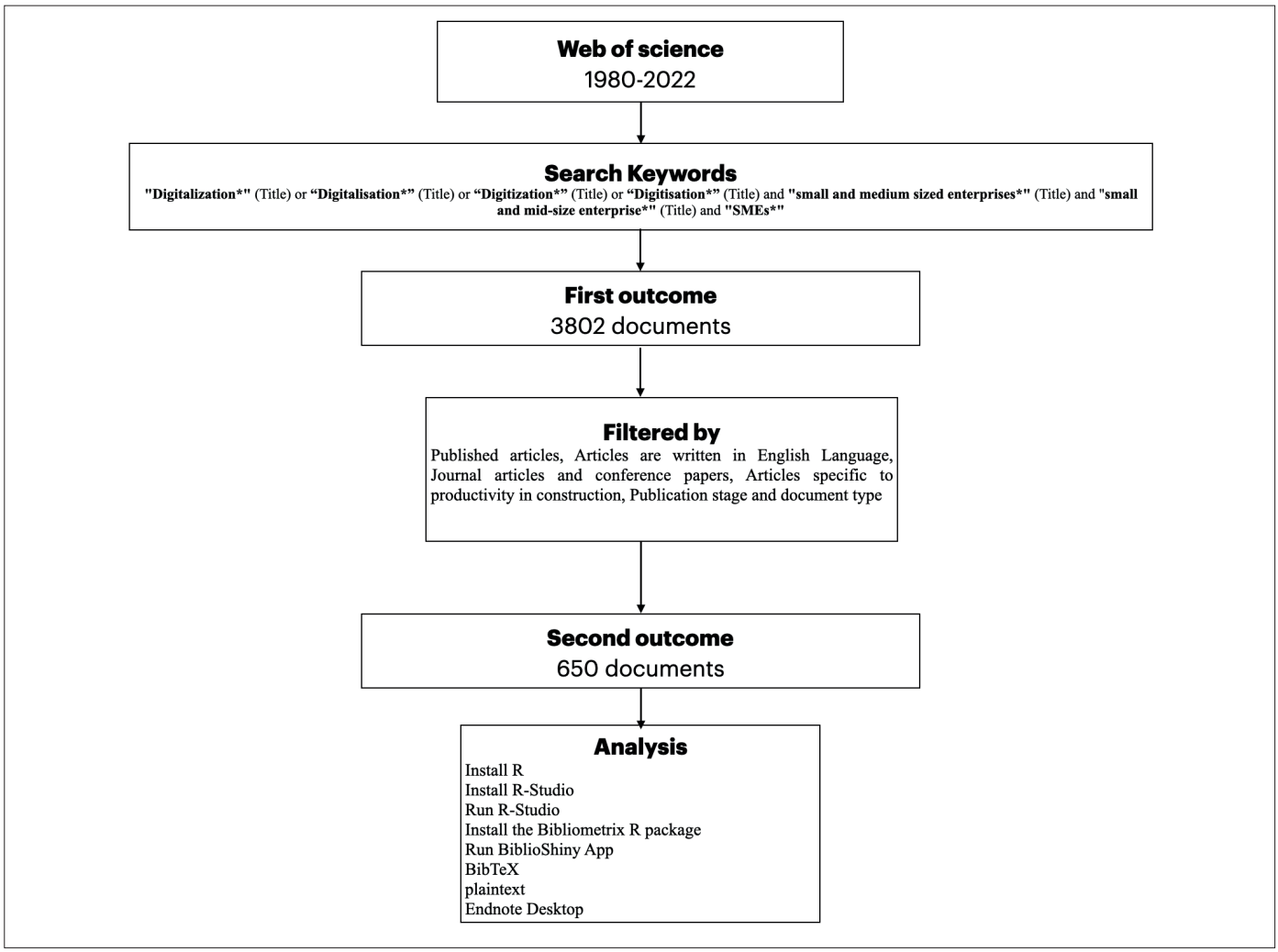
Methodology

In this work, we employed a bibliometric strategy. Data from 1956 to 2022 were included in the analysis. Publications in the Web of Science-Social Sciences Citation Index (WoS-SSCI) database on SME digitization worldwide were the basis for this analysis. The Web of Science-Social Sciences Citation Index (WoS-SSCI) is a valuable resource for bibliometric studies, offering a comprehensive and multidisciplinary database of peer-reviewed articles. WoS-SSCI covers various subject areas, ensuring diverse perspectives and insights. Its extensive citation data facilitates citation analysis, enabling researchers to evaluate the impact, influence, and interconnectedness of publications, authors, and institutions. Moreover, WoS-SSCI employs a rigorous selection process, ensuring the inclusion of high-quality research. Finally, its standardized metadata enhances comparability and consistency, making WoS-SSCI a reliable and essential tool for bibliometric investigations.

We used Science Citation Index Expanded (SCI-EXPANDED) and Social Sciences Citation Index (SSCI) for the search string. The first search was: "Digitalization*" (Title) or "Digitalisation*" (Title) or "Digitization*" (Title) or "Digitisation*" (Title); as the first result, 3802 documents were obtained, then a second search was made combining "small and medium-sized enterprises*" (Title) and "small and midsize enterprise*" (Title) and "SMEs*" (Title) with exclusion criteria such as Published articles, Articles are written in English Language, Journal articles and conference papers, Articles specific to productivity in construction, publication stage, document type and a result of 650 articles was obtained to perform the study and subsequent analysis dated 03 February 2022.

All types of publications were selected for analysis. Complete bibliographic data were retrieved from the Web of Science-Social Sciences Citation Index (WoS-SSCI) database in BibTeX(.bib) format. Initially, the R package bibliometrics (version 2.3.2 released on 11/23/2019) was installed and loaded via R Studio. Then, the biblioshiny application was started by entering the command biblioshiny () in the R console. The biblioshiny: biblioshiny application for bibliometrics from the R statistical package (https://bibliometrix.org/Biblioshiny.html) was used to perform the present bibliometric analysis. It is an application that provides a web interface to the bibliometric tool (https://bibliometrix.org/Biblioshiny.html)

Figure 1: PRISMA protocol guidelines

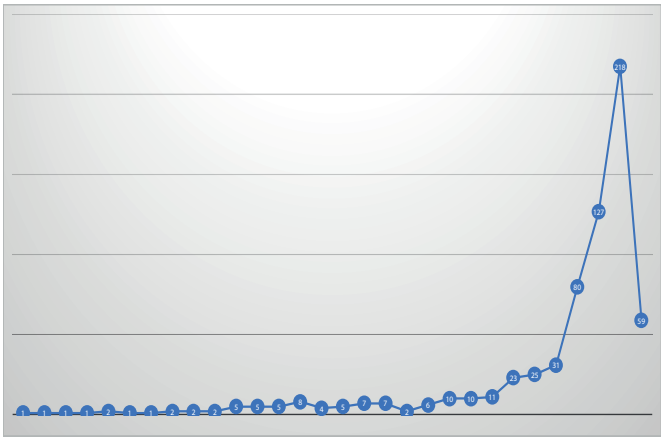


Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

Results and Analysis

Figure 2 shows the analysis of the development evolution of tracking year by year in time series or divided into different stages. The annual distribution of the document number reflects the overall situation and research trends on SME digitization, and the latter shows the characteristics of the general direction by describing the different stages of development. The two methods were combined in this study.

Figure 2: Distribution of Annual Documents



Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

The present research was also conducted based on the average number of citations/citations in the article related to the topic of SME digitization, both on average per year and theme. The research period on this topic was published from 1980 to 2022. Table 1 shows that the most articles related to SME digitization were published in 2021, totaling 218 articles. Then, based on the average total citation of each piece, the highest occurred in 2003, with an average of 311.80 citations. While for the average annual citation, the research with the highest citation occurred in 2003 at 16.41. These results show that articles published in 2003, 2011, and 2017, are more cited than in any other year on SME digitization.

Table 1: Average citation per year

Year	N	MeanTCperArt	MeanTCperYear	CitableYears
1980	1	4,00	0,10	42
1984	1	0,00	0,00	38
1986	1	11,00	0,31	36
1992	1	0,00	0,00	30
1995	2	2,00	0,07	27
1996	1	9,00	0,35	26
1997	1	0,00	0,00	25
1999	2	13,00	0,57	23
2000	2	5,50	0,25	22
2002	2	24,00	1,20	20
2003	5	311,80	16,41	19
2004	5	5,40	0,30	18
2005	5	17,40	1,02	17
2006	8	17,13	1,07	16
2007	4	1,50	0,10	15
2008	5	4,60	0,33	14
2009	7	8,29	0,64	13
2010	7	21,71	1,81	12
2011	2	120,50	10,95	11
2012	6	12,33	1,23	10
2013	10	19,80	2,20	9
2014	10	14,90	1,86	8
2015	11	32,00	4,57	7
2016	23	18,39	3,07	6
2017	25	37,76	7,55	5
2018	31	19,94	4,98	4
2019	80	12,11	4,04	3
2020	127	11,06	5,53	2
2021	218	3,75	3,75	1
2022	59	0,76		0

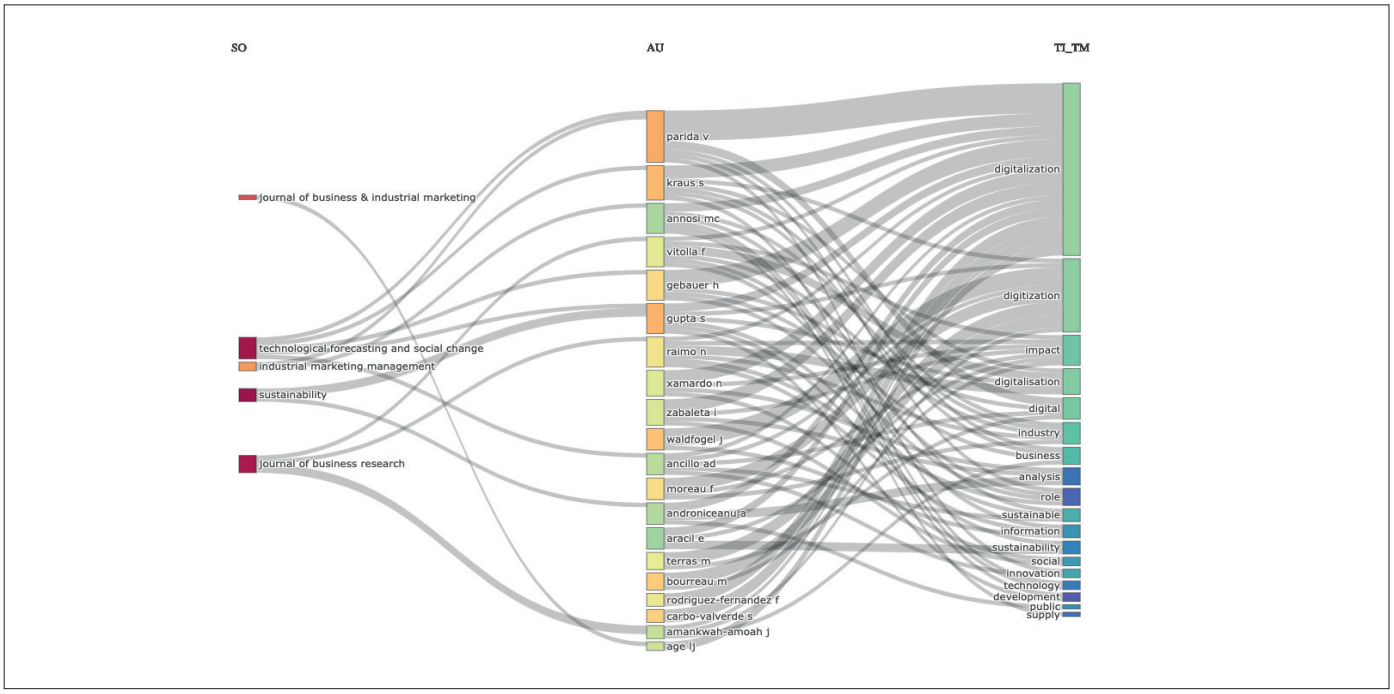
Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science.
Bibliometrics R Package

The diagram of the three fields in figure 3 is an image consisting of three elements: the name of the journal of publication, a list of the terms of the authors, and the topics/themes used. The three elements are connected by a gray graphic related to each other. Considering the journal's name, each journal reveals the author's name contributing to its publishing; next, each author shows the topic they generally utilize for the research undertaken with the issue of SME digitalization. The size of the rectangle illustrates the large number of publications associated with each of these elements.

From the image on the left, it is known that, in the first element, five journals are indexed in the diagram of the three fields that publish articles on SME digitization. The leading journals that publish the most significant number of reports are Technological Forecasting and Social Change, represented by a red rectangle connected to several authors such as Parida V, Kraus, and Ancillo. Then, the second element is in the center of the image, which shows the author's name. Where there are several authors linked to the journal, the author will also be associated with subject keywords often used to the right of the image. Where in this study, there were 20 prominent researchers enrolled in this diagram. The rectangle size indicates each author's respective number of research publications. The authors in this study mainly publish on SME digitization topics, such as Parida, Kraus, and Gupta, represented by light orange rectangles and a more potent orange.

Finally, the third element describing the research topic is found on the right side of the image. Each case is related to writers who write a lot on related issues. From the image results, 20 keyword topics are listed. Of all the issues listed, digitization is the most frequent word marked with a light green rectangle. Meanwhile, the terms impact and digital in the second position, often used by almost all authors, are marked with a dark green rectangle. This matter illustrates that the words "digitization," "digital," and "impact" are closely related to research on the topic of SME digitization.

Figure 3: Three fields plot

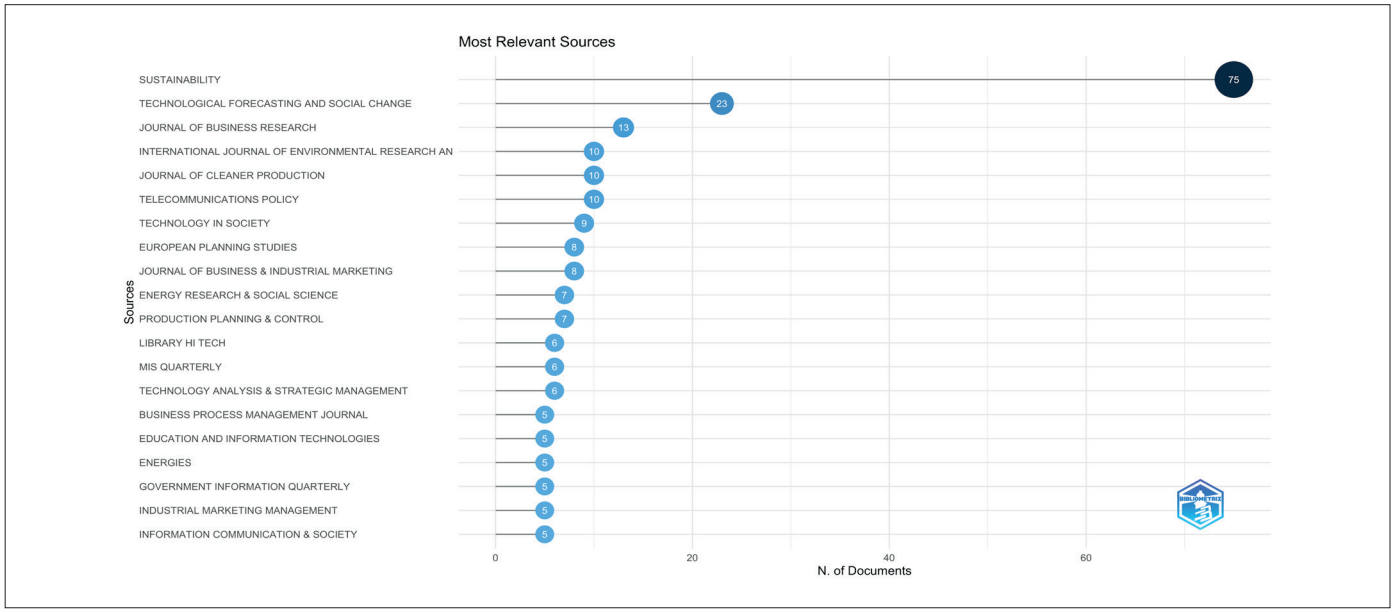


Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science.
Bibliometrics R Package

Figure 4 below shows the number of research papers published by each journal as a function of the level of relevance to the topic of SME digitization. The data shows a list of the names of the top journals published and the range for the number of papers published with a blue and light blue graph. The darker the blue color, the more quantity and relevance to the research topic; the number of documents published by all journals ranges from 0 to more than 40.

Sustainability is a journal that is in the first position, with the number of published papers of more than 40 papers shown in a dark blue graph compared to the other journals. This question is because the journal is relevant to the topic discussed. Meanwhile, there are six journals marked in light blue for the journals that are in the lowest position with several publications <5. This means that the topic of SME digitization is missing in terms of quantity and relevance. Apart from that, in total, there are 20 journals listed as the most relevant data sources.

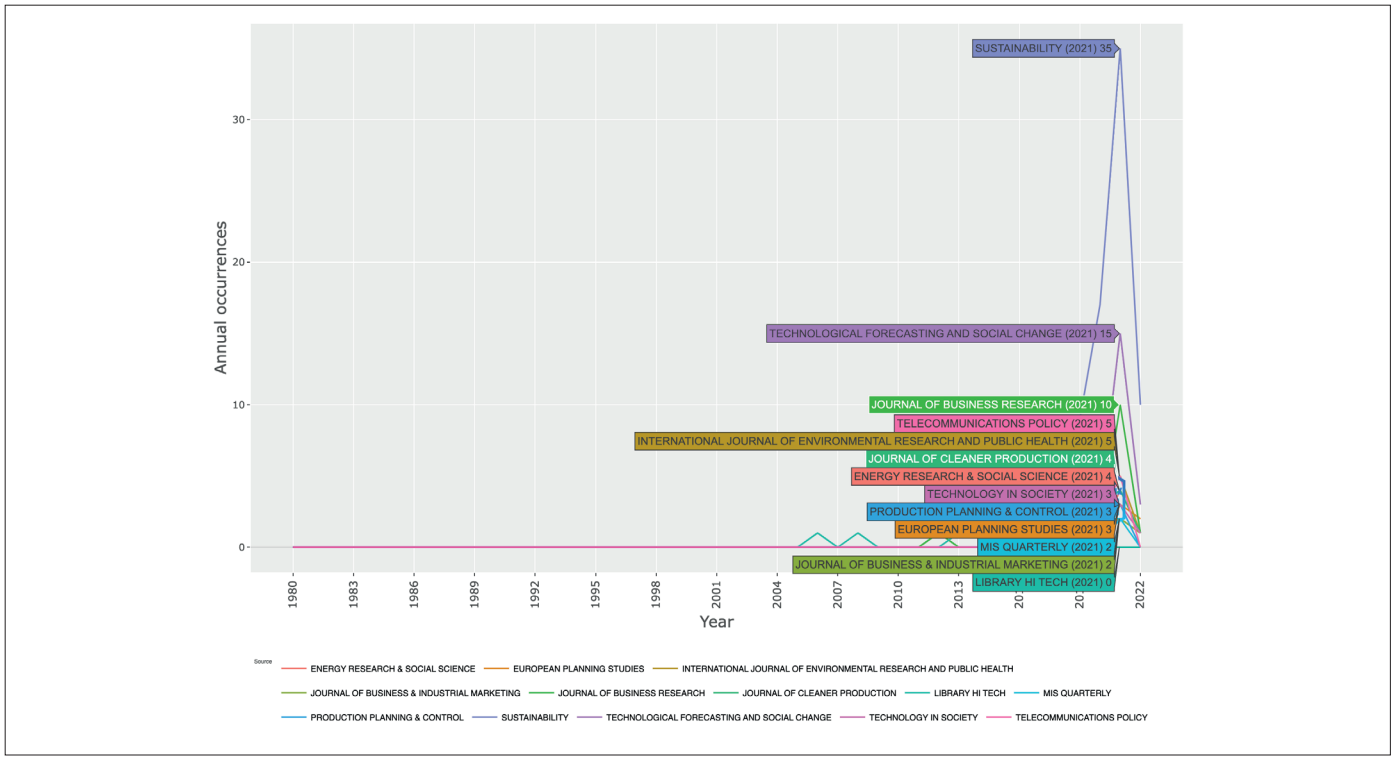
Figure 4: Most Relevant Sources



Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

This research also analyzes the development of journals that become sources of research on SME digitization topics. The curve in Figure 5 shows the result of the annual occurrence of each journal from 1980 to 2022. The graph shows the fluctuation in the amount of research on the digitization of small and medium-sized enterprises (SMEs). The above curve shows that some journals have developed since 2004 and continue to increase even though they have declined in several years, such as the: "journal of business & industrial marketing." Meanwhile, other journals that have decreased drastically in 2021 are LIBRARY HI TECH.

Figure 5: Sources of growth

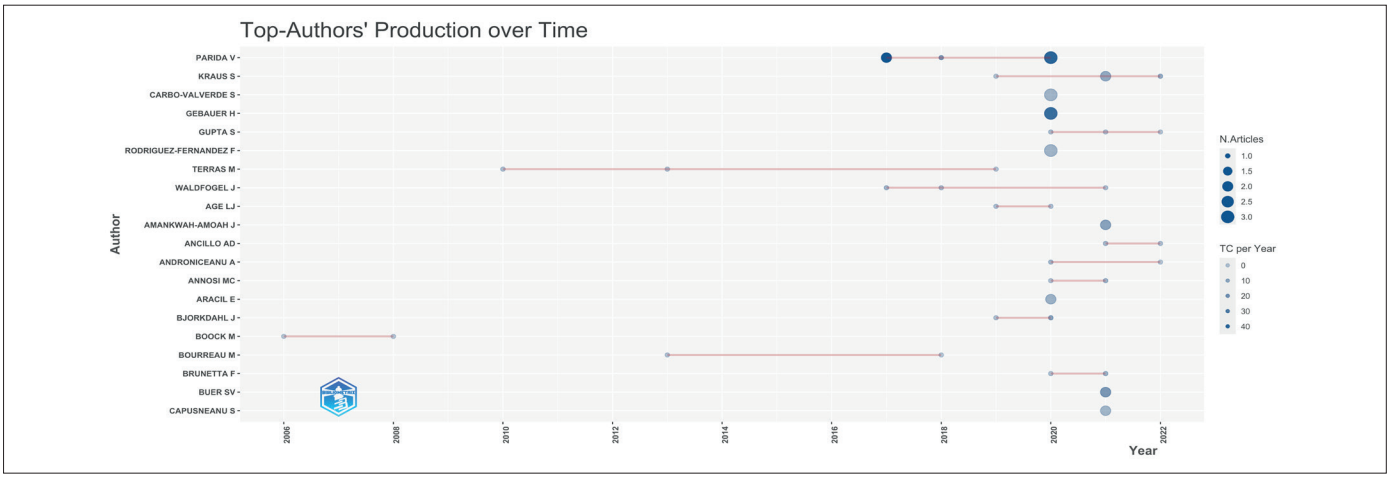


Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

Moreover, productivity can be measured not only for journals but also for the individual author. Figure 6 shows the productivity of some of the top authors during the study period, i.e., from 1995 to 2019. A red line indicates this productivity from when the author published their research to the last year, they published their study. In addition, the circle in the red line shows the number of papers issued according to the applicable year.

The graph presents an overview of authors who have been writing research on SME digitization for a long time or recently. The author who has published research on SME digitization for a long time is Terras M, who publishes from 2010 to 2019 productively and increasingly. In addition, researchers with a long history are just addressing these topics, such as Parida V, who wrote between 2017 and 2020, and Kraus S, between 2019 and 2022.

Figure 6: Authors' Production over Time



Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

Authors who have published their articles can also be classified according to the resulting impact based on the h-index. The h-index values of the authors range from 0 to 6. The magnitude of the effect is marked in dark blue above. Figure 7 shows that the authors with the highest h-index obtained Parida V, with the achievement of number 6 marked with a dark blue color describing the maximum impact. Then followed three other authors with a value of h-Index 4 with a reasonably good result, as is Waldfogel J, on the other hand, with h-index of 3 authors as Gebauer H, Kraus S, Raimon N and Vitolla F.

Figure 7: Author Local Impact by H index

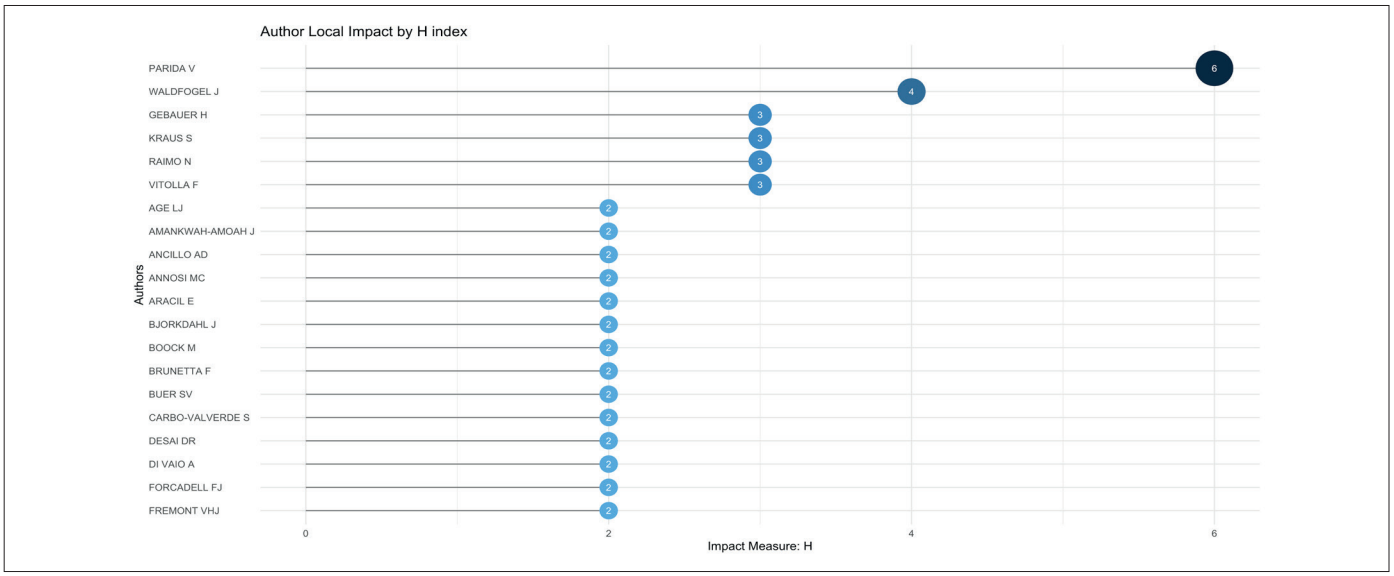


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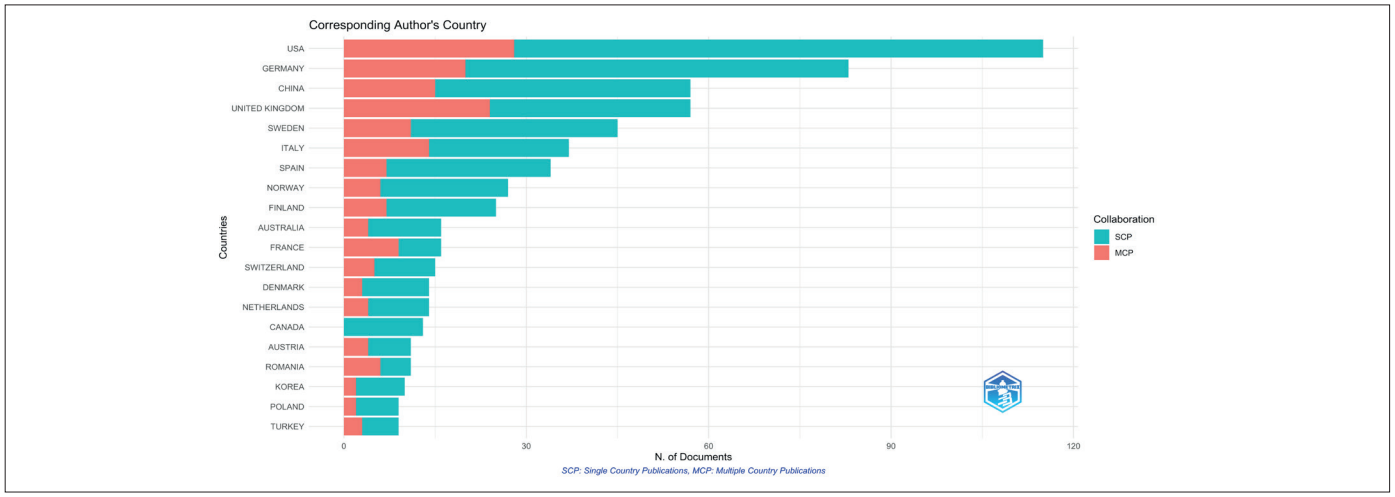
Figure 8 shows the countries of authors' correspondence in each paper with the calculation of the total form of collaboration between SCP (single-country collaboration) or single-country collaboration, non-MCP (multi-country partnership), or multi-country association.

There are 20 major countries included in this data, and the document quantity range is between 0 and more than 120 paper documents published on SME digitization.

The results are that the USA has the highest author correspondence, with more than 87 published papers. In addition, the second place is Germany, with more than 63 published articles. Finally, Austria, Romania, Korea, Poland, and Turkey with an average of 7 published articles. These data show the need to increase research on the digitization of SMEs in other countries. To capture new and better ideas and innovations, which contribute to the development of digitization.

Figure 8: Corresponding Author's Country



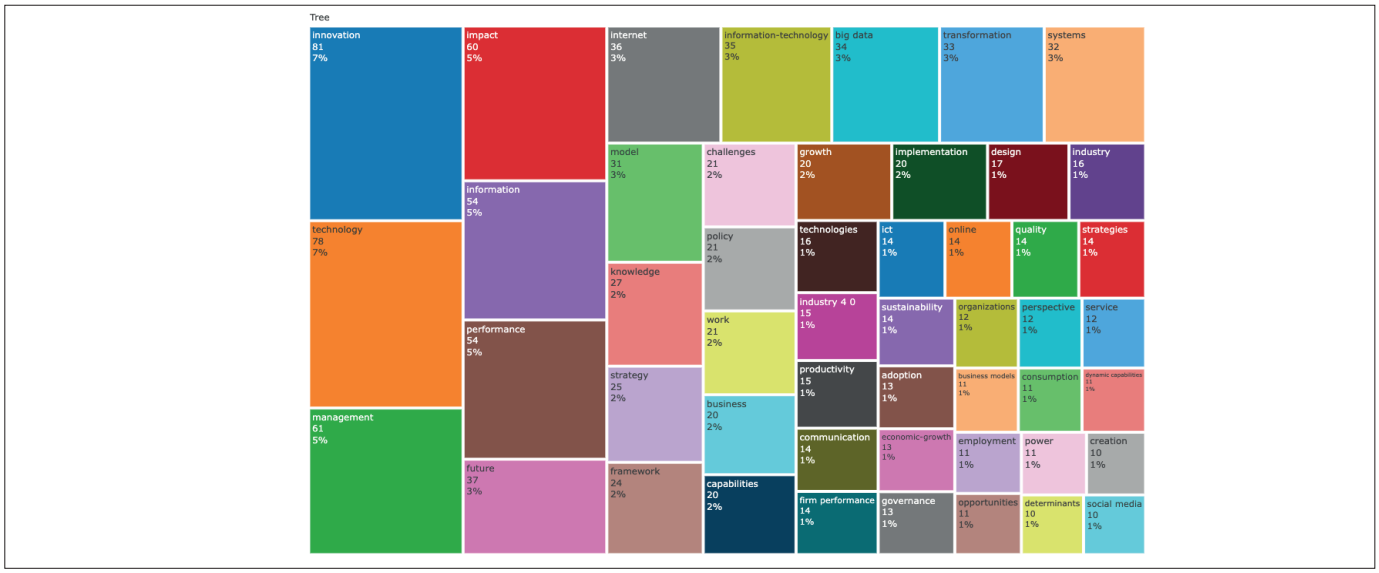
Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

Documents that are the subject of the study, where there are several words with several occurrences between 0 and more than 110 times. The top 50 words in the list marked with the blue diagram show the comparison of the number of events of use of each term and its relevance to the topic of SME digitization.

The top word with the highest number of occurrences and the most relevant to the research topic is the word innovation, with total usage of 81times indicated in blue. This figure illustrates that the research topic SME digitization is closely related to the word innovation which often appears in the research on this topic. Also, in second place is the word technology, with an occurrence amount of 78 times. Then, in third place is the word management with an occurrence amount of 61 times.

The word tree map in Figure 9 shows words that often appear in squares like regions on the map, where the more words appear, the larger the square area.

Figure 9: TreeMap



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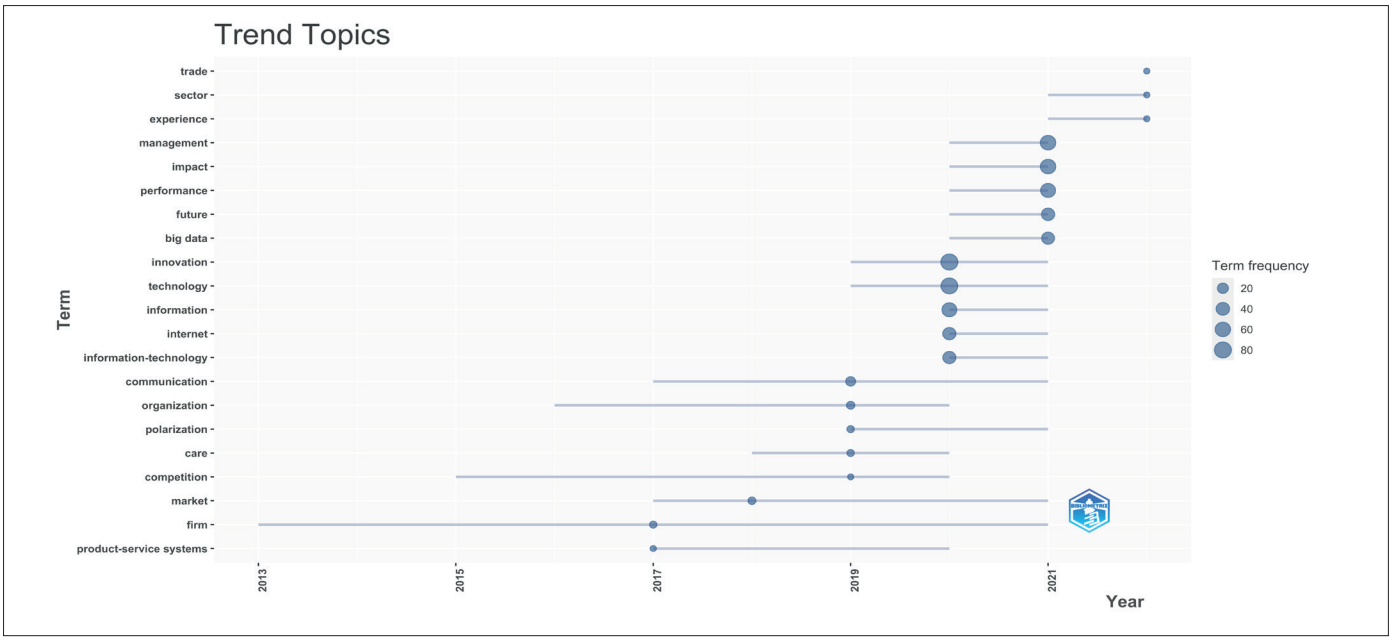
These trends are also part of this research, where Figure 10 shows an overview of theme development from time to time with division by year. To know the themes used for a long time and the themes used recently. The appearance of the issue also matches the frequency of how often the word appears in the research on SME digitization topics. The larger the circle, the more the term is used and recent. The development of the issue began to experience a significant increase in 2019.

Based on the description of the above data, the topic that has been used since 2013 is product-services systems and firms, especially those related to the issue of SME digitization. Then, in 2015, the theme of competition started to appear. Although much time has passed, the number of articles that emerged in 2015 is still small. The pieces widely used in 2019 include communication, information technology, internet, innovation, impact, performance, and experience with different amounts.

Figure 10: Thematic Trends



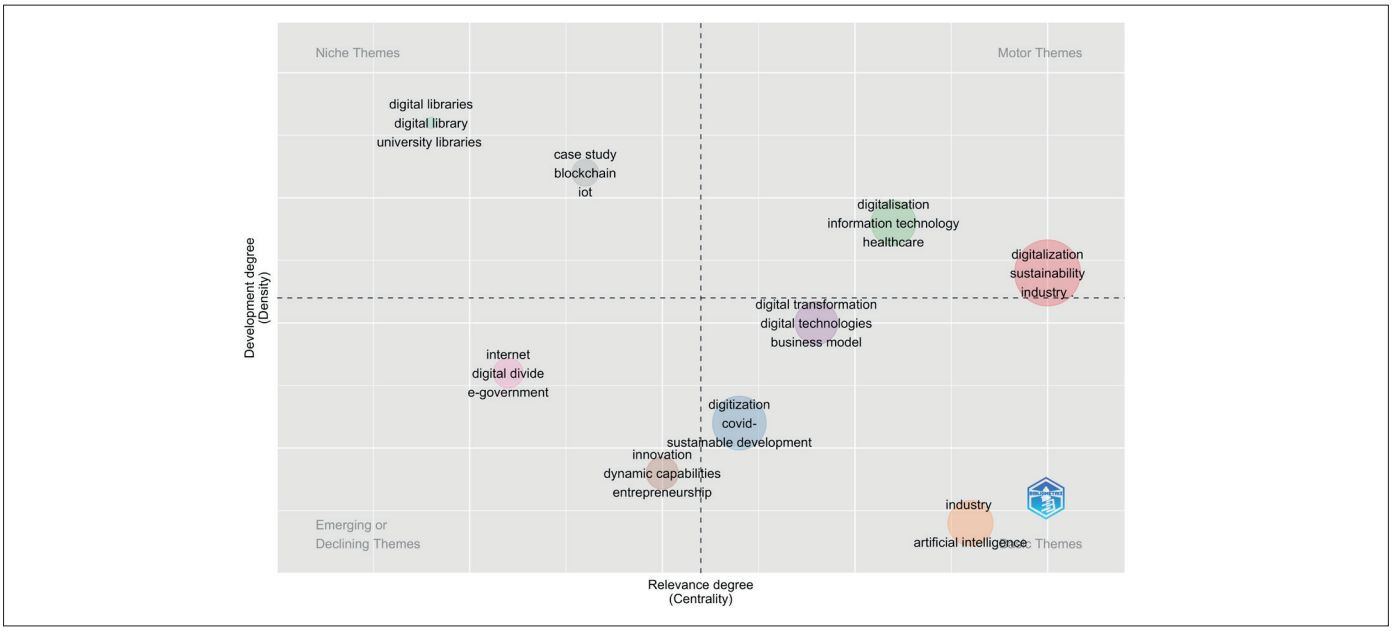
Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

In this study, an analysis of thematic maps based on density and centrality was also carried out, which were divided into four thematic quadrants, as in Figure 11. This result is obtained from a semi-automatic algorithm by reviewing the titles of all references to the research object and adding relevant keywords other than the author's keywords so that the results can capture more profound variations.

The upper right quadrant is a driving theme characterized by high density and centrality, so it should be developed and is essential to be studied in future research. This quadrant has digitalization, sustainability, information technology, healthcare, and industry themes. In addition, the upper left quadrant shows a specific piece but has high development, indicated by high density and low centrality. Articles in this quadrant include digital libraries, university libraries, blockchain, and IoT.

In addition, in the lower left quadrant, some topics have been used for a long time but have experienced a downward trend with a marked low centrality, issues such as the internet, digital device and e-government, innovation, dynamic capabilities, and entrepreneurship. Finally, the lower right quadrant is a basic theme characterized by high centrality but low density. These themes are essential to be included in the research because they are general themes that are commonly used, including sustainable themes such as digital transformation, digital technologies, business models, covid and sustainable development. The topics used in the articles that are the research subject keep changing, especially from articles that have been published recently compared to articles that have been posted for a long time.

Figure 11: Thematic Maps



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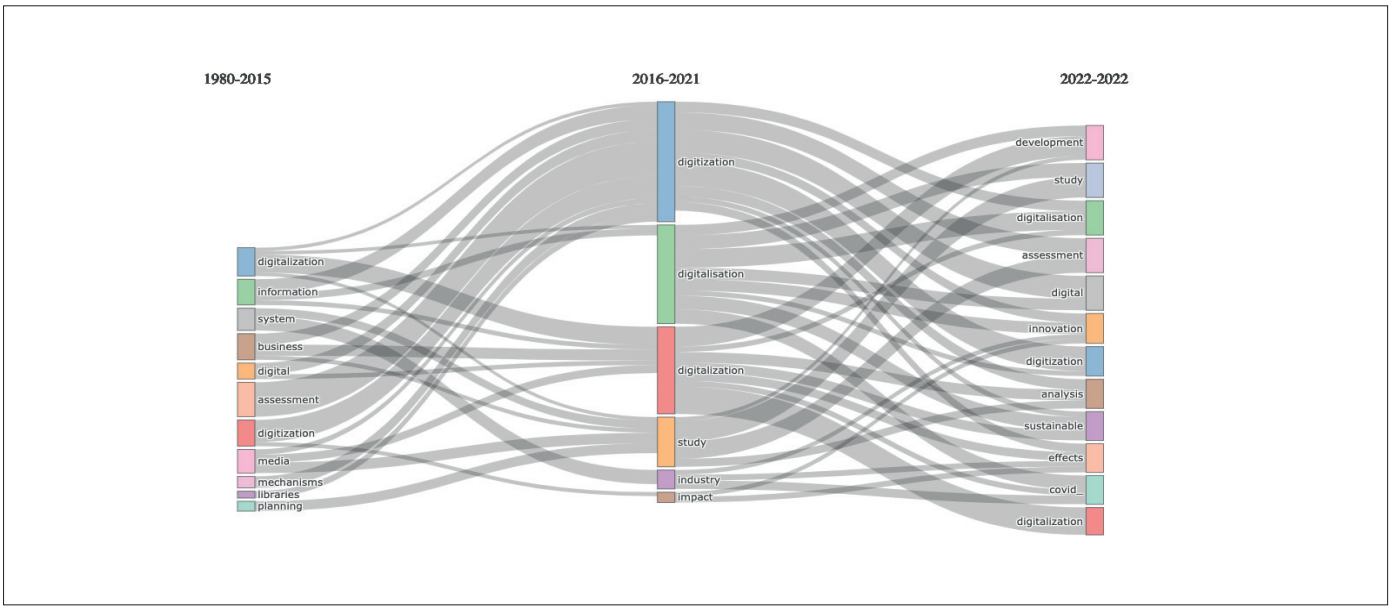
The evolution of the theme is shown in Figure 12. Although the piece of this study is SME digitization, these data indicate several widely used subthemes. The left side shows some of the topics widely used from 1980 to 2015; there are 11 topics listed with different sizes depending on the topic usage. The digitalization theme took the first position, followed by the information theme.

The second or middle part shows some widely used themes from 2016 to 2021. Some of the articles that emerged during this period are an evolution of previously used pieces and have a connection to their content; for example, the theme "industry" emerged as a form of theme revolution. These themes "study" and "impact" show that research tends to these research themes. The third section, the right, offers the most recently used topics from 2021 to 2022. There are 12 themes listed, of which the most recent we can say: are development, assessment, digital, innovation, sustainability, and covid.

Figure 12: Developments in the field

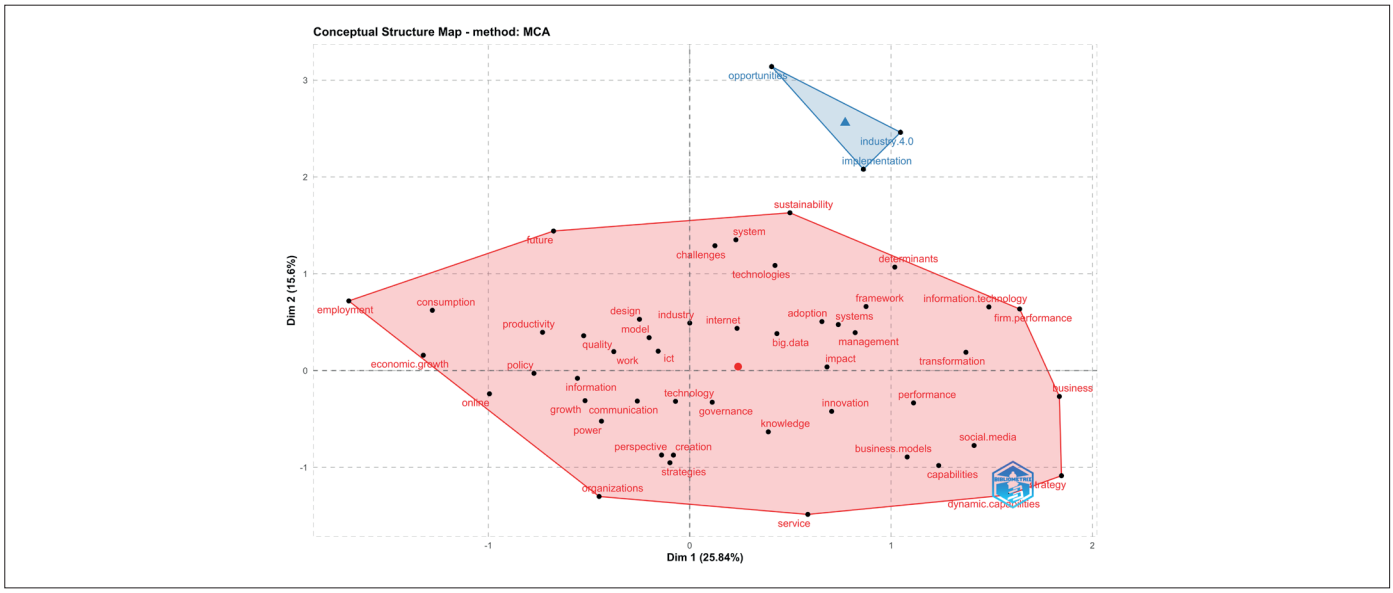


Note: (*) 03 February 2022. Source: Social Sciences Citation Index–SSCI/Web of Science. Bibliometrics R Package

This study also describes a conceptual structure map or a map of the contextual structure of each word that often appears in research papers on the topic of SME digitization by dividing it according to the mapping of the relationship between one word and another through area mapping. Each dish is placed according to Dim 1 and Dim 2 to produce a mapping between terms whose values do not differ much.

In this data, there are two parts of the area that are divided, namely the red zone and the blue area; each site contains words that are related to each other. Based on Figure 13, the red area shows more and more different words; this indicates that many research papers link the terms listed in this area.

Figure 13: Conceptual Structure Map



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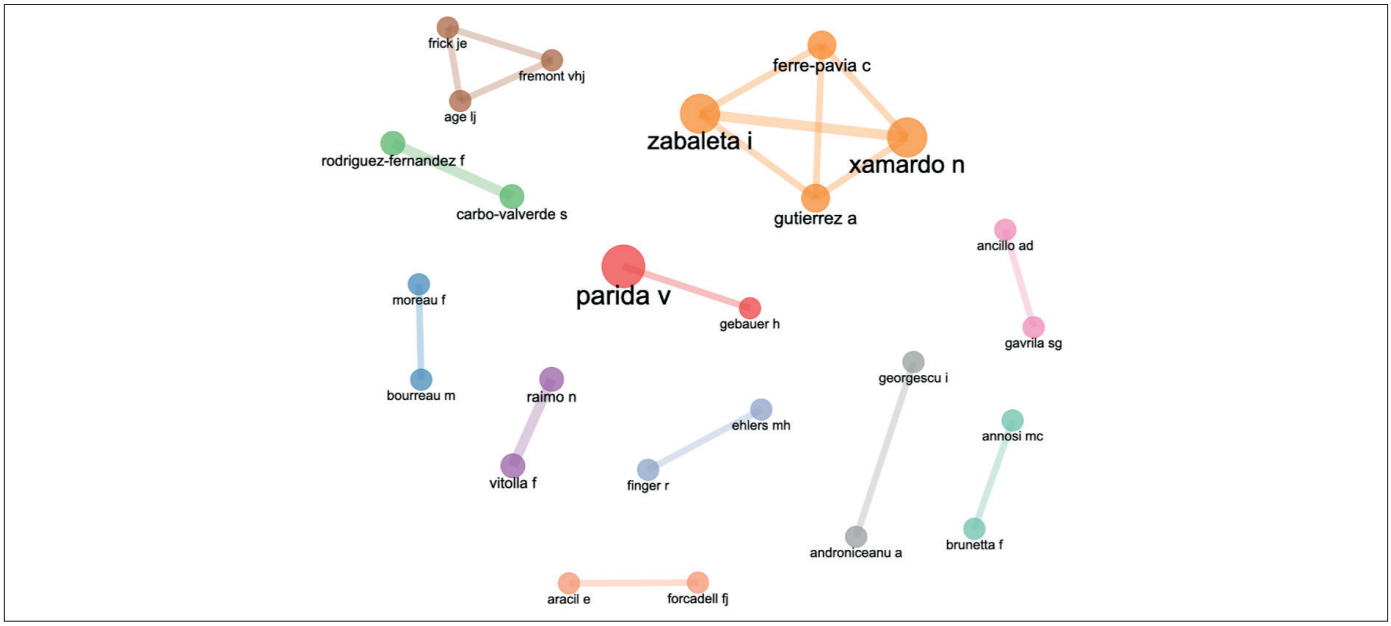
Regarding the collaboration network that the authors carry out in research on the digitization of SMEs, Figure 14 shows that the most significant collaborations are those of the researchers: Parida and Gebauer; on the other hand, other vital researchers who collaborate are Zabaleta, Gutiérrez, Ferre, and Xamardo: Zabaleta, Gutierrez, Ferre and Xamardo and finally; it is observed, another essential collaboration of researchers such as Frick, Age, and Fremont.

Figure 14: Collaboration Network



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Conclusions

The study was conducted to determine the development of research on SME digitization from 1980-2022. The 650 papers used in this study show that research on SME digitization has increased yearly. The first papers appear in the early 1980s, and after 2018, the number of documents on this topic increases significantly. The data reflect that this growth has not stopped and that the issue of SME digitization is still a developing research stream. Hence, the diversity of definitions to describe this topic is not surprising.

A remarkable result of the bibliometrics is that articles published in impact journals found a common environment on how to define digitization in SMEs and terms related to: "innovation", "technology", "management", "impact", "information", "performance", "future", "internet", "information-technology", "big data", "transformation", "systems", "model", "knowledge", "strategy", "policy", and "business".

By embracing digitalization and improving their strategy, SMEs can better compete in the domestic market and expand into new markets, including foreign ones. Moreover, to reap the benefits of digital marketplaces or platforms (e-commerce). The correct adoption of a digital strategy will allow them to minimize production and communication costs and, consequently, compete through their costs or bet on market niches, as well as improve other non-cost-based features of their competitive strategy access to new distribution channels, enhance their services and increase the choices given to consumers.

The wave of digital change has had a remarkable effect on the competitiveness of the global value chain, in which process industries are no exception. Although often seen as laggards in the overall progress towards adopting digital technologies, the pressure to reduce costs and overhaul existing business models has prompted process industry forerunners to re-evaluate their business operations. Research trends on SME digitization in the last three years focus on: information technology, file digitization, digital transformation, innovation, industry 4.0, technology, sustainable development, covid-19, sustainability, and public policy.

SME digitization is driven by the rapid emergence and adoption of digital technologies, changing social conventions and organizational routines. Digitization ranges from established technologies (social, mobile, analytics, and cloud) to emerging ones (distributed ledger, artificial intelligence, extended reality, and quantum computing. Consequently, digitization implies a hyper-connected environment for SMEs, characterized by access to new data sources, merging the digital and physical worlds, pervasive connectivity, and interactions between individuals, organizations, and real-world objects.

In Latin America, it is essential to mention that the evolution of research topics related to SME digitization reveals the growing importance of digitization, sustainability, IT, healthcare, and industry. Understanding these trends can help Latin American businesses and policymakers adapt to a rapidly evolving digital landscape. Furthermore, the analysis of research citations highlights influential work and novel concepts that have shaped SME digitization research, providing valuable insights for Latin American researchers, practitioners, and policymakers.

Future agenda, trends, or gaps

Future research can explore the following areas to address existing gaps and trends: investigate strategies to develop digital skills in SMEs and identify ways to reduce the gap between available skills and industry requirements. Also, assess the effectiveness of public policies and support programs to foster SME digitization and address barriers to digital adoption. Furthermore, we could examine how SMEs can leverage digital technologies to improve their resilience to economic shocks, such as the COVID-19 pandemic, and adapt to changing market conditions. We could also explore the ethical implications of SME digitization, focusing on data privacy, security, and the responsible use of emerging technologies. Furthermore, we could investigate strategies to ensure equitable access to digital technologies for SMEs in different sectors, regions, and socio-economic contexts.

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