CHAPTER 14

World Research and Intellectual Structure in Digital Transformation on SMEs in Covid-19 Times

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14.1 Introduction

In recent decades, the phenomenon of digital transformation (DT) has been impacted by profound changes in almost all sectors of economies and at different organizational, operational, strategic, and management levels [1, 2]. These changes are in line with its definition, understood

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as the effects caused or influenced by the use of digital technology in human life in general and in organizations in particular [3, 4]. Thus shaping a new trend called Industries 4.0, related to the Internet of Things (IoT), cloud computing, artificial intelligence (AI), and mobile computing [5, 6].

Digital transformation (DT) and its effects on organizations have been studied extensively due to its growing interest among academics and researchers [7]. Busulwa and colleagues find that the hotel and tourism industry has developed digital business capabilities to improve customer engagement, customer experience management, and hotel management [8]. Alenezi explores the effects of DT on various dimensions of the higher education system in its substantive functions of teaching, research, and engagement with society [9]. Vu and Hartley find that DT is the primary driver of labor productivity growth and recovery in the electricity sector in different economies [10].

Currently, companies are experiencing a disruption in their industries due to the rise of digital processes leading to a change in previously established structures and putting consolidated business models under pressure [11, 12]. Within this restructuring process, business innovation is essential in applying digital technologies to achieve the company's goals and thus improve products, processes, and business models to create value [13, 14]. In addition, digitalization influences various business activities, namely technology acquisition and business models, and provides opportunities for collaboration between companies and building relationships with customers and employees [15, 16].

However, organizations face challenges in the digitalization process. For example, Parida and colleagues mention that the main challenge

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consists of value creation, delivery, and capture [17]. Furthermore, Eller and collaborators explain that Small and medium-sized enterprises (SMEs) face challenges in adopting new technologies regarding resources and management skills. However, these challenges could be overcome by developing the required skills (hard and soft), investing in digital technologies, and developing a detailed strategy and measurement plan [18]. On the other hand, Almeida, Santos, and Monteiro consider that a post-pandemic world will require creating a distance working model with high interactivity and cooperation that allow people to work in companies in another geographical area [19].

The presence of the Covid-19 pandemic has accelerated DT in society due to the rapid diffusion and application of information systems (IS) technologies and internet-based infrastructures [20]. SMEs play an essential role in the global economic context by representing approximately 90% of businesses and 40% of GDP in developing economies and generating two-thirds of the world's jobs [21]. The digital transformation had a remarkable effect on this type of company compared to other businesses due to their commercial dynamics and great importance in almost every country globally [22].

In this space, the questions arise: How has research on digital transformation in SMEs evolved during Covid-19 times? What is the intellectual structure of this field of study in Covid-19 times? This paper aims to answer these questions and thereby contribute to a better understanding of the effects of digital transformation on economies. At the same time, this study contributes to the reflection on the development of digital transformation in SMEs at the global and Latin American levels.

To achieve this purpose, we conducted a bibliometric analysis to explore the intellectual structure of this field. In this way, the characteristics and research areas of digital transformation in SMEs can be determined by quantitatively evaluating the existing academic literature [23, 24]. It also allows for identifying emerging research areas and collaboration between institutions and researchers [25]. Therefore, these analyses make it possible to evaluate the performance of scientific publications and map their structure by employing a two-dimensional network [26, 27].

The results show that the intellectual structure is related to dynamic capabilities in business model innovation—likewise, the impact of the pandemic on SMEs and their reactions. At the same time, there is abundant literature about the barriers and practices of smaller companies in

their integration process to Industry 4.0, primarily through digitalization strategies for performance improvement.

The article is structured as follows. The second section develops the materials and methods, detailing the database used and the systematic data collection process. In the third section, the relevant results of this study, trends, and new lines of research. The fourth section discusses the primary relationships between the results obtained. Finally, the fifth section includes the conclusions and limitations of the study.

14.2 Materials and Methods

In recent years, the exploration and evaluation of scientific literature have been possible to resort to various review methods such as systematic literature reviews, meta-analyses, and bibliometric analyses [23]. The latter, bibliometric analyses, provides insight into the intellectual structure of a research field by analyzing its scientific output through its performance and visualization of its structure [26, 27]. In addition, some researchers use this type of analysis to evaluate various fields of knowledge, such as management [28, 29], environment [30, 31], tourism [32, 33], and others.

This bibliometric analysis requires a systematic and rigorous process similar to systematic literature reviews to ensure its quality. These characteristics allow a four-stage methodological scheme:

14.2.1 Search Terms for the Research Field

Digital transformation describes the using technology that enables radical improvement in the business model, products, organizational structures, or performance [34, 35]. Under this conception, the terms: *digital transformation*, *digital disrupt*, *digitalization*, and *digitization* are the most commonly used to identify this field of study [2, 34]. When considering organizations, it is essential to analyze small and medium-sized enterprises (SMEs) as they play a vital role in global economic development by contributing to poverty reduction, income, and job creation, representing 90% of businesses [36, 37]. Therefore, it is necessary to explore this type of company's various names, such as small and medium-sized businesses, small and medium enterprises, SMEs, and others [26]. Combining the terms "Digital Transformation" and "SMEs" allows for the construction of the required information base.

14.2.2 Database and Document Selection

Bibliometric studies require a reliable database, so Scopus was selected. The selection criteria are related to: (i) its broad coverage of publications in different areas of knowledge in terms of time and volume; (ii) high-quality standards such as CiteScore and SCImago Journal Rank; (iii) easy access to references, and (iv) data download and analysis tools [38–40].

The data was extracted in January 2022, using the topic search: TS ((TITLE-ABS-KEY ("digital transformation*") OR TITLE-ABS-KEY ("digital* disrupt*") OR TITLE-ABS-KEY ("digitalization") OR TITLE-ABS-KEY ("digitization"))) AND (((TITLE-ABS-KEY ("small business") OR TITLE-ABS-KEY ("medium business") OR TITLE-ABS-KEY ("small-sized firm") OR TITLE-ABS-KEY ("medium-sized firm") OR TITLE-ABS-KEY ("small and medium-sized business") OR TITLE-ABS-KEY ("SME") OR TITLE-ABS-KEY ("SMEs") OR TITLE-ABS-KEY ("small firm*") OR TITLE-ABS-KEY ("medium firm*") OR TITLE-ABS-KEY ("small enterprise*") OR TITLE-ABS-KEY ("medium enterprise*") OR TITLE-ABS-KEY ("small and medium enterprise*") OR TITLE-ABS-KEY ("small and medium-sized enterprise*")))). Resulting in 1004 records.

14.2.3 Selection Criteria, Data Processing, and Software Selection

The global economy and business have undergone drastic changes and devastating effects since the COVID-19 outbreak [37, 41]. For this reason, we have established the criterion of excluding the years prior to the pandemic outbreak (less than 2020) and 2022 as it is the current year. The result was 612 records. All available documents and languages are considered inclusion criteria.

The data obtained were downloaded in CSV format (comma-separated values) with bibliographic and citation information of the related scientific production (authors, titles, years, and sources, among others). This information was processed using two software packages:

- Microsoft Excel: Allows pre-processing of data by checking outliers caused by omissions, errors, or duplication [42, 43]. Corrected for these errors, we obtained 612 records. Additionally, this software allows the analysis of the performance of various units of analysis such as authors, countries, and documents [27].

- VOSviewer: Software that allows the visualization of the intellectual structure of the field of study by constructing a two-dimensional bibliometric network [44]. A network of co-occurrence of keywords allows the analysis of this structure, revealing existing topics and themes [24]. In addition, other bibliometric studies in various academic disciplines have used this software [45–47].

14.2.4 Analysis of the Results

Bibliometric analyses comprise two main approaches: performance analysis and science mapping [27]. The former allows the evaluation of the performance of scientific production and its impact. In contrast, the latter allows the observation of the dynamic aspects of the intellectual structure of the topic of study [48].

14.3 Results

14.3.1 Subject Area

There are 612 documents on Digital Transformation in SMEs between 2020 and 2021. Figure 14.1 shows the most important thematic areas that have enabled the development of this topic. Business, Management, and Accounting leads this academic field with 253 papers, with a business focus on topics related to digital transformation, such as business models [49, 50], smart technologies [51], absorptive capacity [50, 52], internationalization [53, 54], sustainability [55, 56], value creation [57, 58], and Industry 4.0 for SMEs [59, 60].

The second subject area corresponds to Computer Science with 252 publications, focused on the technological part of digital transformation, in topics such as digitalization [61, 62], data management [63], big data [64], data mining [65], digital technologies [66, 67], digital twin [68, 69], digital readiness [70], artificial intelligence [71, 72], Internet of Things (IoT) [73, 74], and cloud computing [66, 74], among others.

Furthermore, Fig. 14.1 exhibits other minor subject areas such as Engineering (16%), Decision Science (11%), and Social Science (8%) out of a total of 22 subject areas.

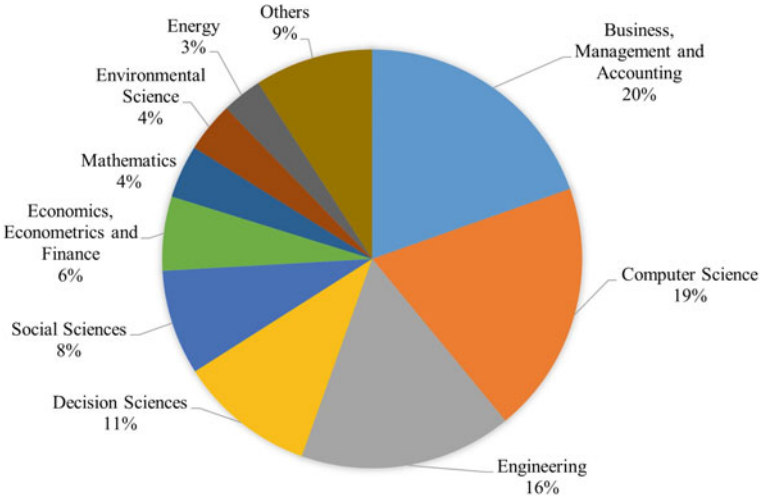

Fig. 14.1 Subject area (*Source* Scopus)

14.3.2 Type of Document and Language

Figure 14.2 shows the types of documents in the study area. Articles and Conference papers are the document types that account for most publications (86%). Articles occupy the first place with 313 documents, where the journal *Sustainability* is representative with 22 articles, and Conference paper with 217 documents. On the other hand, there are 217 Conference papers, with *Procedia* standing out (22 publications), followed by *IFIP Advances in Information and Communication Technology* and *Lecture Notes in Networks and Systems* (with 17 documents each). Finally, *Advances in Intelligent Systems and Computing* with 11.

The dissemination of this scientific output is according to seven languages. English is the most representative, as it is the predominant language of scientific dissemination [38]. Other languages are German (24), Russian (4), Spanish (3), and other minor languages.

14.3.3 Scientific Production

The scientific output of Digital Transformation in SMEs in 2020 shows some highly cited papers despite being recent. These studies address

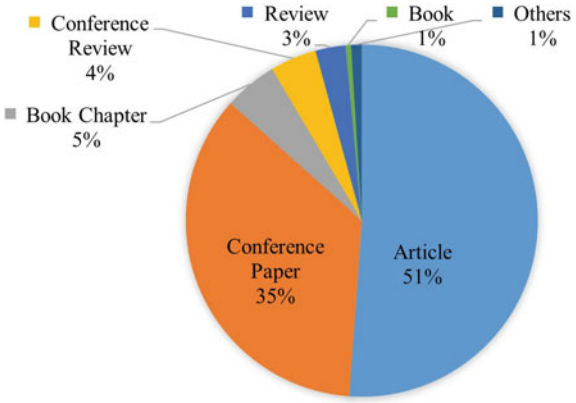

Fig. 14.2 Type of document

SMEs' background, consequences, advantages, and challenges due to digitalization in Industry 4.0 [61, 75–77]. Likewise, the role of the supply chain in the performance of smaller firms [51, 78] and the impact of digitalization on economic growth [62]. In addition, some articles examine the challenge faced by these companies due to the Covid-19 pandemic [79, 80].

In 2021, high-impact research explored the role of dynamic capabilities in business model innovation [50, 58] and the impact of the pandemic on SMEs and their reactions [22, 81, 82]. Similarly, some studies delve into the barriers and practices of smaller companies in their integration process into Industry 4.0 [67, 83, 84], primarily through the digitization strategy for performance improvement [53, 85, 86].

14.3.4 Countries Collaboration

Figure 14.3 shows the 75 countries that have contributed to the scientific production of Digital Transformation in SMEs during the last two years. In the top 10, there is a majority participation of European countries such as Germany, the Russian Federation, Italy, the United Kingdom, Portugal, Spain, Finland, and Austria. Therefore, the presence of Asian countries such as Indonesia and China. In 2020, these countries were more affected than others [87, 88].

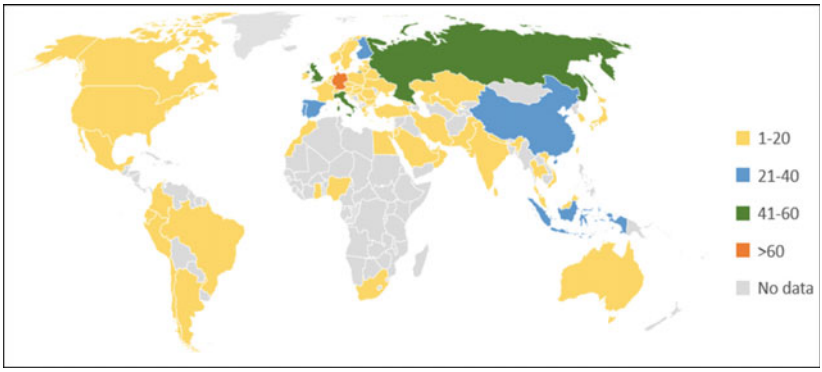

Fig. 14.3 Countries collaboration (*Source* Scopus)

Germany leads the field with 112 papers and 259 citations, collaborating with 23 different nations through 36 papers, with Austria, Spain, and the United Kingdom contributing the most with three papers each. Furthermore, it is worth noting that Germany's most impactful research has focused on the growth opportunities offered by digitalization and the strategies and process of digital transformation of SMEs in the framework of Industry 4.0 [50, 60, 89, 90].

On the other hand, Italy has the highest number of citations, which has achieved an average of 416 citations through 56 papers. These studies address the advantages of Industry 4.0 applications for sustainability [60, 76] and digital transformation in smaller companies [58, 61, 91]. The work of Erwin Rauch (affiliated with the Free University of Bozen-Bolzano) stands out, and he has contributed five research papers receiving 64 citations. Dominik T. Matt (Fraunhofer Italia Research) has also contributed to four publications. Both authors have conducted joint studies exploring Industry 4.0 in SMEs, its advantages, challenges, and requirements [76, 92, 93].

In Latin America, the COVID-19 outbreak emerged in the early 2020s, following Europe, soon becoming the center of the pandemic and registering the highest number of cases and deaths and significantly affecting the region's economy [94, 95]. Furthermore, some scholars explored the effects of SARS-CoV-2 on the digital transformation of the enterprise [79, 82, 96], the integration of Industry 4.0 [97], and ERPs [98]. Therefore, some studies analyze the impacts on agriculture [80] and the wine industry [99].

14.3.5 Co-occurrence Author Keyword Network

Bibliometrics offers several tools to analyze the intellectual structure of an academic field, one of which is co-occurrence analysis. This analysis makes it possible to find connections between concepts using authors' keywords [100]. In this way, it facilitates the observation of relevant topics and research lines developed in the study of Digital Transformation and SMEs in Covid-19 times. Thus Fig. 14.4 shows the science map constructed through VOSviewer with 1380 keywords, in which 55 co-occur at least five times; therefore, the visualization has 55 nodes (relevant topics) and six clusters (lines of research).

Cluster 1 (red color) "*SMEs in Covid-19*" is located in the center of Fig. 15.4, consisting of 17 nodes with 432 occurrences. The studies belonging to this cluster focus on challenges, difficulties, and solutions for small and medium-sized enterprises [18, 60]. These studies cover different topics, such as implementation of Industry 4.0 [75], digitization

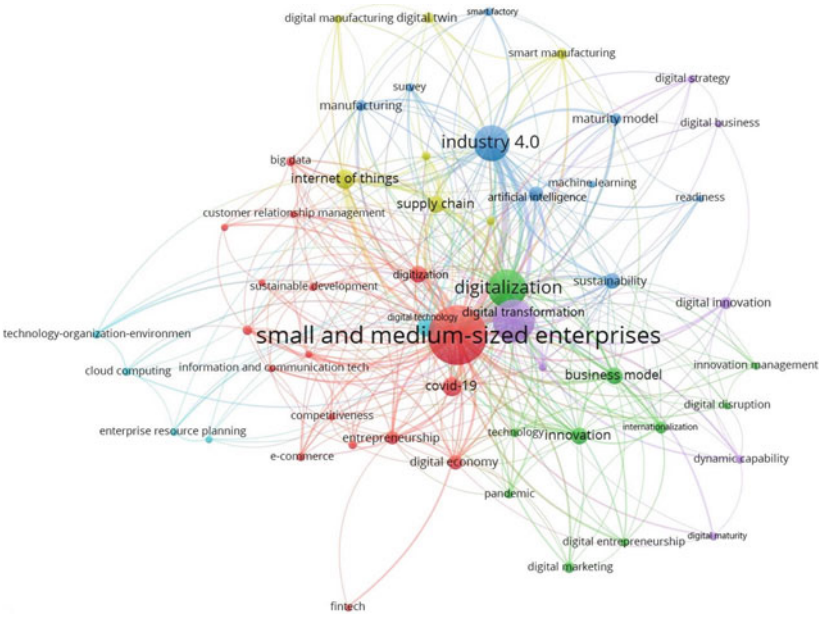

Fig. 14.4 Visualization of co-occurrence author keyword network (*Source* Scopus)

process [101], digital economy [102], value creation [57, 58], supply chain [78], sharing economy [103], entrepreneurship process [104], sustainable development [105], and adoption of information and communication technologies (ICT) [106]. In addition, many of these articles focus on different economic sectors such as manufacturing [77], food [58, 107], fintech [108], fashion [109], and tourism [110]. Other studies addressed the Covid-19 pandemic and its implication on the activities of SMEs [22, 111], as well as the approach to solutions involving digital transformation [105, 112–114].

Cluster 2 (green color) "*Digitalization and Business models*" consists of 10 nodes with 219 occurrences. In this cluster, the research addresses the effect of digitalization on business activities [110, 115, 116] and internationalization [117–119]. Furthermore, other scholars focus on the process and challenges of its implementation [120–122], even for the entrepreneurs [123]. Finally, several researchers studied the role of digitalization in the redesign of the business model [124, 125] and the resulting performance [126, 127].

Cluster 3 (blue color) "*Industry 4.0*" consists of 9 nodes with 188 occurrences. These studies explore Industry 4.0, its advantages [128, 129], the challenges and barriers in its application [61, 83], SMEs readiness [130, 131], execution of maturity models to assess the degree of implementation [132, 133], as well as its focus on sustainability [76, 134]. Similarly, this framework has been a reference for the design of business models [50], the adoption of artificial intelligence [71, 135], and the application of machine learning processes [136]. Likewise, several research projects have focused on the smart factory, the goal of digitalization in manufacturing [137, 138].

Cluster 4 (yellow color) "*IoT*" consists of 7 nodes with 96 occurrences. In this cluster, the studies explore the benefits of systems that target smart and connected devices via the internet. When these systems are from a B2C (business-to-consumer) perspective, this is known as the internet of things (IoT). This technology has a significant role in digital transformation studies due to its advantages in the enterprise's user-centered innovation process, especially in challenging times such as Covid-19 [81, 139]. Furthermore, different aspects concerning its adoption in SMEs have been examined [73, 140]. Meanwhile, when systems are from a B2B (business-to-business) perspective, it is referred to as the industrial internet of things (IIoT). Therefore, some studies focus on this concept for its applications in business [141] and because some scholars

consider it an essential strategy for the digital transformation process [142, 143].

Cluster 5 (purple color) "*Digital innovation and transformation*" consists of 7 nodes with 183 occurrences. This cluster contains documents about digital innovation, and the process companies follow to adopt such an approach. This process of change is called digital transformation. These studies involve different mechanisms, such as digital innovation hubs (DIH) [144, 145], dynamic capabilities [58, 146], design thinking [147], and business process management (BPM) [90], among others. Similarly, some researchers have proposed frameworks to detail the digital transformation process of companies, the digital strategies involved [50, 148], as well as the evaluation of this process [149, 150] through the level of digital maturity [151, 152].

Cluster 6 (sky-blue color) "*Digital Technology*" consists of 5 nodes with 53 occurrences. This cluster comprises the keywords: *digital technology*, *cloud computing*, *technology–organization–environment (TOE framework)*, *enterprise resource planning (ERP)*, and *information system (IS)*. The papers belonging to this cluster focus on how digital technologies transform SMEs' business processes [54, 91, 153]. In addition, some of these studies examine the opportunities of these digital technologies in the field of information systems, specifically in an ERP system [154, 155]. Also, the use of the TOE framework to analyze different digital technologies such as IoT [156] and cloud computing [66, 73].

14.4 Discussion

The study of the Digital Transformation of SMEs is necessary to approach it considering one of the important events for humanity, such as the Covid-19 pandemic. Therefore, this paper analyzes 612 documents published between 2020 and 2021 in seven languages and produced by 75 countries from five continents, mostly developing countries (Fig. 14.3). The top 10 contributing countries include 8 European and 2 Asian countries, which were affected at the onset of the pandemic and required digital transformations in their SME business activity [e.g., 80–82, 112, 157, 158, 159, 160]. This involved considerations in their business models [79], sustainability [22, 105, 161], supply chain [162], and purchasing processes [163]. As well as economic impacts on the labor market and human capital [164]. Latin America's participation in this field of study is less than the European and Asian continents, but with

significant repercussions when studying the effects of the pandemic on the digital transformation of the company and its integration into the 4.0 industry [79, 82, 96, 97].

The use of the scientific map of co-occurrence of authors' keywords complemented the analysis of the intellectual structure (Fig. 14.4). The main topics addressed were the management of SMEs in times of COVID-19 (red cluster), digitalization and business models (green cluster), and Industry 4.0 (blue cluster). Other smaller clusters addressed IoT, Digital Innovation, and Technology.

This study addresses the intellectual structure of digital transformation in SMEs at the Covid-19 time to understand how the company sought to change its practices and activities at a turbulent time for humanity.

14.5 Conclusions

This research aimed to assess the scientific structure of digital transformation in SMEs, specifically when COVID-19 appeared and was developed, through a bibliometric analysis using the Scopus database and VOSviewer software. In addition, the present study reveals the cognitive structure of this topic developed thanks to the collaboration of 75 countries.

The results showed the supremacy of scientific production in the areas of Business, Management and Accounting, and Computer Science. Likewise, the high production of articles and conference papers. In addition, we highlight the outstanding participation of Germany and Italy in research dissemination. Furthermore, the co-occurrence author keyword network revealed 55 relevant topics and six lines of research comprising the intellectual structure of this area: the management of SMEs in times of COVID-19 (red cluster), digitalization and business models (green cluster), Industry 4.0 (blue cluster), IoT (yellow cluster), digital innovation and transformation (purple cluster), and digital technology (sky-blue cluster).

However, this study has some limitations: (i) The use of the Scopus database and not considering other databases such as Web of Science and Dimensions; (ii) Not considering the use of regional databases such as Latindex and Scielo. These limitations could omit critical information and contributions in this field of study. Nevertheless, these limitations may broaden the scope and breadth of the subject matter presented. Therefore, this study is a guide tool for academics and researchers related to digital transformation in SMEs.

Finally, it is worth noting that in the wake of the SARS-CoV-2 pandemic, academia has shown a high level of interest in the ravages of this disease in the economic sphere, with a particular focus on small and medium-sized enterprises, which are the main ones affected. Therefore, researchers have developed studies to explore the lessons, challenges, and effects of this pandemic to develop proposals and solutions for smaller companies to adapt to this new reality through digital transformation. In addition, however, there is a need to explore the possibility of expanding research in this area. The following are some lines of research that future studies could consider:

1. Digital ecosystem for the work: Covid-19 has forced companies to adapt to new ways of working, which has increased the number of employees in the home office or under a hybrid system. This remote system is here to stay, so firms should guide their efforts toward developing and implementing digital workplaces adapted to the new reality and the needs of workers. Therefore, future research could contribute to exploring and developing these digital systems.
2. Development of digital skills: In many countries, due to the SARS-CoV-2 pandemic, governments have put in place mobility restrictions to contain the virus. However, this has led to a transformation in the way businesses and individuals communicate. Therefore, this situation has highlighted the importance of digital skills to cope with the crisis. For this reason, future research could direct its efforts toward exploring the different digital skills needed for different business conditions and developing a measurement framework for these skills.
3. Innovation in smart technologies: SMEs have faced many challenges due to COVID-19. This pandemic has led to their adoption of smart technologies to continue operation and achieve sustainability. Therefore, future research could broaden the innovative technologies needed for enterprises from various economic sectors.

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