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Analysis of Studies on Digital Strategy: Bibliometric Research of Three Decades

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Abstract: This article empirically examines the research on digital strategy, addressing its temporal evolution, sources of scientific production, countries and organizations generating knowledge, and the topics investigated. It highlights key authors and journals from 1991 to 2023, contributing to Sustainable Development Goal (SDG) 9. Methodologically, traditional bibliometric laws and computational tools (VOSviewer software version 1.6.18) were applied for data processing. The results show an exponential increase in publications from 2005 to 2022 with a critical mass in digital strategy studies, concentrated in 11 journals and 83 authors with two or more publications. The main organizations leading scientific production in this field are in the USA. Finally, the primary Web of Science categories for the leading journals are Business, Management, and Psychology. The research examines the use and adoption of digital strategies in marketing, the impact of digital transformation on business models, and the challenges it poses for human resources. In addition, the challenges arising from the impact of COVID-19, the rise of artificial intelligence, and the integration of digital strategies in public administration should continue to be addressed. Finally, digital transformation is a topic of increasing interest in digital strategy studies.

Keywords: digital strategy; bibliometrics; innovation; technology management; technology behavior; digital skills; organizations; SDG9

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1. Introduction

Digital strategy has experienced significant growth in recent years. However, as a research topic, it remains relatively young. The earliest studies and use of the term 'digital strategy' date back to the early 1990s, beginning with the work of [1]. At that time, the focus was primarily on chemistry and physics, where digital resources such as the Internet and computers were employed for academic rather than commercial purposes.

In the *Harvard Business Review*, Diane Coutu [2] presented a case on the adoption of technologies and the impact that non-adoption would generate at that time [2], providing some of the first information on digital strategy.

Its true breakthrough came a decade later, in 2010, driven by the disruptive onset of the digital era and the transformative impact of algorithms and real-time data management [3]. The impact has not only been in technology areas, but also in agriculture [4], pharmaceutical [5], politics [6], and mining [7] sectors. Digital strategy is distinguished from "IT strategy" as it addresses issues such as network effects, digital ecosystems, and new business models [3].

From the year 2017, the phrase digital transformation began to be included in scientific articles that have "Digital Strategy" as a keyword. This is because digital transformation affects the entire organization, not just its administrative functions. [8] identified [9] two key steps for implementing digital transformation strategies: establishing an operational backbone and creating a digital services platform. Furthermore, it is established that companies that rapidly embrace the digital era—profoundly changing their current strategies, systems, operating habits, and business models—are highly likely to outperform their competitors and succeed in this dynamic environment [10].

In 2019 the COVID-19 pandemic generated an acceleration of both digital transformation and digital strategies in different fields, significantly impacting healthcare, organizations, and the day-to-day life of the population worldwide [11–13].

1.1. Use of Information Technology

In the field of digital strategy, digital technologies are closely linked to the emergence of the Internet [14]. Although technology can be defined as the creative factor behind things developed by man [15,16], it is the use of technology and the Internet that have triggered processes of economic value creation [17]. In the 21st century, digital technologies have generated transformative processes that cause disruptions at both social and industrial levels [18]. The adoption of Information Technology (IT) to develop digital ecosystems offers multiple benefits, both social and economic [19]. In addition, digital capabilities drive innovation in business models, and integration in global chains facilitates the adoption of new business models [20]. UNESCO [21] has identified the use of Information Technology (IT) as an imperative social need (UNESCO) [21]. This knowledge is also vital for businesses, where the employee is expected to adopt an intrapreneurial approach in the implementation of digital strategies [22].

The adoption of new technologies and the transformation of processes are generating significant changes in organizations [17]. These changes are supported by systems, information technologies (IT), strategies, and people [23], with human capacity, skills, and mindset being the decisive factors for the success or failure of digitalization [22,24]. Moreover, the excessive self-confidence of leaders significantly influences digital transformation and sustainable competitive performance of SMEs [25]. Therefore, digital transformation has become a key pillar for organizations to remain competitive in this digital era [26]. SMEs should promote digital culture and develop technology strategies to strengthen their capabilities and ensure their sustainability in dynamic markets [27].

IT transformation processes have marked a significant milestone in the implementation of continuous improvement in companies [28]. That change has generated a digital divide between those companies that are already immersed in the "wave" of digitization and those that have not yet decided to adopt this transformation [29,30]. Crucial sectors in the implementation of digital advances include industry [17], agriculture [31,32] commerce [33], tourism [34], finance [35], government [36], and education [37].

It is crucial for both small and large companies to recognize the opportunities and threats arising from the dynamism of digital transformation [38]. This phenomenon profoundly impacts organizational structures, which highlights the need for more scientific research, clear methodologies, and practical applications to manage it properly [39]. In addition, it is critical to pay attention to each step of the digital transformation to ensure that the results are long-lasting and sustainable [40].

On the other hand, many small and medium-sized enterprises (SMEs) face significant challenges related to digital innovation processes [28,41]. Not all organizations succeed in implementing digital transformation, with estimates suggesting that four to five out of every six such initiatives fail [42–44]. This phenomenon may be related to the poor execution of digital strategies [42], the dynamic environment, and the innovations they are trying to implement [45]. A 2017 SAP report revealed that although five out of six companies consider digital transformation vital, only 3% have successfully completed it at

the corporate level [35,46]. Market-driven business model innovation is key to improving sustainable performance and connects digital strategies to business success [47].

Finally, the rapid growth that digital technologies have experienced poses a number of challenges, including cybersecurity [48], privacy [49], and digital inclusion [50]. Also, there is a proliferation of various models and theories to understand the adoption and diffusion of technologies [36], among these models are the Technology Acceptance Model [51], the Unified Theory of Technology Acceptance and Use [52,53], and the Technology-Organization-Environment (TOE) framework [54]. There are models that allow assessing the progress and digital readiness of organizations [55], with the objective of measuring the level of digital maturity in different sectors [56,57]. To achieve a successful digital transformation, it is essential to create a strategic roadmap that directs the process from the formulation of the vision to its effective implementation [58].

This context demands continuous improvement in processes, driven by the disruption brought by artificial intelligence (AI) [59] and the growing relevance of sustainable models [60], which represents an inescapable challenge for organizations in the digital society. Although large companies often have defined digital strategies, these are not always aligned with sustainability objectives [61]. It is critical for digitized companies that meet societal expectations and sustainability goals to achieve acceptance and legitimacy among their stakeholders [62].

1.2. Innovation and Digital Strategy in Organizations

Digital leadership and organizational agility are two pillars of successful digital transformation [63]. Since digital strategy must go beyond technology and focus on human potential, developing investment in the entrepreneurial and innovative spirit of employees is a key element for a successful and sustainable digital transformation [22].

Digital innovation is a performance driver, but its impact depends on effective IT implementation and a human team with the necessary competencies [28]. Therefore, training, communication, and active participation reduce organizational resistance for the industry to succeed [17].

It is critical to analyze the routines that companies adopt to identify, leverage, and reconfigure their dynamic capabilities in the context of innovation driven by digital transformation [64]. Creating a Digital Transformation Strategy (DTS) is an ongoing process that requires flexibility, constant learning, and adaptation to changing business needs [35]. Therefore, the success of digital transformation depends on closing the gap between strategy formulation and its practical implementation [42]. Furthermore, aligning digital strategies with resource mobilization is essential to ensure long-term sustainable results [65].

Having a clear and well-defined digital strategy allows companies to establish partnerships with technology firms, which gives them access to new technologies and improves efficiency in their operations [66]. The advent of digital technology is radically transforming the business landscape [67], where the desire for control and the ability to measure in real time are key driving forces of Industry 4.0 [17]. The transition to Industry 5.0 will be achieved when digital strategies reinforce technological development, integrating technology and people to optimize both operations and innovation [68].

Therefore, this article analyzes data and metadata of scientific production on digital strategy for three decades, identifying authors, countries, journals, and globally relevant articles on this topic and its links with the SDGs; furthermore, it estimates the current thematic trends in digital strategy research.

2. Materials and Methods

Based on secondary data and metadata obtained from articles published in the Web of Science Core Collection—WoSCC (Arts & Humanities Citation Index (A&HCI), Book Citation Index—Science (BKCI-S), Book Citation Index—Social Sciences & Humanities (BKCI-SSH), Conference Proceedings Citation Index—Science (CPCI-S), Conference Proceedings Citation Index—Social Science & Humanities (CPCI-SSH), Emerging Sources

Citation Index (ESCI), Science Citation Index Expanded (SCI-EXPANDED), Social Science Citation Index (SSCI), with a thematic search vector on digital strategy, defined as {TS=(digital NEAR/0 strateg*)} was used. A simultaneous search was carried out on 15 November 2023, in the fields of title, abstract, author keywords, and Keywords Plus©, for the documents containing the concept with both keywords, arranged contiguously (with zero words between them), and present in one or more of these four search fields. This search ensured a clean and duplicate-free extraction of documents [69].

In the following, we describe 6 items referring to laws, indexes, and techniques of bibliometrics that we apply to tend to more limited and free information datasets unrelated to the focus of this research (see Table 1), the digital strategy is outlined as follows:

(1) Price's Laws offer the possibility to examine the exponential growth of science, represented by the exponential adjustment of the number of annual publications. This reflects an accumulation of knowledge that is of interest to a particular study. Additionally, these laws also indicate the obsolescence of scientific publications, contrasting with the contemporaneity of science, which is documented in two half-periods divided by the median number of publications ordered chronologically (each half-period tends to concentrate 50% of the publications). This separation between contemporary and obsolete literature carries the notion of classical literature, which stands out within obsolete literature due to the recognition it receives from the epistemic community, expressed in the high number of citations received [70,71].

(2) Zipf's Law addresses the concentration of word usage within a specific language. In this framework, keywords assigned as metadata by Web of Science or Keywords Plus© are used as a starting point to examine this concentration, highlighting those keywords that are most frequently used in the set of articles. To calculate this concentration, a square root operation is performed on the complete set of keywords, which is then adjusted according to a discrete number of keywords. The resulting set obtained from Keywords Plus© is referred to as outstanding keywords, avoiding concluding on keywords of low relevance to the topic under study [72,73].

(3) Lotka's Law allows differentiating between highly-productive authors in a specific area and those who have an ephemeral participation in a particular field of scientific knowledge (characterized by a high percentage of authors who only present one or a few published articles). To estimate the concentration of authors, a square root is applied to the total number of authors, which is then adjusted according to a discrete number of publications. The resulting set of authors is known as prolific authors, avoiding concluding on authors of low relevance to the topic under study [74–76].

(4) Bradford's Law focuses on the realm of journals, specifically on what is known as the Bradford core, which represents the smallest subset of journals capable of covering one-third of the total number of studied documents. The other two-thirds of the documents, ordered by the increasing number of journals, are grouped into what are known as zones 1 and 2. Although attention is paid to the Bradford core because it tends to be the environment where the most specialized authors, reviewers, and editors congregate in a particular subject area [77,78].

(5) The Hirsch index, also known as the h-index, is used to evaluate the relative impact of scientific production in a specific collection of articles. This index is represented by a value n, indicating that these n documents have received n or more citations in a common counting basis for all of them. In this context, the h-index will be applied to the total set of extracted documents, as this index can be retrieved from the Web of Science ResearcherID database for some authors.

(6) Co-authorship analysis is used to identify social links between both prominent authors and organizations with prominent members. In this instance, it is carried out through data clustering using VOSviewer [79].

Table 1. Characterization of document corpus to be analyzed.

Phase	Variable	Value (or Sample, n)	Unit	Subsampling Criteria
1	Time	1991–2023	Year	Period without blanks, Price's Law [70]
2	Authors	2120	Person	Lotka's Law [74]
3	Documents	674	Article	Hirsch's index (h-index)
4	Place (Affilliation)	90	Country/Territory	Census
5	Journals	487	Journal	Bradford's Law [77,78]
6	Keywords Plus©	1094	Words	Zipf's Law [72]

3. Results

Between 1991 and 2023, a total of 674 duplicate-free articles on digital strategy indexed in the various WoSCC databases were published. However, for scientific production, only years of continuous scientific production (2005 to 2022) were considered, showing an adjustment to exponential growth (R^2) of 92%, based on 541 articles. Therefore, studies on the concept of digital strategy presented a critical mass of researchers worldwide, which shows an interest in expanding the body of knowledge related to digital strategy (see Figure 1). With a contemporary half-period of publications from 2020 to 2022, 304 of the 541 articles were published (56% in the adjusted period, 2005 to 2022). Therefore, the period for an article to become a classic or go into obsolescence is only 3 years.

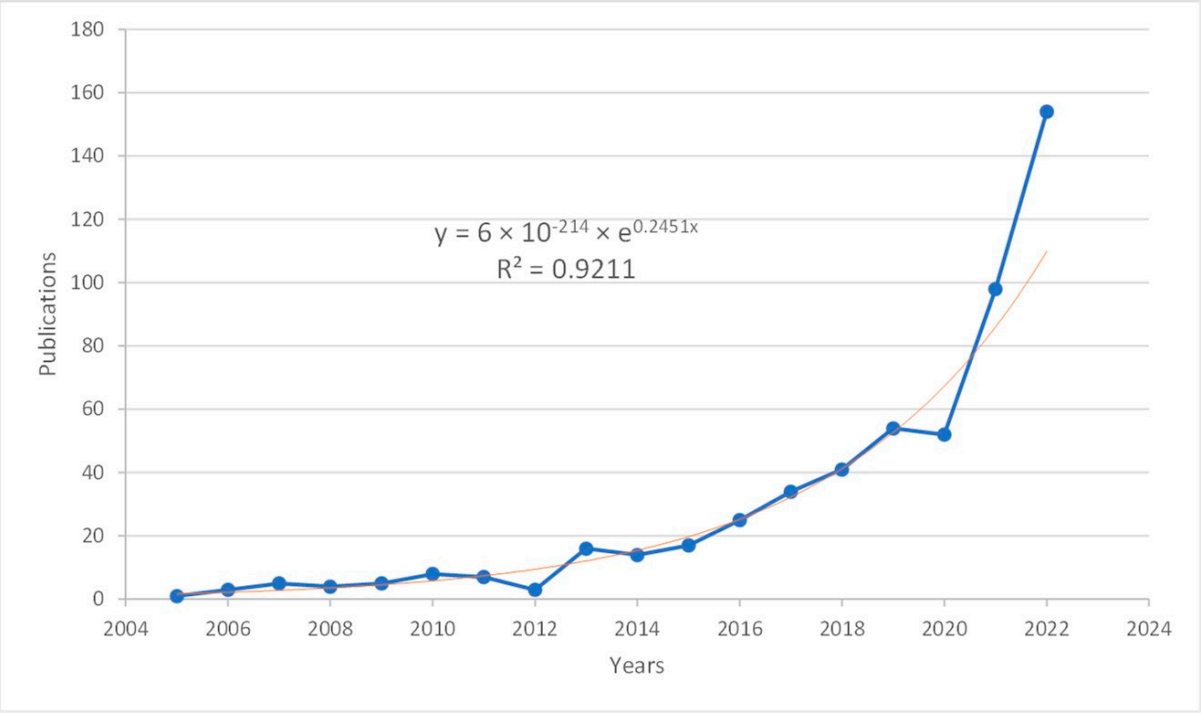

Figure 1. Time series and trends of publications on digital strategy. Where the blue line is a time series of research, and the orange line is the trend.

The total of 674 articles is the scientific production of 2120 authors, and the prolific authors were estimated using Lotka's [74] law as the square root of 2120 (≈46). Thus, it was estimated that the authors with the greatest contribution to the production of this knowledge were 46. However, given the discrete number of articles, it is noteworthy that only nine authors have published more than two articles related to digital strategy and 83 have conducted a minimum of two studies on this topic (see Figure 2). As for the prolific authors, Rezende is identified with 12 publications, positioning him as the author who has made the most contributions to the subject, followed by Alizadeh, Giannakopoulos,

Kanellos, and Sakas with four papers and Feijo de Almeida with three. As this is a recent topic, those who have carried out more than three studies on this subject are considered prolific (see Figure 2).

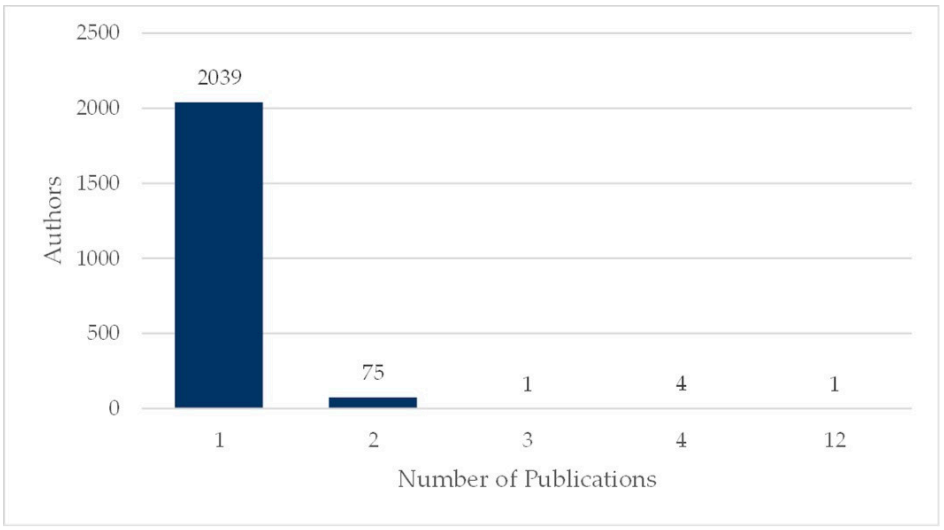

Figure 2. Relationship between the level of scientific production and authorship. The figure shows the number of publications per author.

Figure 3 shows a co-authorship graph, where each author is reflected as a node and the links between the nodes represent the joint participation in one or more documents, the nodes and links of the same color group the clusters of authors according to the intensity of their degree of cooperation, identifying nine clusters, including four triads (see Figure 3).

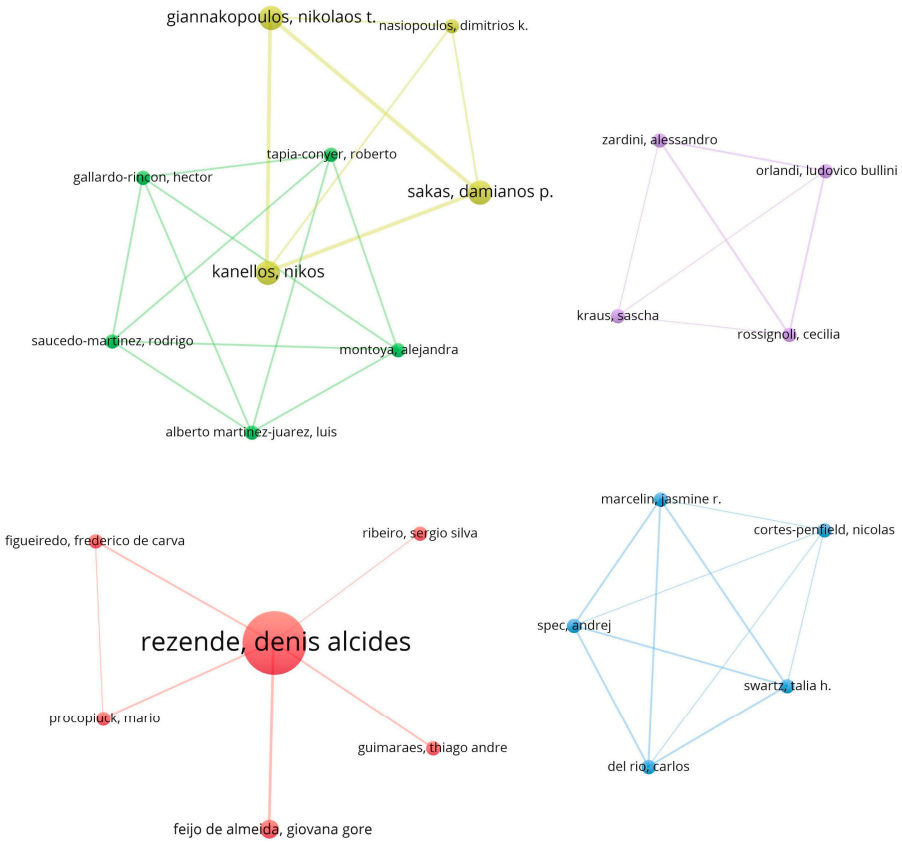

Figure 3. Graph of prolific co-authorship and its relationships with three or more connections.

Table 2 below details the different clusters of authors involved in research related to digital strategy, differentiated by color to facilitate their identification. The table also provides information on the institutions with which they are affiliated and their respective countries. This representation provides a better visualization of the academic collaboration, and the main institutions involved in this field of study and their connections.

Table 2. Prolific author clusters and affiliations with four or more relationships.

Authors	Cluster	Affiliation	Country
Rezende, Denis Alcides	Red	Pontificia Universidade Catolica do Parana	Brazil
Guimaraes, Thiago Andre	Red	Fed Inst Sci & Technol Parana IFPR, Tech & Technol	Brazil
Ribeiro, Sergio Silva	Red	Briercrest Coll & Seminary	Brazil
Procopiuck, Mario	Red	Pontificia Universidade Catolica do Parana	Brazil
Figueiredo, Frederico de Carvalho	Red	Pontifical Catholic Univ, Postgrad Program Urban Management	Brazil
Feijo de Almeida, Giovanna Gore	Red	Pontificia Universidade Catolica do Parana	Brazil
Alberto Martínez-Juarez, Luis	Green	London School of Hygiene & Tropical Medicine	England
Gallardo-Rincon, Hector	Green	Universidad de Guadalajara	Mexico
Saucedo-Martinez, Rodrigo	Green	Carlos Slim Fdn, Mexico City	Mexico
Montoya, Alejandra	Green	Carlos Slim Fdn, Mexico City	Mexico
Tapia-Conyer, Roberto	Green	Universidad Nacional Autonoma de Mexico	Mexico
Swartz, Talia H.	Blue	University of California System	USA
Spec, Andrej	Blue	Emory University	USA
Marcelin, Jasmine R.	Blue	University of Nebraska System	USA
Del Rio, Carlos	Blue	University of Nebraska Medical Center	USA
Cortes-Penfield, Nicolas	Blue	University of Nebraska Medical Center	USA
Giannakopoulos, Nikolaos T.	Yellow	Agricultural University of Athens	Greece
Kanellos, Nikos	Yellow	Agricultural University of Athens	Greece
Nasiopoulos, Dimitrios K.	Yellow	Agricultural University of Athens	Greece
Sakas, Damianos P.	Yellow	Agricultural University of Athens	Greece
Kraus, Sascha	Purple	Free University of Bozen-Bolzano	Italy
Orlandi, Ludovico Bullini	Purple	University of Bologna	Italy
Zardini, Alessandro	Purple	University of Verona	Italy
Rossignoli, Cecilia	Purple	University of Verona	Italy

As part of the findings, it cannot be ignored that these prolific authors have contributed to the publication on digital strategy and how there are collaborative works in their research projects. However, there is no international relationship in publications between countries such as Brazil, the USA, Greece, and Italy where there are authors who have done joint work, but with a high national endogamy. Among the prolific authors, there is more national networking (endogamy) than evidence of work in networks, except for the USA and Italy. Table 2 highlights the countries where this kind of work is being developed.

Next, the number of citations by authors is detailed through the calculation of the Hirsch index (h-index), which presents the impact of scientific productivity on the digital strategy; Figure 4 details the relationship of the different publications with the Sustainable Development Goals (SDGs) and Table 3 lists the articles with over 100 citations within these 39 papers or the most recognized articles on this topic.

To know the connection between authors, journals, and WoS categories of digital strategy studies, we incorporated the Hirsch index (h-index) as a filter factor for citation impact. Figure 4 shows the h-index intercept, with 39 papers with 39 or more citations.

In relation to the set of clusters identified in Table 2, these prolific authors have a very low relationship with the highly cited articles identified within the h-index set. Thus, only the purple cluster is related to one of these 39 articles, called "Digital strategy implementation: The role of individual entrepreneurial orientation and relational capita" [22].

According to Web of Science, the articles are associated with the following SDGs, the main one being SDG-9, followed by SDG-3, and SDG-4 (See Figure 5).

Table 3. h-Index documents (with 100 or more citations).

Authors	ISO Journal Abbreviation	Cited Times, Wos Score	Year Pub.	WoS Categories	Wos Index	SDGs	Price Half-Period
Yoo, Henfridsson, and Lyytinen [80]	Inf. Syst. Res.	1231	2010	Information Science and Library Science; Management	(SSCI)	9	Classical
Bharadwaj et al. [81]	MIS Q.	1212	2013	Computer Science, Information Systems; Information Science and Library Science; Management	(SCI-E); (SSCI)	9	Classical
Horvath and Szabo [17]	Technol. Forecast. Soc. Chang.	435	2019	Business; Regional and Urban Planning	(SSCI)	9,12	Classical
Dwivedi et al. [82]	Int. J. Inf. Manage.	372	2020	Information Science and Library Science	(SSCI)	4	Contemp.
Raj et al. [83]	Int. J. Prod. Econ.	349	2020	Engineering, Industrial; Engineering, Manufacturing; Operations Research and Management Science	(SCI-E); (SSCI)	9,12	Contemp.
Sebastian et al. [9]	MIS Q. Exec.	335	2017	Information Science and Library Science; Management	(SSCI)	9	Classical
Helbig, Gil-Garcia, and Ferro [29]	Gov. Inf. Q.	241	2009	Information Science and Library Science	(SSCI)	4	Classical
Yeow, Soh, and Hansen [45]	J. Strateg. Inf. Syst.	238	2018	Computer Science, Information Systems; Information Science and Library Science; Management	(SCI-E); (SSCI)	9	Classical
Perboli, Musso, and Rosano [84]	IEEE Access	235	2018	Computer Science, Information Systems; Engineering, Electrical and Electronic; Telecommunications	(SCI-E)	None	Classical
Bossetta [85]	Journal. Mass Commun. Q.	213	2018	Communication	(SSCI)	None	Classical
Chanias, Myers, and Hess [35]	J. Strateg. Inf. Syst.	209	2019	Computer Science, Information Systems; Information Science and Library Science; Management	(SCI-E); (SSCI)	9	Classical
Mithas, Tafti, and Mitchell [86]	MIS Q.	197	2013	Computer Science, Information Systems; Information Science and Library Science; Management	(SCI-E); (SSCI)	9	Classical
Correani et al. [42]	Calif. Manage. Rev.	171	2020	Business; Management	(SSCI)	9	Contemp.
Eller et al. [28]	J. Bus. Res.	166	2020	Business	(SSCI)	9	Contemp.
Kreiss and McGregor, [87]	Polit. Commun.	131	2018	Communication; Political Science	(SSCI)	None	Classical
Barrett, Oborn, and Orlikowski, [88]	Inf. Syst. Res.	117	2016	Information Science and Library Science; Management	(SSCI)	9	Classical

Table 3 shows the details relating to Figure 4, indicating the details of each h-index document and where they are concentrated according to SDGs, mainly SDG 9: "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". Additionally, 12 of the 16 articles are identified as classic literature in digital strategy (they have high citations but belong to the obsolescence half-period) and only 4 of 16 (25%) correspond to contemporary articles with high citations. These articles are titled "Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life" [82], "Barriers to the adoption of industry 4.0 technologies in the manufacturing sector: An inter-country comparative perspective" [83], "Implementing a Digital Strategy: Learning from the Experience of Three Digital Transformation Projects" [42], and "Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization" [28].

In Figure 6, the geographical relationship of the co-authors is shown (See Figure 6), where each country is represented as a node and the links between the nodes represent the co-collaboration in the production of digital strategy. Table 4 shows the main countries with the productivity of articles, citations, and connections with other documents.

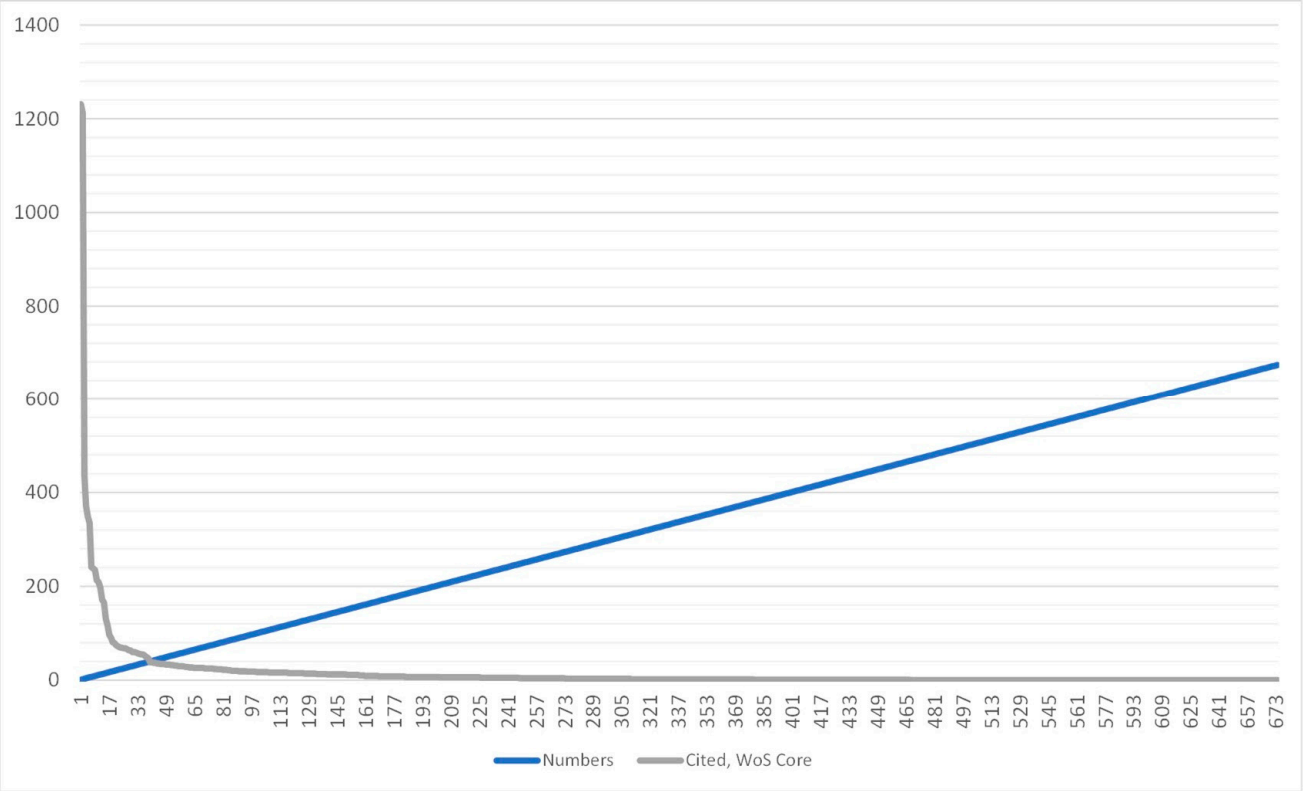

Figure 4. h-index estimation. The blue line is a time series and the gray line is a trend.

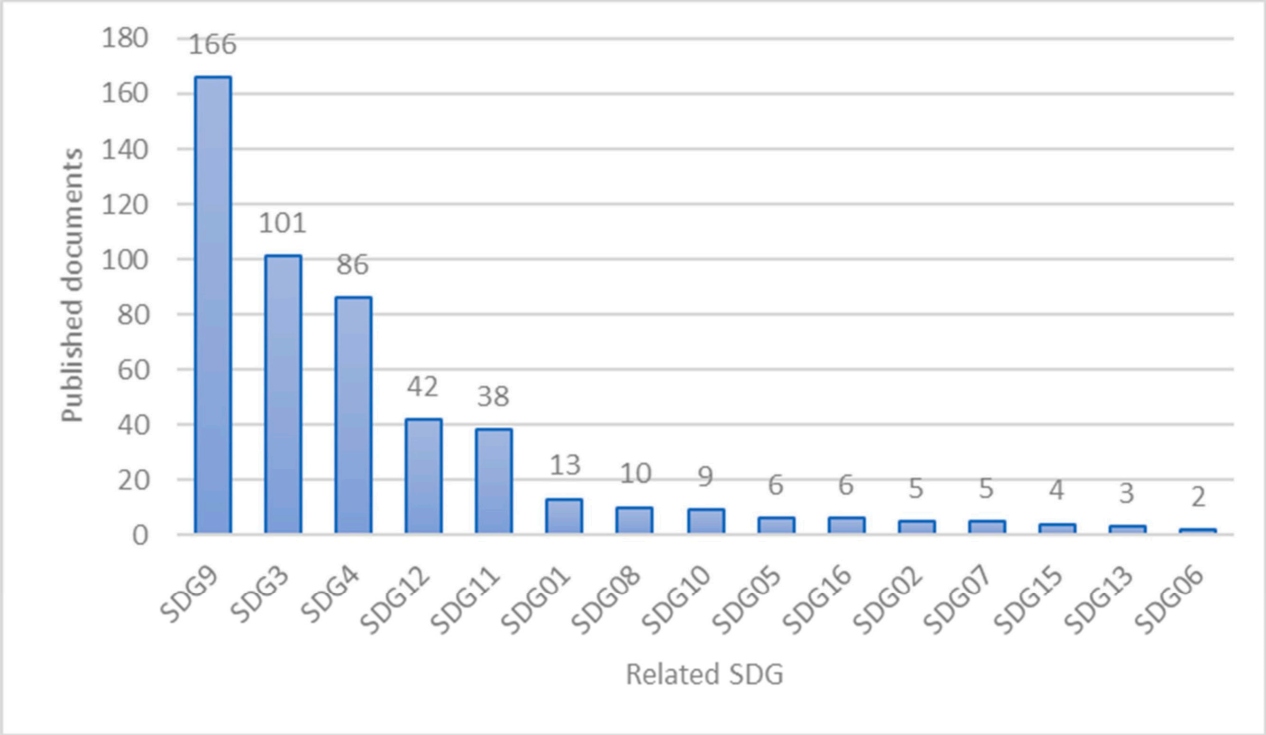

Figure 5. Association of WoS articles to the SDGs.

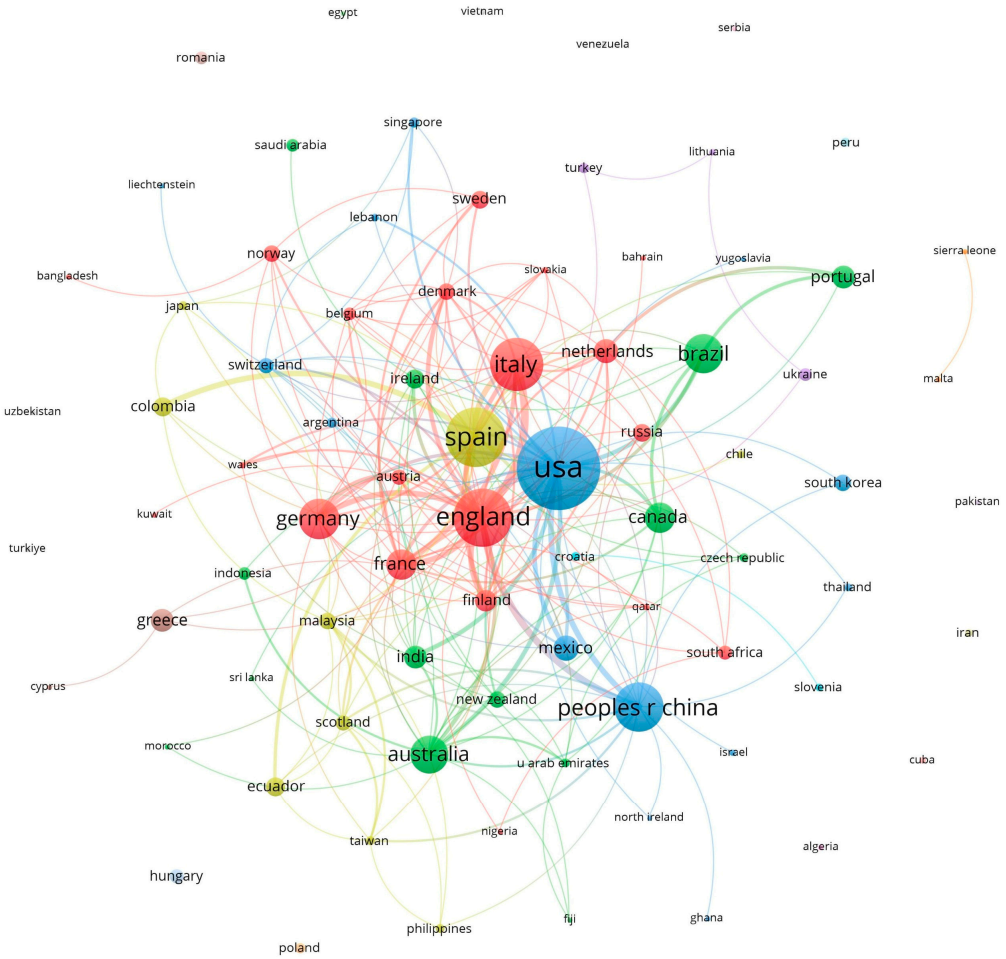

Figure 6. Co-authorship/countries graph.

Table 4. Countries with the highest production of publications.

Number	Countries	Publications	Citations	Degrees of Centrality	Percentage
1	USA	119	5012	30	17.66%
2	Spain	70	308	21	10.39%
3	England	69	1578	36	10.24%
4	Italy	58	774	19	8.61%
5	China	53	578	17	7.86%
6	Germany	39	902	16	5.79%
7	Brazil	36	150	8	5.34%
8	Australia	35	465	20	5.19%
9	Canada	25	563	11	3.71%
10	France	24	760	20	3.56%
11	Mexico	19	313	5	2.82%
12	Holland	17	116	13	2.52%
13	Greece	16	110	4	2.37%
14	India	16	912	15	2.37%
15	Portugal	16	132	4	2.37%
16	Finland	15	194	14	2.23%
17	Colombia	12	19	5	1.78%
18	Ecuador	12	20	5	1.78%
19	Ireland	12	143	11	1.78%
20	Russia	11	51	5	1.63%

In Figure 6 and Table 4, the countries with a high degree of scientific production always stand out, such as the United States with 17.6%, Spain and England with 10% each, and the People's Republic of China with 8.6%, which represents 46% of the scientific production

on Digital Strategy. Only the USA is present among the countries that also have prolific authors, the rest of the countries do not present the same production dynamics.

However, when looking at the degrees of centrality of publications by country, it can be seen that although the United States has the largest amount of research, in terms of international connections England is positioned in first place with 36 connections (the highest degree of centrality), followed by the United States with 30. Countries in the European Union, such as Spain, France, and Italy, along with Australia, have an average of 20 connections, indicating a similar degree of centrality in their publications. Although England has the highest number of connections, it has only one prolific author, compared to the USA and Italy (see Table 4).

Table 4 shows the details of Figure 6, indicating the details of the first 20 countries with the highest number of published papers and citations.

Therefore, the five most prolific countries (USA, Spain, England, Italy, and China), are related to some of the clusters in Table 2: blue cluster—USA, green cluster—England, and purple cluster—Italy.

In Table 5, the estimation of Bradford's areas is presented, indicating the distribution of articles according to the most important journals in the Web of Science (WoS), with the journals standing out for their number of citations and documents.

Table 5. Journals with the highest scientific production on digital strategy.

Journal	Article; h-Index Article *	Categories WoS	Times Cited, WoSCC	Times Cited, WoSCC/Article **	Impact Factor	Cite Score	Keywords Plus©
Sustainability	23; 0	Green and Sustainable Science and Technology; Environmental Sciences; Environmental Studies	111	4.8	3.9	6.8	Models; Management; Technologies; Innovation; Systems; Performance; Capabilities; Adoption; Systems; Transformation
Technological Forecasting and Social Change	9; 3	Business; Regional and Urban Planning	574	63.8	12.0	21.3	Digital Transformation; Technology; Information; Innovation; Dynamic Capabilities; Performance; Strategy
Journal of Business Research	5; 3	Business	337	67.4	11.3	20.3	Business; Transformation; Information; Innovation; Dynamic Capabilities; Performance; Management
International Journal of Production Economics	5; 1	Engineering, Industrial; Engineering, Manufacturing; Operations Research and Management Science	361	72.4	12.0	21.4	Models; Management; Technologies; Innovation; Systems; Performance; Industry 4.0
IEEE Access	5; 1	Computer Science, Information Systems; Engineering, Electrical and Electronic; Telecommunications	245	49.0	3.9	9.8	Systems; Adoption; Integration; Big Data; Process Integration
International Journal of Innovation Management	5; 0	Management	30	6.0	2.1	3.7	Business; Transformation; Models; Innovation; Dynamic Capabilities; Performance; Strategy
Harvard Business Review	5; 1	Business; Management	76	15.2	6.8	1.4	Digital Strategy; Business; Models
Information Communication & Society	5; 0	Communication; Sociology	58	11.6	4.2	10.2	Communication; Internet; Politics; Media
Journal Of Strategic Information Systems	4; 2	Computer Science, Information Systems; Information Science and Library Science; Management	473	118.3	7.0	17.4	Business; Technology; Innovation; Information-Systems Strategy; Capabilities; Performance; Management
BMJ Open	4; 0	Medicine, General and Internal	9	2.3	2.9	3.4	Behavior; Risk; Validation; Innovation
Frontiers In Psychology	4; 0	Psychology, Multidisciplinary	6	1.5	3.8	5.3	Innovation; Transformation; Capabilities
Heliyon	4; 0	Multidisciplinary Sciences	6	1.5	4.0	4.5	Big data; Management

Table 5. *Cont.*

Journal	Article; h-Index Article *	Categories WoS	Times Cited, WoSCC	Times Cited, WoSCC/Article **	Impact Factor	Cite Score	Keywords Plus©
MIS Quarterly	3; 2	Computer Science, Information Systems; Information Science and Library Science; Management	1409	469.7	7.0	6.7	Information-Systems Research; Organizational Routines; Performance; Innovation; Technology; Modularity; Infrastructures; Capabilities
Information Systems Research	3; 2	Information Science and Library Science; Management	1348	449.3	5.0	9.1	Software; Organizations; Capabilities; Architecture; Governance;

* Articles with 39 or more citations, ** Mean number of times cited in WoSCC.

Table 5, according to Bradford's law, shows that the first two journals are *Sustainability* and *Technological Forecasting and Social Change*. In accordance with the objectives and goals pursued by these scientific journals, they have distinguished themselves from other publications by their research areas, comprehensively prioritizing the topics of digital strategy and innovation in organizations. Publications on emerging technologies and digitization influence business transformation, improving efficiency and competitiveness. The *Journal of Business Research* and the *International Journal of Innovation Management* stand out for their focus on creating and managing innovation and fostering the development of new ideas and technologies to maintain a competitive advantage in an increasingly digitized world. *IEEE Access* provides an analysis of the rapid dissemination of technological discoveries and their social impact, while *Harvard Business Review* offers practical strategic perspectives on how companies can integrate digital technologies into their operations and market strategies.

The *Journal of Strategic Information Systems* explores the strategic use of information systems, with an emphasis on IT governance. *Sustainability* provides interdisciplinary research on sustainability and its link to processes within organizations. Together, these journals offer a broad and multidimensional understanding of how digital strategies and innovation can be effectively implemented and managed in the contemporary business environment.

Being a database extracted from WoSCC, journals with Q1 are highly cited and recognized in the world, as can be seen in Table 5. The journals with the highest impact such as *Technological Forecasting and Social Change* and *International Journal of Production Economics*, both with an Impact Factor higher than 12 and with a Cited Score higher than 21.3 lead the digital strategy research in terms of the number of citations and articles published on the topic. It is important to note that these journals are highly specialized in their research area, such as business and engineering. While journals such as *Sustainability* have the largest number of articles published on this topic (23 articles); however, its citations are below 8% in relation to the journal with the most citations. It is also established that there are 171 journals that have published only one (1) article on digital strategies. Additionally, it is relevant to highlight that the journals with the highest contribution to the h-index are *Technological Forecasting and Social Change* and the *Journal of Business Research*, with 3 articles each. The journals whose articles on digital strategy have the most average citations in WoSCC are *MIS Quarterly* and *Information Systems Research*.

Zipf's law presents the keyword plus© graphs, where each node reflects the keywords. These are linked in the same color, grouping clusters of keywords according to the intensity of occurrences in the scientific articles and identifying four clusters (see Figure 7).

In accordance with Figure 7, the keywords were grouped into topics within the scientific production on digital strategy. For the 674 papers, a total of 1094 Keywords Plus© were identified. According to Zipf's law [72], 34 Keywords Plus© were chosen, considering as estimator the square root of 1094 (=33.07) with the highest frequency of use, between nine and 55 occurrences.

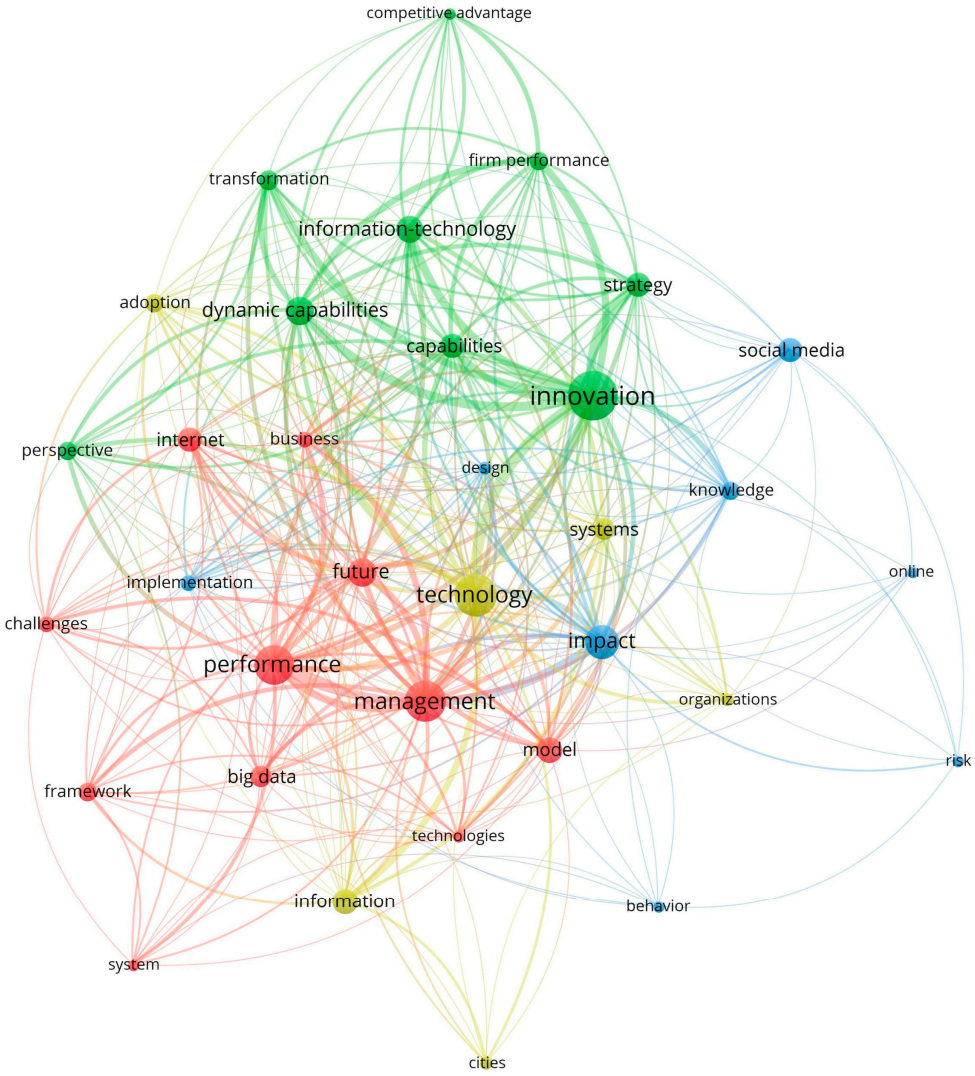

Figure 7. Keywords Plus© co-occurrence graph. Nodes of the same color form a thematic cluster.

Thus, the set of Keywords Plus© generated four clusters: As for the Keywords Plus©, four clusters were identified, as shown in Figure 8. The first cluster (green) relates innovation and information technology to the dynamic capabilities and strategy of the companies. The second cluster (Red) is more oriented to management and performance, related to business models and the use of big data. The third cluster (Blue) is more oriented to impact social media including knowledge, and design. Finally, the fourth group (Yellow) focuses more specifically on technology and its adoption as an information system.

Figure 8, based on the author's keywords, presents the topics that have been generating trends in recent years, indicating the direction of the research. Using Zipf's law [72], 46 author keywords were chosen considering as inclusion estimators the square root of 2253 (=47.46) with a frequency of use between six and 30 occurrences.

Figure 8 shows that the trend in recent years in research on digital strategy incorporates the following topics: artificial intelligence, COVID-19, sustainability, digital maturity, and digital transformation (see Figure 9). Topics such as the internet, social networks, smart city, ICT, Twitter, and Facebook present on average a higher seniority with respect to the other author keywords. But the detail of Figure 9, shows that the most powerful topic in the field of digital strategy is digital transformation and its influence on industry processes for its sustainability. On the other hand, research challenges to be considered are as follows: (1) the impact of COVID-19 on the digital transformation of organizations, (2) the rise of AI in digital transformation, and (3) the implications of digital strategy in public administration.

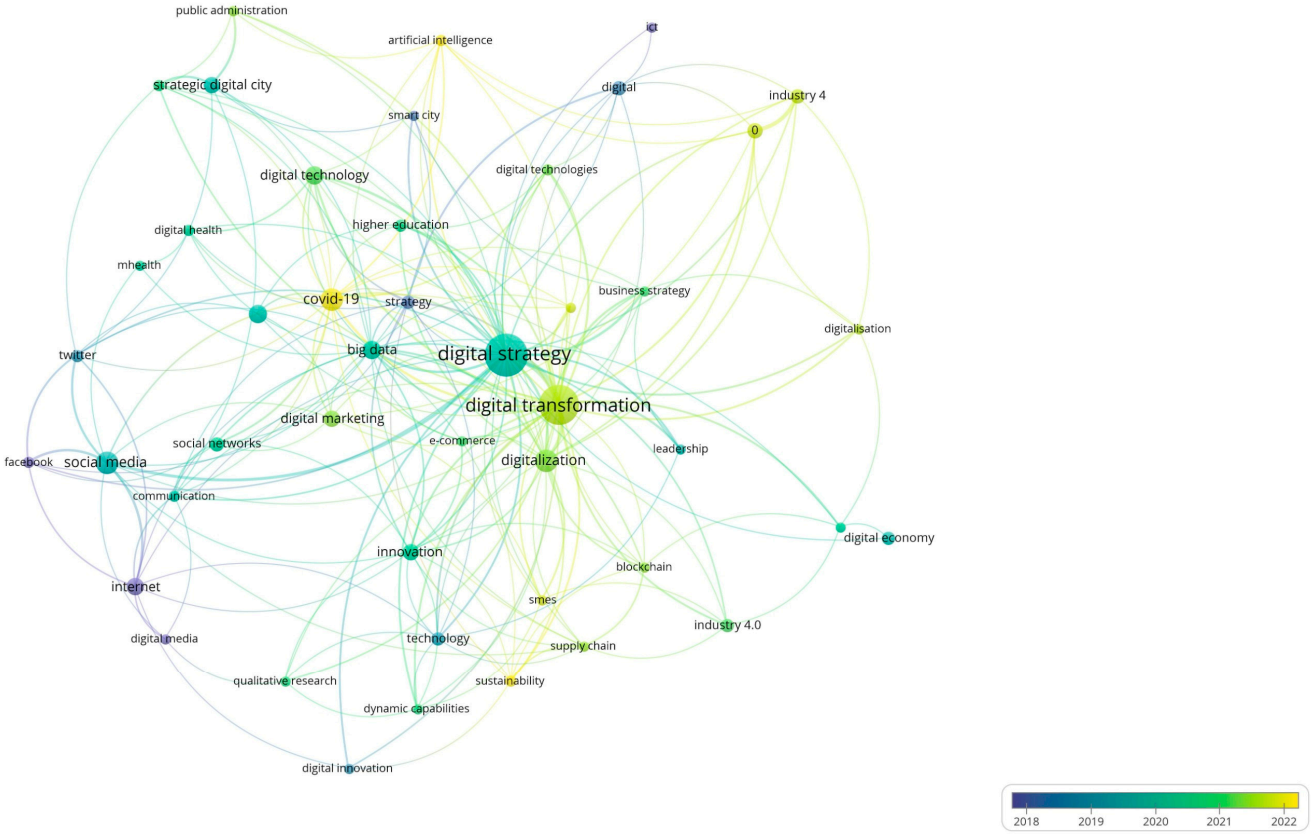

Figure 8. Author's keywords co-occurrence graph by year.

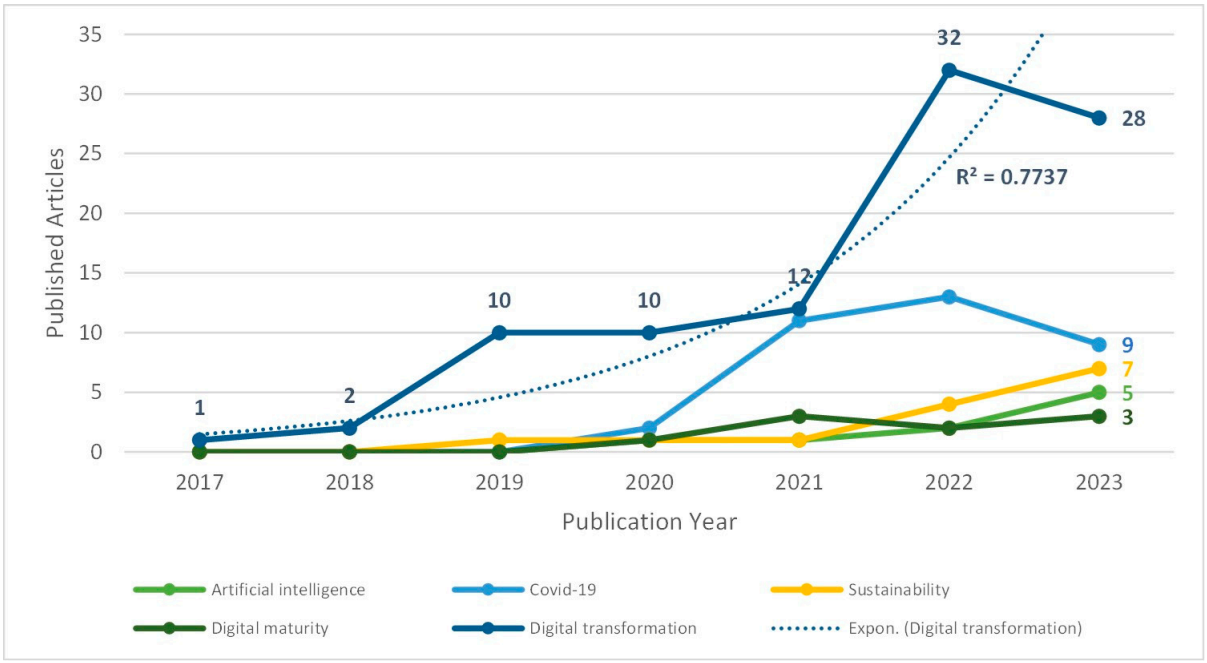

Figure 9. Contemporary thematic trends on digital strategy.

4. Discussion

The study analyzes the evolution of the digital strategy using a large WoS database and applying bibliometric laws such as Price's Law [70] to indicate the exponential growth and critical mass of authors in this area [68,89,90]. This contrasts significantly with other

studies, using databases such as Scopus or Google Scholar [91,92], that cover fewer sources and have a smaller scope in certain fields of study compared to WOS. Using Zifp's Law, 34 keywords and four clusters were used, which provides a more precise approach compared to other works [92] that manage more keywords and clusters coinciding with relevant topics such as digitization, innovation, and business models (SME). In addition, through the application of Lotka's Law, 45 authors were identified who have contributed significantly to digital strategy studies, although only nine of them have more than two publications on digital strategy, which contrasts with other less rigorous research in the identification of prolific authors [89,91].

Our study concludes based on the Keywords Plus© that the themes of innovation, performance, impact, and dynamic capabilities are relevant aspects in digital transformation research. This reinforces the findings of Ren et al. [93], regarding the significant attention that these topics are receiving in the research on the construction of digital transformation capability. On the other hand, we have established key concepts: digital strategy, digital transformation, and digital maturity. These also coincide with the research of Schallmo et al. [94], which offers a holistic view of digitalization, encompassing aspects of strategy, transformation, implementation, and digital maturity as dominant aspects in contemporary research on this topic.

The analysis shows a trend toward national collaboration in scientific output, with notable exceptions in the United States and Italy [92]. In terms of countries, Sang [95] also highlights the prolificacy of the USA, China, and England (UK). Furthermore, Zhang et al. [96], although in another order of priority, coincidentally with our study, highlight the USA, Spain, England, Italy, China, and Germany as the six most prolific countries, and emphasize the degree of centrality of England and the USA. On the other hand, among the most prominent journals in research on digital transformation and COVID-19 in SMEs are the *Journal of Business Research* and *Technological Forecasting and Social Change*. Both journals are also highlighted by Zhang et al. [96], and in relation to the largest publication volumes, our study, like others, highlights the role of the journal *Sustainability* [95,96].

Studies such as Rezende et al. [97] and Marino-Romero et al. [98] highlight how digital strategy and digital capability are critical for organizational transformation, especially in SMEs. In addition, recent studies highlight the relevance of artificial intelligence, sustainability, and digital maturity as emerging areas of research.

Finally, the current landscape of digital strategy research highlights the importance of continuing to explore key topics such as the impact of COVID-19, the rise of artificial intelligence, and the implications for public administration, aligning with the conclusions of Agostini et al. [99] on the influence of digital technologies on business models. Digital transformation in industrial processes for sustainability shows less interaction with other key concepts analyzed, but like other studies of digital transformation, it is a topic of interest in recent research [93,96,99,100].

5. Conclusions

Several findings were found during the bibliometric study. First, the scientific production in WoSCC on digital strategy began in 1991 and has had exponential growth since 2013, which demonstrates the interest that the topic has aroused in the last decade. This significant increase in the growth of annual scientific production at an exponential rate ($R^2 \approx 92\%$) is a product of the contribution of 2120 that have built a substantial knowledge base on digital strategy.

Second, while digital strategy and digital transformation function simultaneously, they should not be confused, as research in recent years has adopted both terms in parallel. Third, the prolific author who has contributed the most to digital strategy has published 14 articles, focusing his collaborative networks mainly with co-authors from Brazil with little contribution to digital strategy work with the rest of the world. The research with the most citations on digital strategy is that of Yoo, Henfridsson, and Lyytinen [80] entitled "The New Organizing Logic of Digital Innovation: An Agenda for Information Systems

Research" in which their focus is to describe the new systems architecture and future organizational innovation as it is currently being experienced.

Fourth, the global scientific production is diverse, since within the database there are contributions from authors from 80 countries with at least one article on digital strategy, with the United States, Spain, England, Italy, and China generating the most research. Fifth, the study also highlights the topics on which digital strategy research revolves, where digital transformation, digital maturity, and digitization are currently the most relevant, and topics such as the internet and social networks (Facebook, Twitter) have been relegated by new trends. Although the rapid growth of new technologies is understood, there is no doubt that many fields will contribute to this topic.

Finally, it is recommended to deepen the studies of digital strategy regarding the digital maturity of organizations, the impact of digital transformation inherent to the adoption of digital tools, and the cost of adoption and non-adoption in the short and medium term as future lines of research.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16208789/s1, Table S1: DS_DATA.xlsx.

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