Analysis of Studies on Digital Strategy: A Bibliometric Study

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Article

Analysis of Studies on Digital Strategy: A Bibliometric Study

Gustavo A. Cruz-Martínez [1], Alejandro Vega Muñoz [2,3,*], Guido Salazar-Sepúlveda [4,5,*] and Pablo Toledo-Aceituno [6]

[1] Facultad de Ciencias Económicas, Administrativas y Contables, Universidad Nacional Autónoma de Honduras, Tegucigalpa 11101, Honduras
[2] Facultad de Medicina y Ciencias de la Salud, Universidad Central de Chile, 8330507 Santiago, Chile
[3] Facultad de Ciencias Empresariales, Universidad Arturo Prat, 1110939 Iquique, Chile.
[4] Facultad de Ingeniería, Universidad Católica de la Santísima Concepción, 4090541 Concepción, Chile
[5] Facultad de Ingeniería y Negocios, Universidad de Las Américas, 4090940 Concepción, Chile
[6] Facultad de Administración Finanzas y Negocios, Universidad Sek, 7520317 Santiago, Chile
* Correspondence: alejandro.vega@ucentral.cl (A.V.-M.); gsalazar@ucsc.cl (G.S.-S.)

Abstract: This article examines empirically 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) 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 2 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, industrial digital transformation and the challenges of Big Data in higher education have less connection with other key concepts analyzed.

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

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.

Diane Coutu [2] in the Harvard Business Review, presented a case on the adoption of technologies and the impact that non-adoption would generate at that time [2], being 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]. And where the impact has not only been in technology areas, but these range from agriculture [4], pharmaceutical [5], politics [6], and mining [7]. Digital strategy is distinguished from "IT strategy" as it addresses issues such as network effects, digital ecosystems, and new business models [3].

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It is from the year 2017, that the phrase Digital Transformation begins to be included in scientific articles that has "Digital Strategy" as a key word, because since the 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].

Because in 2019 the Covid19 pandemic generated an acceleration of both digital transformation and digital strategies in different fields, given this global issue that posed a crisis in healthcare, organizations and in 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 applied closely linked to the emergence of the Internet [14] although technology can be defined as the creative factor in 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 and therefore 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, 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], and SMEs should promote a 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]. Being crucial sectors in the implementation of digital advances: 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 4 to 5 out of every 6 such initiatives fail [42–44]. This phenomenon may be related to 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 5 out of 6 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

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proliferation of various models and theories to understand the adoption and diffusion of technologies [36], among these models is 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 for 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, as 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 [64].

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 [65]. 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 [66].

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 [67]. The advent of digital technology is radically transforming the business landscape [68], 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 [69].

Therefore, this article seeks through a performance analysis and scientific mapping to distinguish authors, journals, and articles on innovative behavior of high recognition in the epistemic community around this topic, as well as the social relationships of co-authorship that occur within this community.

2. Materials and Methods

Based on articles published in Web of Science Core Collection (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*), a simultaneous search was carried out on November 15, 2023, in the fields of title, abstract, author keywords and keywords plus, for the concept composed of both keywords, arranged contiguously (with zero words between them) and with presence in one or more of these four search fields [70] .

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1) The 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 the accumulation of knowledge that is interesting to study. Additionally, these laws also indicate the obsolescence of scientific publications, contrasting with the contemporaneity of science, which is documented in two semi-periods divided by the median number of publications ordered chronologically. 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 [71,72].

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 [73,74].

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 [75–77].

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 is 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 [78,79].

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 [80].

Table 1. Characterization of document corpus to be analyzed.

Phase	Variable	Value (or Sample, n)	Unit	Subsampling criterion
1	Time	1991-2023	Year	Period without blanks, Price's Law [71]
2	Authors	2046	Person	Lotka's Law[75]
3	Documents	674	Article	Hirsch's index (h-index)
4	Place (Affilliation)	90	Country / Territory	Census
5	Journals	487	Journal	Bradford's Law [78,79]
6	Keywords Plus	1094	Words	Zipf's Law [73]

3. Results

Between 1991 and 2023, a total of 674 articles on digital strategy were published and indexed in the various WoSCC databases. However, for scientific production, only years of continuous scientific production (2005 to 2022) were considered, showing an adjustment to exponential growth (R2) of 92%. Therefore, studies on the concept of digital strategy presented a critical mass of researchers worldwide, which shows the interest in expanding the body of knowledge related to digital strategy (see Figure 1).

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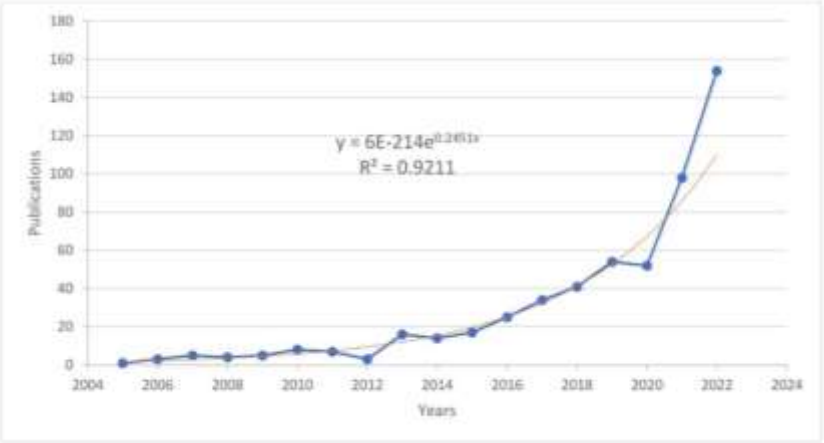

Figure 1. Time series and trends of publications on digital strategy. Where the blue line is a time series of research and the orange line is the trend.

The total of 674 articles is the scientific production of 2046 authors, and the prolific authors were estimated using Lotka's [75] law as the square root of 2046 (≈ 45.23). Thus, it was estimated that the authors with the greatest contribution to the production of this knowledge were 46, but given the discrete number of articles, where it stands out that only 9 authors have published more than 2 articles related to digital strategy and 83 have conducted a minimum of 2 studies on this topic (see Figure 2). As for the prolific authors, Rezende, Denis Alcides 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 4 papers and Feijo de Almeida with 3. As this is a recent topic, those who have carried out more than 3 studies on this subject are considered prolific (see Figure 2).

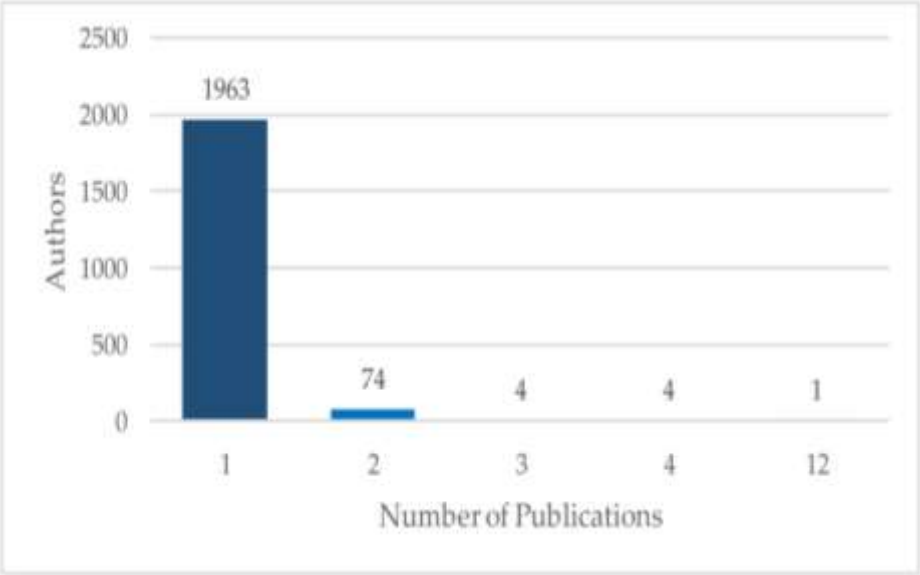

Figure 2. Relationship between the level of scientific production and authorship. The figure shows the number of publications per author.

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).

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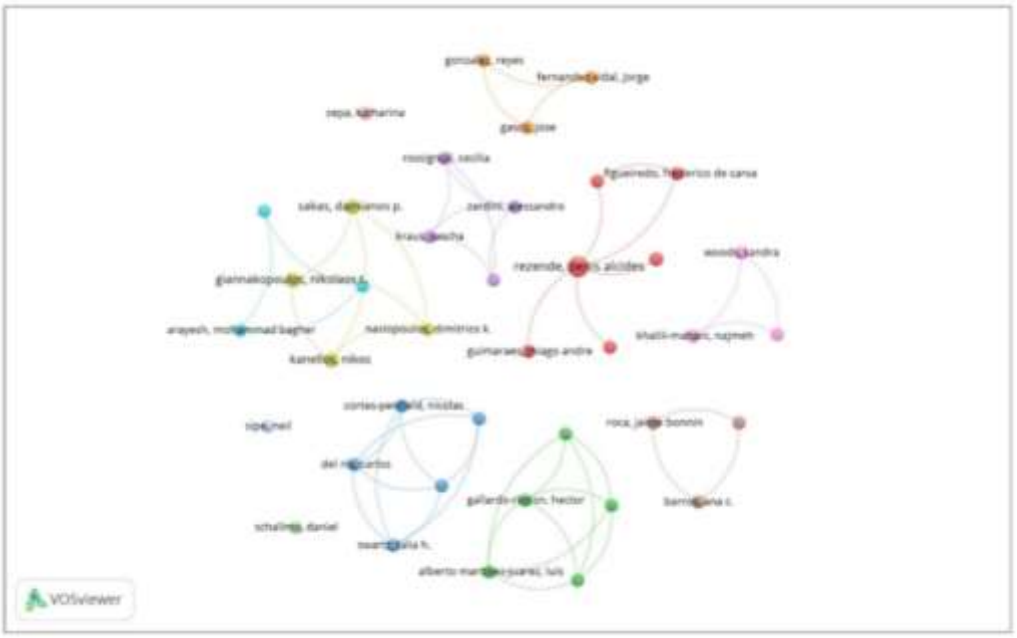

Figure 3. Graph of prolific co-authorship and its relationships with three or more connections.

Table 2 below details the different and 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 4 or more relationships.

Authors	Cluster	Afiliattion	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

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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, 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, with the exception of the USA and Italy. Highlight the countries where this kind of work is being developed (See Table 2).

Next, the number of citations by authors is detailed through the calculation of the Hirsch index (h-index) presenting the impact of scientific productivity on the digital strategy; Figure 5 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.

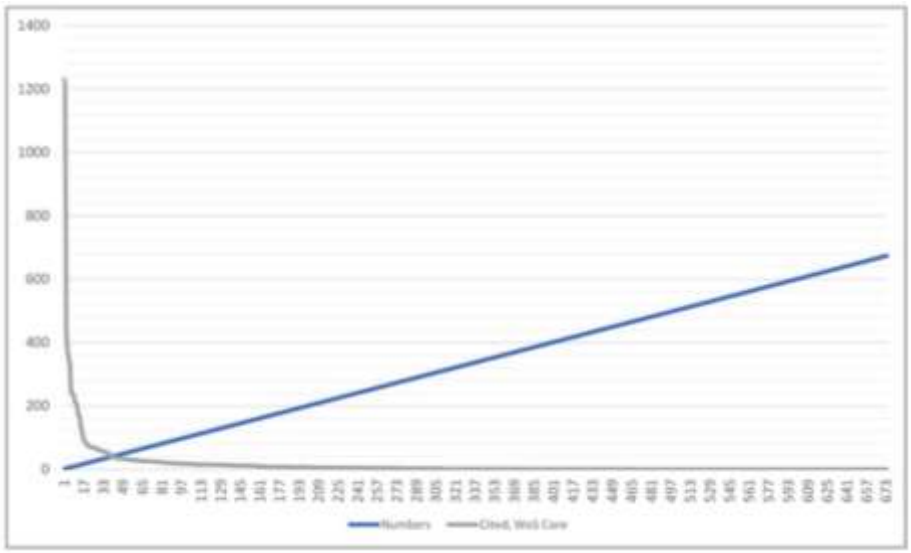

Figure 4. h-index estimation. The blue line is a time series and the gray line is a trend.

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.

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).

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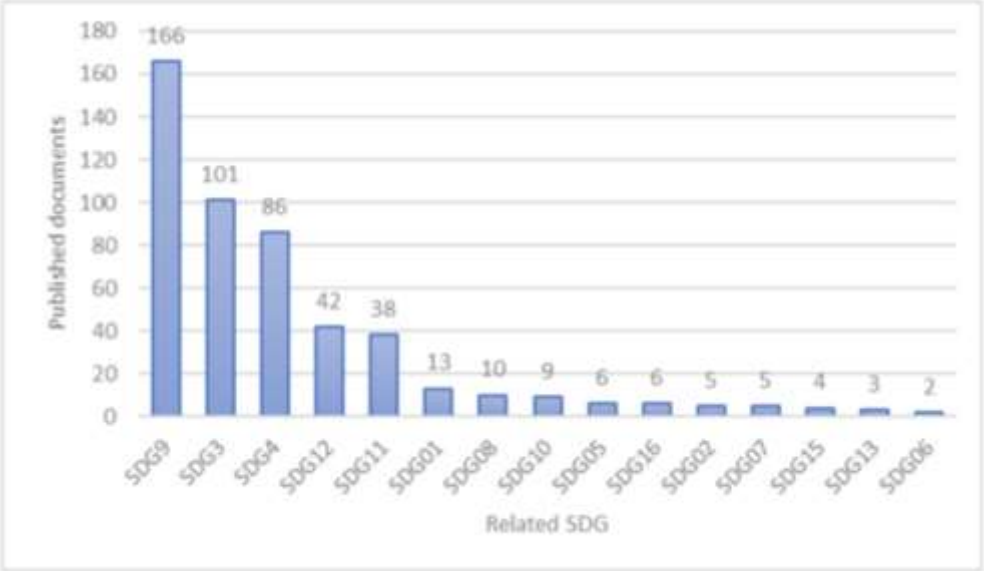

Figure 5. Association of WoS articles to the SDGs.

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
Yoo, Henfridsson, & Lyytinen [81]	Inf. Syst. Res.	1231	2010	Information Science & Library Science; Management	(SSCI)	9
Bharadwaj et al., [82]	MIS Q.	1212	2013	Computer Science, Information Systems; Information Science & Library Science; Management	(SCI-EXPANDED); (SSCI)	9
Horvath & Szabo [64]	Technol. Forecast. Soc. Chang.	435	2019	Business; Regional & Urban Planning	(SSCI)	9,12
Dwivedi et al., [83]	Int. J. Inf. Manage.	372	2020	Information Science & Library Science	(SSCI)	4
Raj et al., [84]	Int. J. Prod. Econ.	349	2020	Engineering, Industrial; Engineering, Manufacturing; Operations Research & Management Science	(SCI-EXPANDED); (SSCI)	9,12
Sebastian et al., [9]	MIS Q. Exec.	335	2017	Information Science & Library Science; Management	(SSCI)	9
Helbig, Gil-Garcia, & Ferro [29]	Gov. Inf. Q.	241	2009	Information Science & Library Science	(SSCI)	4
Yeow, Soh, & Hansen [45]	J. Strateg. Inf. Syst.	238	2018	Computer Science, Information Systems; Information Science & Library Science; Management	(SCI-EXPANDED); (SSCI)	9
Perboli, Musso, & Rosano [85]	IEEE Access	235	2018	Computer Science, Information Systems; Engineering, Electrical & Electronic; Telecommunications	(SCI-EXPANDED)	None
Bossetta [86]	Journal. Mass Commun. Q.	213	2018	Communication	(SSCI)	None

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Chanias, Myers, & Hess [35]	J. Strateg. Inf. Syst.	209	2019	Computer Science, Information Systems; Information Science & Library Science; Management	(SCI-EXPANDED); (SSCI)	9
Mithas, Tafti, & Mitchell [87]	MIS Q.	197	2013	Computer Science, Information Systems; Information Science & Library Science; Management	(SCI-EXPANDED); (SSCI)	9
Correani et al., [42]	Calif. Manage. Rev.	171	2020	Business; Management	(SSCI)	9
Eller et al., [28]	J. Bus. Res.	166	2020	Business	(SSCI)	9
Kreiss & McGregor, [88]	Polit. Commun.	131	2018	Communication; Political Science	(SSCI)	None
Barrett, Oborn, & Orlikowski, [89]	Inf. Syst. Res.	117	2016	Information Science & Library Science; Management	(SSCI)	9

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.

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.

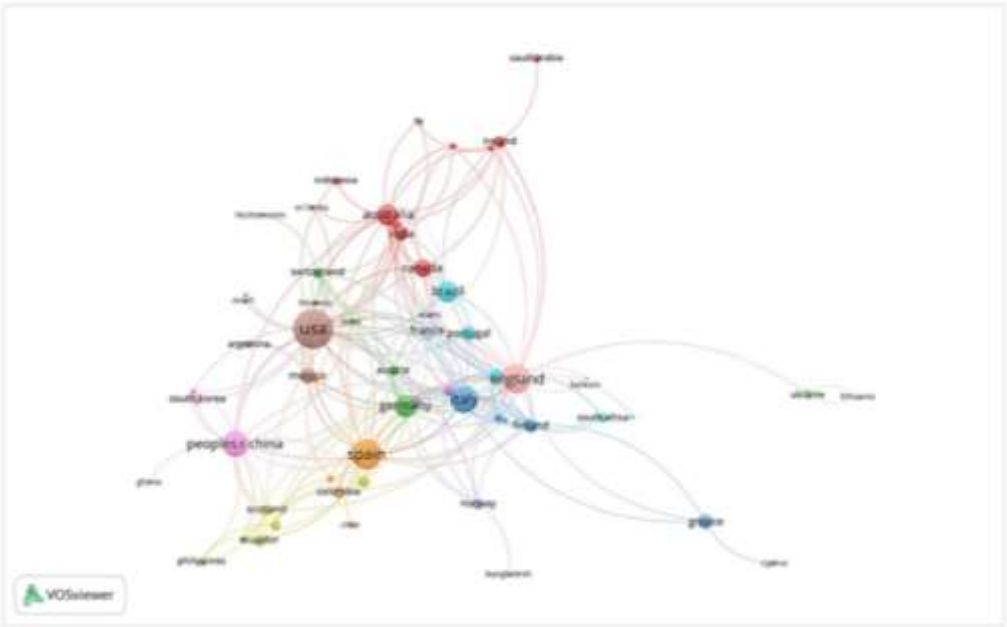

Figure 6. Co-authorship / countries graph.

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	Germay	39	902	16	5.79%
7	Brazil	36	150	8	5.34%

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8	Australia	35	465	20	5.19%
9	Canadá	25	563	11	3.71%
10	France	24	760	20	3.56%
11	Mexico	19	313	5	2.82%
12	Holand	17	116	13	2.52%
13	Grecia	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	Irland	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 connections with other countries it is England that is positioned in first place with 36 connections (the highest degree of centrality), followed by the United States with 30, and then with an average of 20 connections are countries of the European Union such as Spain, France and Italy and the particular case of Australia that also has the same degree of centrality of its 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.

In Table 5, the estimation of Bradford's areas is presented, indicating the distribution of articles according to the most important journals in 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	Categories WoS	Times Cited, WoS Core	Impact Factor	CiteScore	Keywords Plus
Sustainability	23	Green & Sustainable Science & Technology; Environmental Sciences; Environmental Studies	111	3.9	6.8	Models; Management; Technologies; Innovation; Systems; Performance; Capabilities; Adoption; Systems; Transformation
Technological Forecasting and Social Change	9	Business; Regional & Urban Planning	574	12.0	21.3	Digital Transformation; technology; Information; Innovation; Dynamic Capabilities; Performance; Strategy
Journal of Business Research	5	Business	337	11.3	20.3	Business; transformation; Information; Innovation;

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						Dynamic Capabilities; Performance; Management
International Journal of Production Economics	5	Engineering, Industrial; Engineering, Manufacturing; Operations Research & Management Science	361	12.0	21.4	Models; Management; Technologies; Innovation; Systems; Performance; Industry 4.0
IEEE Access	5	Computer Science, Information Systems; Engineering, Electrical & Electronic; Telecommunications	245	3.9	9.8	Systems; Adoption; Integration; Big Data; Process Integration
International Journal of Innovation Management	5	Management	30	2.1	3.7	Business; Transformation; Models; Innovation; Dynamic Capabilities; Performance; Strategy
Harvard Business Review	5	Business; Management	76	6.8	1.4	Digital Strategy; Business; Models
Information Communication & Society	5	Communication; Sociology	58	4.2	10.2	Communication; Intenet; Politics; Media
Journal Of Strategic Information Systems	4	Computer Science, Information Systems; Information Science & Library Science; Management	473	7.0	17.4	Business; Technology; Innovation; Information-Sistems Strategy; Capabilities; Performance; Management
Bmj Open	4	Medicine, General & Internal	9	2.9	3.4	Behavior; Risk; Validation; Innovation
Frontiers In Psychology	4	Psychology, Multidisciplinary	6	3.8	5.3	Innovation; Transformation; Capabilities
Heliyon	4	Multidisciplinary Sciences	6	4.0	4.5	Big data; management
MIS Quarterly	3	Computer Science, Information Systems; Information Science & Library Science; Management	1409	7.0	6.7	Information-Systems Research; Organizational Routines; Performance; Innovation; Technology; Modularity; Infrastructures; Capabilities
Information Systems Research	3	Information Science & Library Science; Management	1348	5.0	9.1	Software; Organizations; Capabilities; Architecture; Governance;

Table 6, according to Bradford's law, shows that the first 2 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, fostering the development of new ideas and technologies to maintain a competitive

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advantage in an increasingly digitized world. IEEE Access provides analysis on 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, where it 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 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 digital strategy. 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 has the largest number of articles published on this topic (23 articles), however, its citations are below 8% in relation to the journal with most cited, it is also established that there are 171 journals that have published only one (1) article on digital strategies.

Zipf's law presents the keyword plus graphs, where each node reflects these are linked in the same color grouping clusters of keywords according to the intensity of occurrences in the scientific articles, identifying four clusters (see Figure 8).

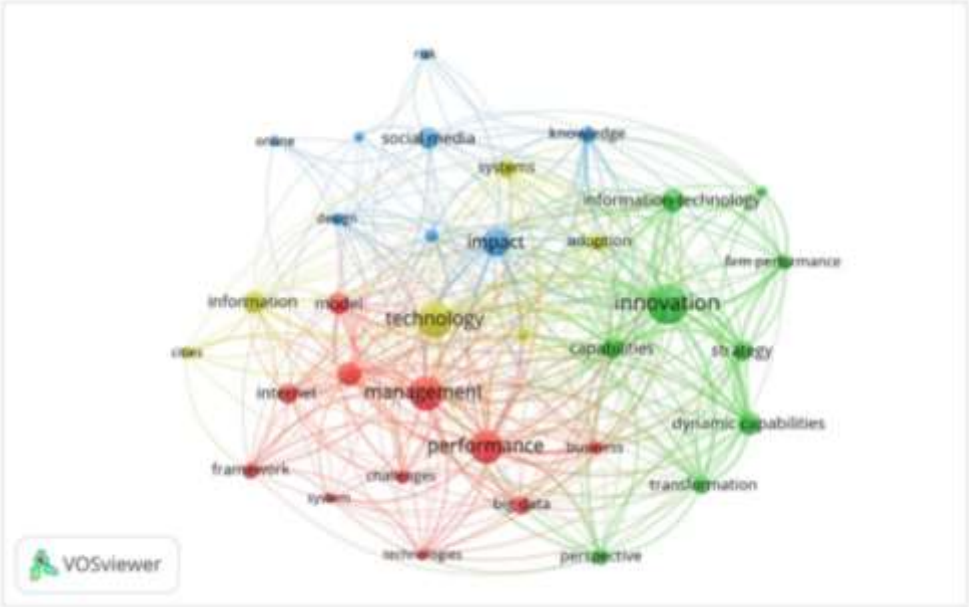

Figure 8. Keywords Plus co-occurrence graph. Nodes of the same color form a thematic cluster.

In accordance with Figure 8, the themes of the scientific production on digital strategy created groups of keywords. For the 674 papers, a total of 1094 Plus keywords were established. According to Zipf's law [73], 34 plus keywords were chosen, considering as estimator the square root of 1094 (=33.07) with the highest frequency of use, between 9 and 55 occurrences.

Thus, the set of Plus Keywords generated four clusters: 1) Use of digital strategies through PR in marketing. The blue, focused on impact, design, social networks, online, risk, knowledge (knowledge and perception of digital strategies); yellow, regarding technology, information, cities, adoption and systems (benefits of digital strategies and their adoption in their environment), the red, associated with management, performance, changes, big data, models, business, (responds to the management demanded by digital strategies); and the green, which has innovation, dynamic capabilities, transformation, strategies and perspective (establishing the new professional profile and

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the opportunity of digital strategy). It is important to highlight that the level of connection between the four clusters is significant. Resulting in the following lines of research: (1) Use of digital strategies through PR in marketing (2) Adoption of digital strategies and their benefits (3) The implications of digital transformation in business models (4) The challenges and opportunities of human resources in the digital strategy.

By means of the Figure 9, by means of the author's keywords, a search was made for the topics that have been generating trends in recent years, which indicates the direction of research. Using Zipf's law [73], 46 keywords were chosen considering as estimator the square root of 2253 (=47.46) with the highest frequency of use, between 6 and 30 occurrences.

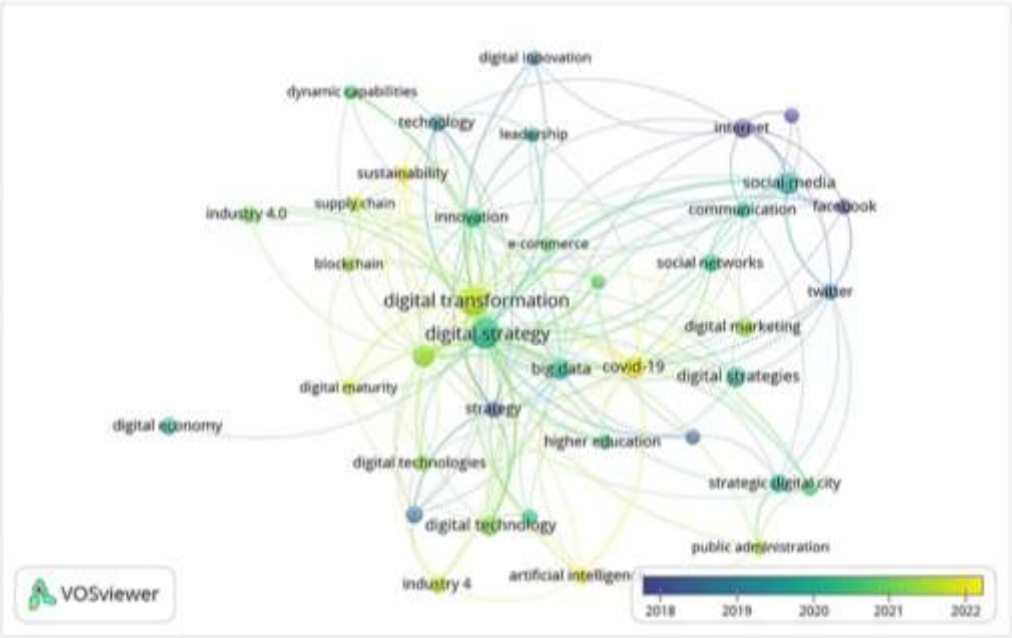

Figure 9. Author's keywords cooccurrence graph by year.

Through Figure 9 above, it is specified that the trend of recent years in research incorporates the themes of: artificial intelligence, covid-19, sustainability, digital maturity, and digital transformation. While the topics such as internet, social networks, Smart city, ICT, strategy and Twitter present on average a higher seniority with respect to the other author keywords. Within the areas that are more isolated within the (1) Digital transformation and its influence on Industry processes for its sustainability. (2) Challenges of Big Data in Higher Education. Research challenges are: (1) The impact of Covid-19 in the digital transformation of organizations. (2) The rise of AI in digital transformation (3) The implications of digital strategy in public administration.

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 [71] to indicate the exponential growth and critical mass of authors in this area [69,90,91]. This contrasts significantly with other studies using databases such as Scopus or Google Scholar [92,93] that cover fewer sources and have a smaller scope in certain fields of study compared to WOS. Using Zifp's Law, 34 keywords and 4 clusters were used, which provides a more precise approach compared to other works [93] that manage more keywords and clusters coinciding in 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 9 of them have more than 2 publications on digital strategy, which contrasts with other less rigorous research in the identification of prolific authors [90,92].

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Currently, the topics of innovation, performance, impact and dynamic capabilities are cutting-edge areas in digital transformation research. According to Ren et al. [94], in their study "Construction of Digital Transformation Capability of Manufacturing Enterprises: Qualitative Meta-Analysis Based on Current Research", these areas are receiving significant attention. On the other hand, terms such as digital strategy, digital transformation and digital maturity have established themselves as key concepts in the field, dominating contemporary research. This is reflected in the study by Schallmo et al., [95], entitled "The Art of Holistic Digitalisation: A Meta-View on Strategy, Transformation, Implementation, and Maturity", which provides a holistic view on digitalization, spanning from strategy to digital maturity, and highlights the importance of these areas in the digital transformation of organizations.

The analysis shows a trend towards national collaboration in scientific output, with notable exceptions in the United States and Italy [93]. The most prominent journals in research on digital transformation and COVID-19 in SMEs include the Journal of Business Research and Technological Forecasting and Social Change. Studies such as Rezende et al., [96] and Marino-Romero et al., [97] 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.

In terms of impact, research on Digital Strategy, with impact factors above 11 and CiteScore above 15, leads in number of citations and published articles. Authors such as Rezende, D.A. [98] who has conducted 14 research studies in this field, stand out in production, although some papers, such as Yoo et al. [81] have a high number of citations, but are limited to a single study.

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 & Nosella [99] on the influence of digital technologies on business models. Digital transformation in industrial processes for sustainability and the challenges of Big Data in higher education show less interaction with other key concepts analyzed. In addition, the digital transformation in industrial processes for sustainability and the challenges of Big Data in higher education show less interaction with other key concepts analyzed.

5. Conclusions

During the bibliometric study several findings were found. The first is to point out that the scientific production on this topic starts from 1991 to 2023, and has had an exponential growth from 2013, which demonstrates the relevance and research strength that the topic has awakened in the last 10 years.

Although it is true that digital strategy and digital transformation work simultaneously, they should not be confused, since the high scientific production of recent years has adopted both terms, reaffirming the contribution of this research. According to the bibliometric analysis provides a revealing insight into the trend over the years observed a significant increase in the growth of scientific production at an exponential rate ($R2 \approx 52\%$), which has allowed 2046 authors to build a substantial knowledge base on digital strategy.

In addition, the prolific authors who have made the most contributions on the topic, with 22 articles on digital strategy, with their article with the most citations being "Toward a model of the municipal evidence-based decision process in the strategic digital city context" [100] with 150 citations. It is important to note that all are researchers from Brazil, which evidences the poor contribution in works in the rest of the world regarding the topic of digital strategies. While the research with the most citations and reference in digital strategy is that of Yoo, Henfridsson, & Lyytinen [81] entitled "The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research" in which its focus is to describe the new architecture of systems and future organizational innovation, as it is currently being experienced.

At the same time, the resulting scientific production in the rest of the world is significant, since within the database there are up to 80 countries that have published at least one article on digital

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strategy. Those that have generated the most research are the United States, Spain, England, China and Germany. In the study presented by Ren et al. [94] their focus was only on China [94] and [95] focuses on a meta-vision of holistic digitization within organizations [95], so this research presents an opportunity to know the context and its research interest worldwide.

The study also highlights the topics on which digital strategy research revolves, where digital transformation, digital maturity and digitization are the most relevant for these studies, and how topics such as internet, social networks (Facebook, twitter) have been relegated by new trends such as industry 4.0, artificial intelligence and sustainability. And understanding the rapid growth of new technologies, there is no doubt that there is a lot of field to contribute on this topic.

Finally, as future lines of research, 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, the cost of adoption and non-adoption in the short and medium term.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org, Table S1: DS_DATA.xlsx.

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