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Evolution and trend of studies on e-government: mapping the area – from 1992 to 2018

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The topic of electronic government (e-gov) frequently appears in academic, professional, and political circles. Consequently, the number of papers published on the subject has increased. This text analyzes the evolution and trend of studies on electronic government to identify scientific production based on the analysis of scientific articles published in journals, indexed in the Web of Science (WoS) from 1992 to 2018. We analyzed 1.516 scientific articles published in journals using the SciMAT software. We identified patterns such as frequency of studies per year, main journals and authors in the field, and the most cited works. Word citation analysis was also carried out, which made it possible to highlight the main research themes by period and the evolution of the field of study. The results indicate an increase in publications about e-gov and the development of different analysis fronts. Social media, technology acceptance model (TAM), transparency, acceptance, and information system are the main themes that indicate trends for future studies focused on e-gov.

Keywords: e-government; cocitation analysis; conceptual framework.

Evolução e tendência de estudos sobre governo eletrônico: mapeamento da área – de 1992 a 2018

O tema governo eletrônico (e-gov) aparece com frequência nos círculos acadêmicos, profissionais e políticos; consequentemente, o número de trabalhos publicados sobre a temática tem se ampliado. Nesse contexto, com o presente trabalho pretende-se analisar a evolução e a tendência dos estudos na área de governo eletrônico, com o objetivo de identificar a produção científica desta, por meio da análise de artigos científicos publicados em periódicos, indexados na base de dados Web of Science (WoS) de 1992 a 2018. Para tanto, foram analisados 1.516 artigos científicos publicados em periódicos por meio do *software* SciMAT. As análises possibilitaram identificar padrões como: frequência de estudos por ano, principais periódicos e autores no campo, assim como os trabalhos mais citados nos artigos constantes da amostra aqui considerada. Além disso, foi realizada uma análise de cocitação de palavras, que permitiu evidenciar os principais temas de pesquisa por período, bem como a evolução do campo de estudo. Os resultados indicam um crescimento das publicações sobre e-gov e o desenvolvimento de diferentes frentes de análise. Os principais temas que indicam tendências para estudos futuros voltados ao e-gov são: *social media*, *technology acceptance model* (TAM), *transparency, acceptance* e *information system*.

Palavras-chave: e-government; análise de cocitação; estrutura conceitual.

Evolución y tendencia de los estudios sobre gobierno electrónico: mapeo del área – de 1992 a 2018

El tema del gobierno electrónico (e-gov) aparece con frecuencia en los círculos académicos, profesionales y políticos y, como consecuencia, el número de artículos sobre el tema ha ido en aumento. En este sentido, este texto se propone analizar la evolución y tendencia de los estudios en el área de gobierno electrónico, con el objetivo de identificar la producción científica en esta área, a partir del análisis de artículos científicos publicados en revistas indexadas en la Web de Science (WoS) de 1992 a 2018. Para ello, se analizaron 1.516 artículos científicos publicados en revistas utilizando el *software* SciMAT. Los análisis permitieron identificar patrones como frecuencia de estudios por año, principales revistas y autores en el campo, así como los trabajos más citados en los artículos de la muestra aquí considerada. Además, se realizó un análisis de cocitación de palabras, que permitió destacar los principales temas de investigación por período, así como la evolución del campo de estudio. Los resultados indican un aumento de publicaciones sobre e-gov y el desarrollo de diferentes frentes de análisis. Las redes sociales, el modelo de aceptación de la tecnología, la transparencia, la aceptación y el sistema de información son los principales temas que presentan tendencias para futuros estudios enfocados en e-gov.

Palabras clave: gobierno electrónico; análisis de cocitación; marco conceptual.

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1. INTRODUCTION

Over the last decades, governments around the world have carried out different reforms (Siddiquee, 2016), seeking innovative alternatives to change and improve operations and models for providing public services (Klievink, Bharosa & Tan, 2016). Among potential alternatives is the adoption of new information and communication technologies (ICTs), focused on internet technologies (Sun, Ku & Shih, 2015). This is the electronic government (e-gov), understood as the use and study of internet-based ICTs in the public sector (Sundberg, 2019).

E-gov is seen as a strategy for reforming public governance (Fan & Yang, 2015), as it offers real prospects of effective changes in government practices (Siddiquee, 2016). Unlike the provision of a traditional service (off-line), where government officials and citizens communicate face-to-face, electronic government services are not limited by distance or operating hours, and offer convenient answers to citizens' demands (Fan & Yang, 2015; Kumar, Sachan & Mukherjee, 2017). This is because e-gov can provide quality services to citizens when and where they require it (Munyoka & Maharaj, 2018), with access 7 days a week, 24 hours a day. This strategy allows providing more cost-effective services and greater transparency of government actions (Ali, Mehmood, Majeed, Muhammad & Khan, 2019), also enabling increased management efficiency and synergy between the different government fronts (Pieterson & Ebbers, 2008).

Considering that the study area on e-gov is wide and multidisciplinary, involving fields such as public management and information systems, Homburg (2018) eventually noticed the existence of polarized research that do not include other areas of knowledge that may be related, leading to the development of theoretical backgrounds in a more or less isolated way. In addition, Wirtz and Daiser (2018) argued that available literature reviews still did not provide a comprehensive view of the main research flows and directions of e-gov, and highlighted the need to develop studies to cover the main related topics, since they considered the field as diffuse.

Conducting literature reviews enables developing studies driven by the knowledge of previous articles, which provides building a basis for future research, deepening underexplored areas, and highlighting promising directions for study (Webster & Watson, 2002). Rodríguez-Bolivar, Alcaide-Muñoz and López-Hernández (2016) observe that bibliometric studies are an important way to analyze the accumulated knowledge on a given area, as they integrate contributions and provide a critical view of papers developed in a given field of study, thus enhancing the understanding on the area.

Due to the importance of the e-gov theme for the Brazilian public sector, it is relevant to find out studies in this area. Assuming that the knowledge of a particular field of study can be identified through the analysis of its scientific publications, we developed the basic question for this study: what is the profile and evolution of the study field on e-government, from 1992 to 2018?

In order to answer this question, this paper focuses on the scientific production in the field of e-government, through the analysis of scientific articles published in journals indexed in the Web of Science (WoS) database, from 1992 to 2018. Therefore, we intended to identify the evolution and trend of this area, in addition to presenting a future research agenda.

To achieve this goal, we carried out bibliometric and keyword co-citation analyses, during the period of 26 years (1992-2018). Then, due to their wide recurrence in the theoretical framework used, we entered the keywords 'electronic government', 'e-government', 'e-gov', and 'digital government' in the multidisciplinary WoS database, developed by Thomson Scientific Institute for Science Information (ISI).

The results of the paper enable confirming and complementing previous findings (Barbosa, 2017; Cunha, Coelho & Przeybilovicz, 2017; Dias, 2019; Macadar, Luciano & Lopes, 2017, among others). This study goes further, by making comparisons by sub-periods, showing the gaps, as suggested by Przeybilovicz, Cunha and Coelho (2015). Furthermore, the analysis of word co-citation is a technique little used in the context of e-gov, which distinguishes this article from previous ones.

2. ELECTRONIC GOVERNMENT (E-GOV)

E-gov is recognized as a key element in the process of restructuring the public sector (Pardo, Nam & Burke, 2012), being an important component of its modernization agenda (N. C. M. Q. F. Ferreira, F. A. F. Ferreira, Marques, Ilander & Cipi, 2015; Szkuta, Pizzicannella & Osimo, 2014). We can confirm this through the growing volume of research on the subject (Arduini & Zanfei, 2014), which initially focused on technological and operational issues, and has recently migrated to broader issues, involving institutional and political aspects (Savoldelli, Codagnone & Misuraca, 2014).

Despite its growing popularity in academic, professional, and political circles, e-gov does not have a universal definition yet, only a general understanding that relates it to electronic delivery of information and government services (Siddiquee, 2016). In this article, we understand e-gov as the widespread and intensive application of ICTs in government processes, in order to enable and improve the efficiency and effectiveness of transactions, communications, and the provision of public services for citizens, employees, organizations, and agencies.

Therefore, there is a general belief that e-gov adds value by promoting positive changes. These aim to increase government access, support public and political accountability, expand citizens' participation, improve inter-organizational cooperation and relationship, as well as provide interaction between government and society (citizens, organizations) for a more effective, accessible, and responsive provision of public services to population's needs (Bekkers & Homburg, 2005; Gil-García & Pardo, 2005; United Nations [UN], 2016). Different from providing a traditional (off-line) service, where government officials and citizens communicate face-to-face, e-government services are not limited by distance and operating hours, offering convenient answers to citizen demands (Fan & Yang, 2015; Kumar et al., 2017).

As government services are offered through automated information systems, as opposed to direct human intervention (traditional offline system), there is an important increase in the productivity of service delivery (Savona & Steinmueller, 2013). E-gov systems affect the improvement of public services and the effectiveness of programs and public policies, especially through their ability to share and integrate information among multiple governmental and non-governmental organizations (Pardo et al., 2012).

2.1. Bibliometric Studies on e-gov

Brazilian studies (Coelho, Przeybilovicz, Cunha & Echternacht, 2016; Cunha et al., 2017; Macadar et al., 2017) and international (Alcaide-Muñoz, Rodríguez-Bolivar, Cobo & Herrera-Viedma, 2016; Dias, 2019; Rodríguez-Bolivar et al., 2016) sought to analyze the scientific production in the thematic area of e-gov. Dias (2019) did a bibliometric study within the Ibero-American community, and examined 1,129 documents present in the Scopus database, published between 2003 and 2017. The analyses included authors, institutions, and countries with higher productivity; most relevant research areas; specific research topics; and standards for international cooperation.

Barbosa (2017) explored, through bibliometric analysis, the Brazilian scientific production in 20 journals published between 2005 and 2015. Cunha et al. (2017), in a literature review of Brazilian and international publications on e-gov, investigated which themes, theories, and methodologies the authors used, and the configuration of collaboration networks between authors and institutions. Macadar et al. (2017) discussed, through a literature review, the use of theories in the e-gov research field, based on 96 articles published between 2003 and 2014 in Brazilian journals.

In Brazilian and international publications, Coelho et al. (2016) identified networks and structures for collaboration between authors, countries, and institutions. Previously, Przeybilovicz et al. (2015) detailed how the field of studies on e-gov was structured in Brazil, using bibliometric and sociometric research, based on 124 articles published in conference proceedings and journals between 2007 and 2012. They presented the annual number of papers and the journals that published them; their conceptual and substantive domain; methodological approaches; and cooperation networks between authors and institutions.

This study differs from those mentioned above, because it considers a longer period of time and a larger number of articles, published in high impact journals. It also presents results regarding the analysis of keywords' co-citation, still little used in this research context.

3. BIBLIOMETRIC STUDIES AND SOFTWARE FOR ANALYSIS

Different ways of assessing scientific knowledge and measuring information flows are present in the literature. Among them, bibliometrics (Francisco, 2011), a set of methods used to analyze academic literature quantitatively (Bellis, 2009). In bibliometric research, Science Mapping allows identifying interrelated groups of publications, authors, or journals (Eck & Waltman, 2017), enabling scientometric studies focused on the co-citation analysis of authors, documents, and words, among other variations. By using their techniques, we can obtain charts or networks, hierarchies, temporal structures, geospatial views, as well as coordinated views of various types (Chen, 2017).

In co-citation analysis, keywords describe the content of a document and, thus, can measure the existing similarity between pairs of documents (Hoz-Correa & Mu, 2018). Maps built with word co-citation analysis, as in the present study, are a tool for predicting future trends (Garfield, 1994),

since the objective of this technique is to interconnect the most significant concepts (Muñoz-Leiva, Viedma-del-Jesús, Sánchez-Fernández & López-Herrera, 2012).

For Garfield (1994) and Muñoz-Leiva et al. (2012), these maps facilitate new understandings on the structure of the study field, highlighting the division of a given area in several subareas and the relationship between them. Still, for these authors, longitudinal maps show advances in scientific knowledge over time, in addition to revealing emerging trends. A longitudinal study, over consecutive periods, detects the subfields of study that are most prominent, productive, and high-impact (Gutiérrez-Salcedo, Martínez, Moral-Munoz, Herrera-Viedma & Cobo, 2018).

To carry out bibliometric analyses using science mapping, we chose, among several software available on internet, the SciMAT (Cobo, López-Herrera, Herrera-Viedma & Herrera, 2012), which is useful in studies on different areas, including e-gov (Alcaide-Muñoz et al., 2016). From data pre-processing to the visualization of results in the analysis flow (Gutiérrez-Salcedo et al., 2018), SciMAT met the objective of this paper. It analyzed the progress of the specific research topic, e-gov, as well as tracked emerging sub-topics, allowing a temporal vision of the evolution and continuity of the intellectual basis of this study field, through the analysis of words' co-citation (Rodríguez-Bolivar, Alcaide-Muñoz & Cobo, 2018).

After these considerations, we present the process of sample definition.

4. SURVEY OF SCIENTIFIC KNOWLEDGE ON E-GOV

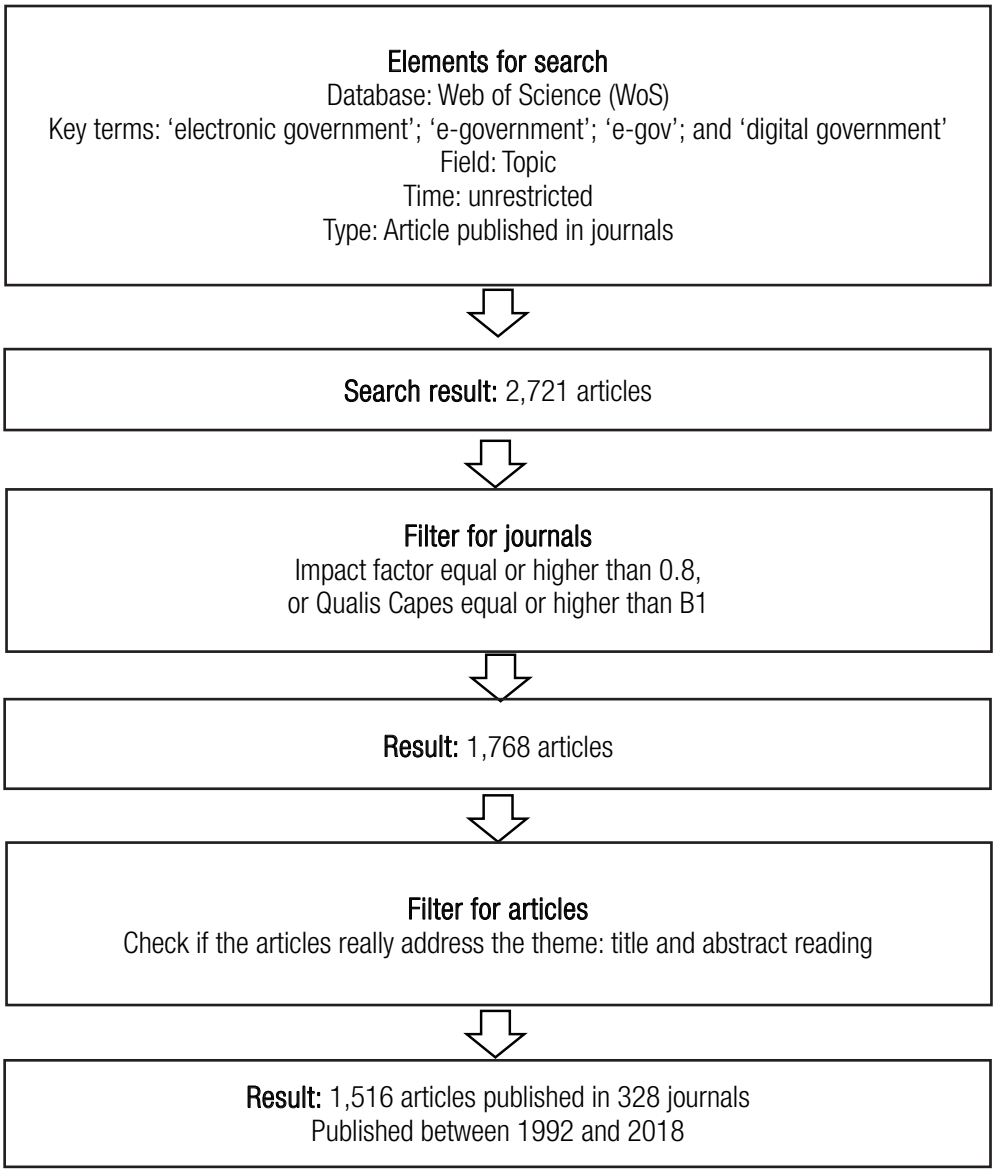
To survey scientific knowledge on e-gov, we looked for scientific articles in the ISI-WoS database, in early December 2018. This base is commonly used in this type of search (Chen, 2017), and covers different areas of study related to e-gov, such as management, information science, and public administration (Khiste & Amanullah, 2017). In addition, it allows the collection of bibliometric metadata of publications, such as quoted references, year of publication, authors, keywords, and abstracts, enabling faster and more accurate quantitative analyses (Haunschild, Hug, Brändle & Bornmann, 2018).

After defining the database, we chose the keywords 'electronic government', 'e-government', 'e-gov', and 'digital government', as did Rodríguez-Bolivar et al. (2016) and Dias (2019), whose papers were published in high-impact journals, with objectives similar to ours; these authors sought to identify trends in research topics on e-gov and applied methodologies. We considered all studies, regardless of language or publication date. However, we did not include in the analysis papers presented in scientific events, communication summaries, letter from the editor, professional articles, books, and book reviews. With these criteria, the result was the selection of 2,721 articles, published in 819 journals.

Then, we applied the Qualis Capes filters, from B1 upwards and an impact factor equal or higher than 0.8 in the Journal Citation Reports (JCR). This criterion is based on the latest assessment of CAPES journals (2017) for the Area of Public and Business Administration, Accounting, and Tourism, where journals with an impact factor equal or higher than 0.7 in JCR were rated B1 or above. Thus, we tried to give this study a higher weight for scientific recognition. At this stage, the sample dropped to 1,768 articles, published in 357 journals, and then changed to 1,516 papers, published in 328 journals,

Brazilian and international, after we read and analyzed their titles and abstracts and removed those duplicate or not related to the study theme.

FIGURE 1 PROCESS FOR SAMPLE DEFINITION: SEARCH ELEMENTS, FILTERS AND RESULTS



Source: Elaborated by the authors.

Having determined the sample, we inserted the metadata of the publications available on the WoS base in SciMAT software (Cobo et al., 2012), as we describe in the next section.

4.1 Adequacy of the database for analysis: pre-processing

Once we defined the sample of articles, we carried out a sequence of activities for data pre-processing (Rodríguez-Bolivar et al., 2018), such as finding in the database keywords present in the articles (4,908 words and terms), removing the duplicates (ex.: written with capital letters or not – trust and TRUST), and adjusting typing errors (ex.: e-govenment). Next, we created word groups for statistical analysis.

We divided the analyzed time interval, from 1992 to 2018, in five periods, as shown in Table 1. We found no studies in 1993, 1995, and 2000. The definition of the periods of analysis occurred after several tests with the software; this configuration allowed creating a cluster in the first period (1992 to 1999), when there was a low number of articles. Between periods 2 and 4, we defined sets of 5 years, while period 5 added the final years included in the sample.

BOX 1 DIVISION OF PERIODS FOR TEMPORAL ANALYSIS

Number	Period	Number of years	Number of articles
1	1992 a 1999	6	15
2	2001 a 2005	5	155
3	2006 a 2010	5	331
4	2011 a 2015	5	542
5	2016 a 2018	3	473

Source: Elaborated by the authors.

The following section presents the stage of data analysis.

5. DATA ANALYSIS

From the set of scientific documents analyzed, SciMAT generated a knowledge base where relationships between the different entities (authors, keywords, journals, and references, among others) were stored, and keywords formed a descriptive term of the analysis. In order to generate a longitudinal structure for examining the field of study (Alcaide-Muñoz, Rodríguez-Bolivar, Cobo & Herrera-Viedma, 2017, p. 547), we took the following steps:

- Grouping of keyword networks, strongly related to each other and corresponding to research problems of interest to researchers;
- View of themes and thematic networks - through strategic diagrams that show the clusters detected in each period of analysis, in a two-dimensional space - and their categorization according to density and centrality measures;
- Creation of a map that shows the temporal evolution of research topics.

Cluster analysis grouped elements automatically connected by the SciMAT software; each cluster received a name related to the most frequent word or theme.

To facilitate understanding the results, we must define the analysis measures used, responsible for showing the contribution of different clusters to the structuring of the general network (Alcaide-Muñoz et al., 2017; Callon, Courtial & Laville, 1991):

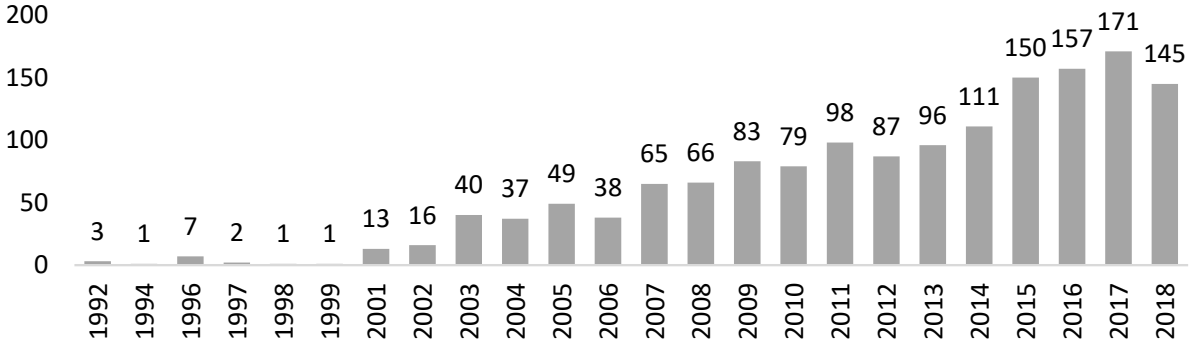
- Centrality – measures the degree of interaction between two networks, and is a measure of the importance of a topic within the whole context of a research field. The greater the number and strength of these relationships, the more the cluster will show a set of research problems that the scientific or technological community consider crucial.
- Density – measures the internal strength of a network, or the measure of a theme's development. The stronger these links, the more the research problems corresponding to the cluster form a coherent and integrated whole. Density provides a good representation of the cluster's ability to sustain and develop over time in the field under consideration.

Having made these considerations, we present and analyze the results.

5.1 Aspects related to the publications

This section highlights the results found in the analyses. We observe in Graph 1 that since 1992 there was a constant increase in the number of publications related to the e-gov, except in 2018, which may relate to the period when we collected data (early December 2018).

GRAPH 1 ABSOLUTE FREQUENCY OF ARTICLES BY YEAR OF PUBLICATION



Source: Elaborated by the authors.

Of the 328 international and national journals selected, 11 (3.3% of the total) published 20 articles or more, and the majority (56.1%) published just one article. Among the journals with more publications, Government Information Quarterly stands out, with 346 articles (23% of the sample), as shown in Box 2.

BOX 2 JOURNALS, NUMBER OF PUBLISHED ARTICLES, AND AREA CATALOGED IN WOS BASE

Journals	N. of Articles	F %
Government Information Quarterly	346	23%
Transforming Government - People Process and Policy	50	3%
International Journal of Public Administration in the Digital Age	40	3%
International Journal of Electronic Government Research	40	3%
Social Science Computer Review	38	3%
International Journal of Information Management	32	2%
Public Administration Review	28	2%
Public Management Review	25	2%
Information Technology for Development	23	2%
Information Development	22	1%

Note: F % - Relative frequency.
Source: Elaborated by the authors.

Among the 2,758 authors, most of them published only one article. Those who published more were Vishanth Weerakkody (23 papers, University of Bradford/UK), and Christopher G. Reddick (21 papers, University of Texas/|United States), shown in Box 3.

BOX 3 AUTHORS THAT PUBLISHED 10 OR MORE ARTICLES ON THE TOPIC

Author's name	F.	Author's name	F.
Weerakkody, V.	23	Rana, N. P.	12
Reddick, C. G.	21	Gil-García, J. R.	12
Dwivedi, Y. K.	19	Rodríguez-Bolívar, M. P.	11
Janssen, M.	19	Royo, S.	10
Jaeger, P. T.	19	Bertot, J. C.	10
Irani, Z.	13	Pan, S. L.	10

Note: F. Absolute frequency.
Source: Elaborated by the authors.

Box 4 shows the 10 articles in the sample that were most cited.

BOX 4 MOST CITED WORKS IN THE SAMPLE

Works reference	N. of Citations
Layne, K., & Lee, J. (2001). Developing fully functional E-government: A four stage model. *Government Information Quarterly*, *18*(2), 122-136.	205
Moon, M. J. (2002). The Evolution of E-Government among Municipalities: Rhetoric or Reality? *Public Administration Review*, *62*(4), 424-433.	179
West, D. M. (2004). E-Government and the Transformation of Service Delivery and Citizen Attitudes. *Public Administration Review*, *64*(1), 15-27.	163
Carter, L., & Bélanger, F. (2005). The utilization of e-government services: Citizen trust, innovation and acceptance factors. *Information Systems Journal*, *15*(1), 5-25.	155
Fountain, J. (2001). *Building the virtual state: information technology and institutional change*. Washington, DC: Brookings Institution Press.	133
Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319-340.	132
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.	123
Ho, A. T. K., & Ni, A. Y. (2004). Explaining the adoption of e-government features: A case study of Iowa County treasurers' offices. *The American Review of Public Administration*, *34*(2), 164-180.	117
Welch, E. W., Hinnant, C. C., & Moon, M. J. (2005). Linking citizen satisfaction with e-government and trust in government. *Journal of Public Administration Research and Theory*, *15*(3), 371-391.	108
Heeks, R., & Bailur, S. (2007). Analyzing e-government research: Perspectives, philosophies, theories, methods, and practice. *Government Information Quarterly*, *24*(2), 243-265.	107

Source: Elaborated by the authors.

Regarding these results, we can see the plurality of areas that study e-gov, and are considered or used to analyze it, strengthening the papers by Dias (2019) and Rodríguez-Bolívar et al. (2016).

5.2 Analysis of research topics: word co-citation

After examining the publications, we present the results regarding the most explored research topics in the 1,516 selected articles. The analysis of keywords (co-word analysis) enabled the temporal examination of themes' evolution, with the articles divided into the five periods presented in Box 1.

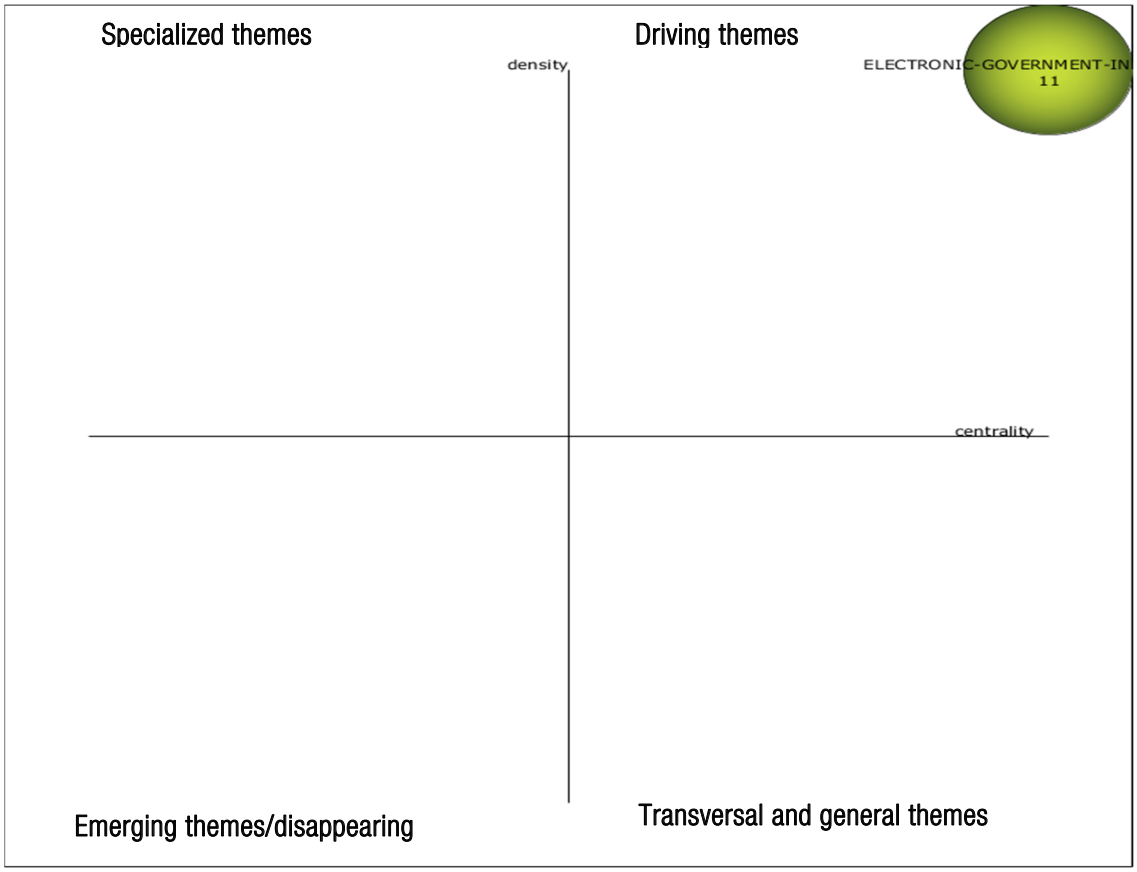
Strategic diagrams, or strategic maps, allow us to view the research field as a set of themes, mapped and classified in four groups, in terms of density and centrality:

(I) driving cluster (upper right quadrant, with high density and strong centrality; 'driving themes');
(II) highly developed and isolated clusters (upper left quadrant, with marginal relevance for the research field; 'specialized themes');
(III) declining or emerging clusters (lower left quadrant, with low density and low centrality; 'emerging or disappearing themes'); and
(IV) basic and transversal clusters (lower right quadrant, with important but undeveloped themes; 'transversal and general themes') (Alcaide-Muñoz et al., 2017; Cobo et al., 2012).

The sphere represents a cluster of words (or themes), and the name of each one is related to the most recurring word or theme. The volume of the spheres corresponds to the number of associated articles – the larger the sphere, the greater the number of articles that mentioned that word as a keyword (Cobo, López-Herrera, Herrera-Viedma & Herrera, 2011; Cobo et al., 2012)

In the strategic map for the period 1992-1999 (Figure 2), the electronic government information cluster appears as a driving theme, which relates to accessibility, internet, libraries, and information.

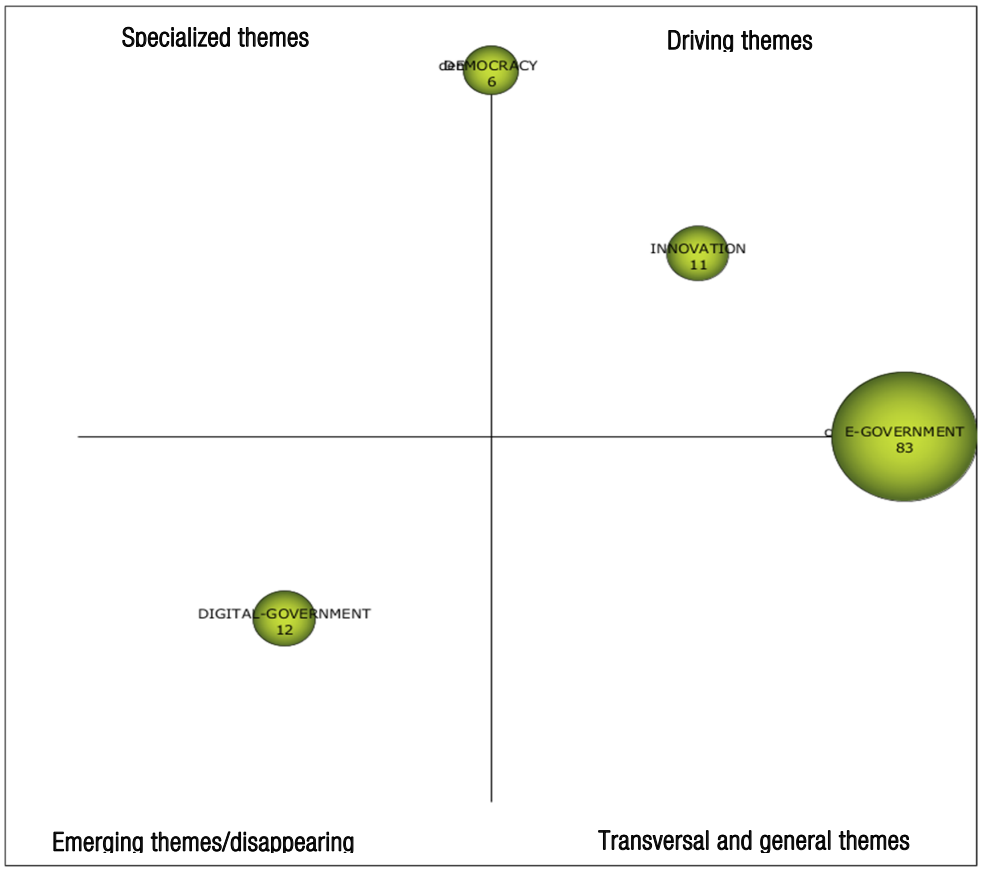
FIGURE 2 STRATEGIC MAPS FOR THE PERIOD 1992-1999



Source: Elaborated by the authors.

In the strategic map for the period 2001-2005 (Figure 3), there are the innovation, democracy, and e-government clusters, of which only the first fits as a driving theme, relating to the words model, technology, local government, services, public administration, and usability. The electronic government information cluster ceased to appear in this period, giving rise to the digital government and e-government clusters, which, although used without distinction, have different approaches. The first, located in the lower left quadrant (emerging or disappearing themes), is linked to words such as interoperability, security, data, information sharing, information systems, accessibility and collaboration, generally referring to technical and software aspects. The e-government cluster is associated with terms such as e-services, internet, citizens, website, ICTs, information, and policy.

FIGURE 3 STRATEGIC MAP FOR THE PERIOD 2001-2005



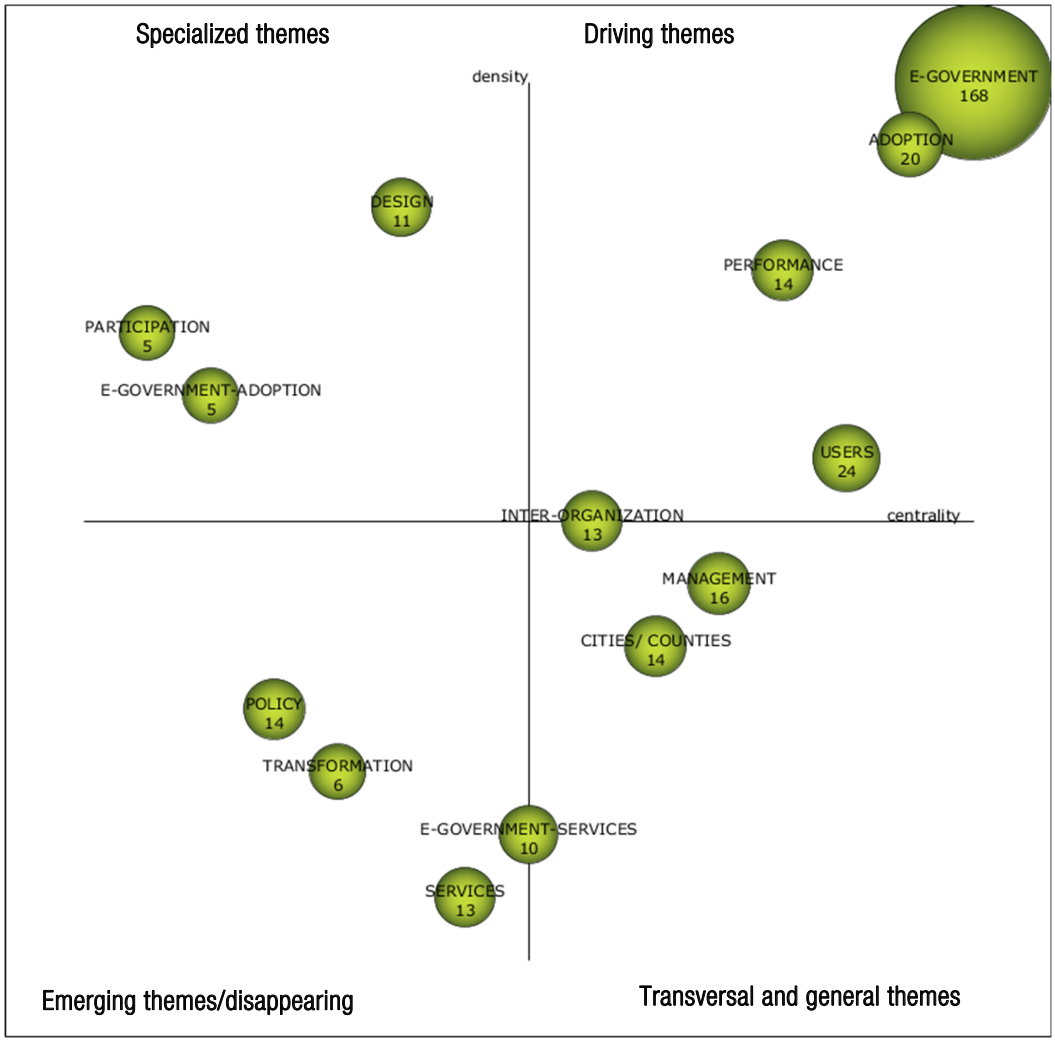
Source: Elaborated by the authors.

In the strategic map for the period 2006 to 2010 (Figure 4), there are 14 clusters, of which e-government, adoption, performance, and users are driving clusters. Among them, the e-government cluster, due to the sphere volume and its location at the extreme of the upper right quadrant, takes the first position as a driving theme, linked to terms such as model, internet, citizens, ICTs, information, public administration, and technology, repeating some that appeared in the previous period. The adoption cluster, stemming from the innovation cluster (period 2001-2005), is associated with

the terms determinants, acceptance, risks, age, unified theory of acceptance and use of technology (UTAUT), innovation, and trust. The terms experience, satisfaction, collective action, leadership, projects, quality and systems connect to the performance cluster. Finally, the terms e-services, usability, expectation, commerce, customer and/or consumer, website, and planned behavior are associated with the users cluster, also originating from the innovation cluster (period 2001-2005). As specialized topics, emerged, in this period, the clusters design, participation, and e-government adoption, while policy, transformation, and services are themes that are emerging or disappearing (lower left quadrant).

The clusters democracy, innovation, and digital government, present in the period 2001-2005, ceased to appear between 2006 and 2010. The democracy cluster shares elements with the clusters design and cities/counties; the cluster innovation shares elements with the clusters adoption, users, e-government services, and cities/counties, while the digital government cluster relates to inter-organization, service, and design, showing the existing relationships between these clusters and between periods.

FIGURE 4 STRATEGIC MAP FOR THE PERIOD 2006-2010

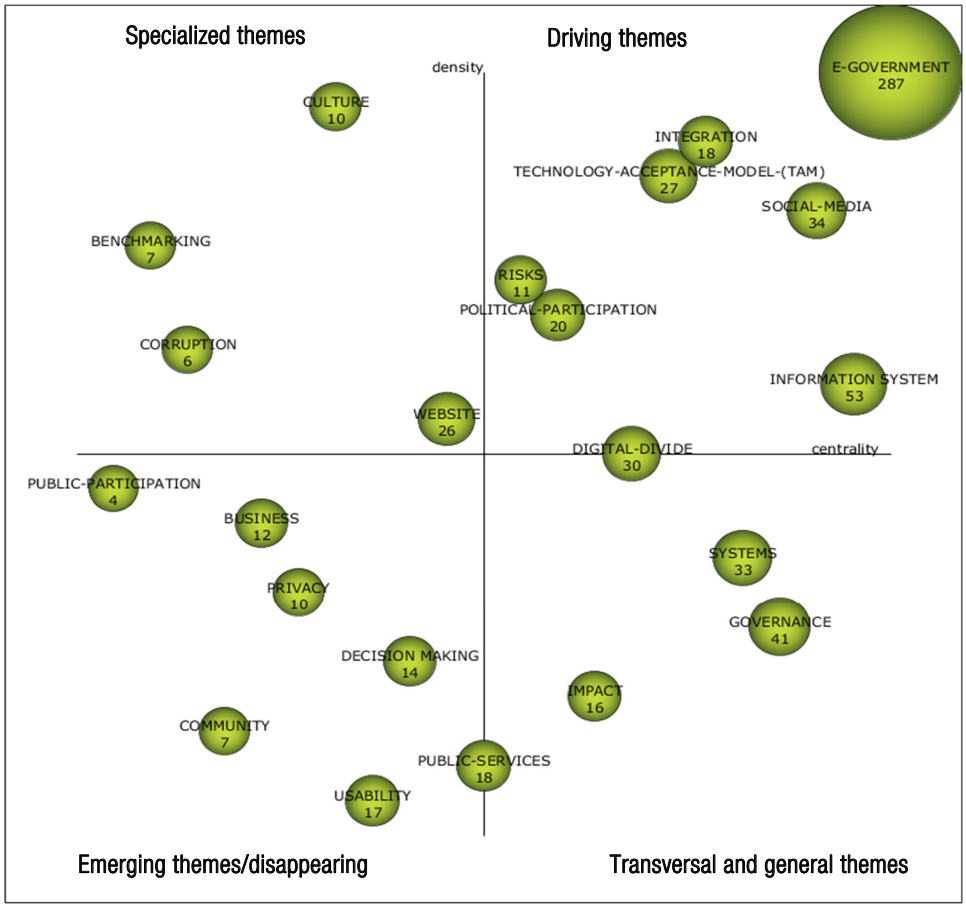


Source: Elaborated by the authors.

In the fourth strategic map, for the period 2011-2015 (Figure 5), the following themes appear as driving themes: e-government, integration, technology acceptance model (TAM), social media, risks, political participation, and information system. In this period, e-government related to terms such as ICTs, internet, services, trust, adoption, public management, and model, while the term integration links to benefits, digital government, information sharing, success, software, organizations, and performance. Technology acceptance model (TAM) relates to users, individual, motivation, expectations, learning, perceived ease, and UTAUT. Risks relates to determinants, social networks, projects, government, costs, opportunities and success of information systems; political participation is associated with the terms citizen participation, e-participation, e-governance, society, voting, citizens and internet use, while information system is associated with strategy, technology, developing countries, design, enterprise-systems, implementation, and management. Finally, social media is associated with civilian, transparency, participation, engagement, web-2.0, Twitter, and Facebook.

As specialized themes, we see culture, benchmarking, website, and corruption. Emerging or disappearing themes were public participation, business, privacy, decision-making, community, and usability (lower left quadrant). Except for the e-government cluster, all others present in period 3 (2006 -2010) no longer existed in period 4.

FIGURE 5 STRATEGIC MAP FOR THE PERIOD 2011-2015



Source: Elaborated by the authors.

The fifth strategic map for the 2016-2018 period (Figure 6) shows seven clusters considered as drivers: technology acceptance model (TAM), social media, transparency, acceptance, information system, risks, and challenges. TAM, a theoretical framework often used in research in the area of Information Systems, associates with terms like users, trust, ease of use, adoption, e-gov services, planned behavior, and commerce. Social media, in turn, is linked to local government, e-gov, web-2.0, participation, engagement, Twitter, and Facebook, while transparency is linked to municipalities, local government, political trust, accountability, governance, open government, and perspectives. Acceptance is linked to intention, attitudes, behavior, UTAUT, quality, systems, and model. Information system relates to citizen satisfaction, cutbacks, identity, management, public administration, projects, and technology; while risks are linked to topics such as extension, fiscal and/or taxes, success, e-gov adoption, determinants, satisfaction, and developing countries (a little different from the terms listed in the previous period). Finally, challenges are associated with e-governance, environment, big-data, capacities, geographic aspects, organizations, and the Geographic Information System (GIS).

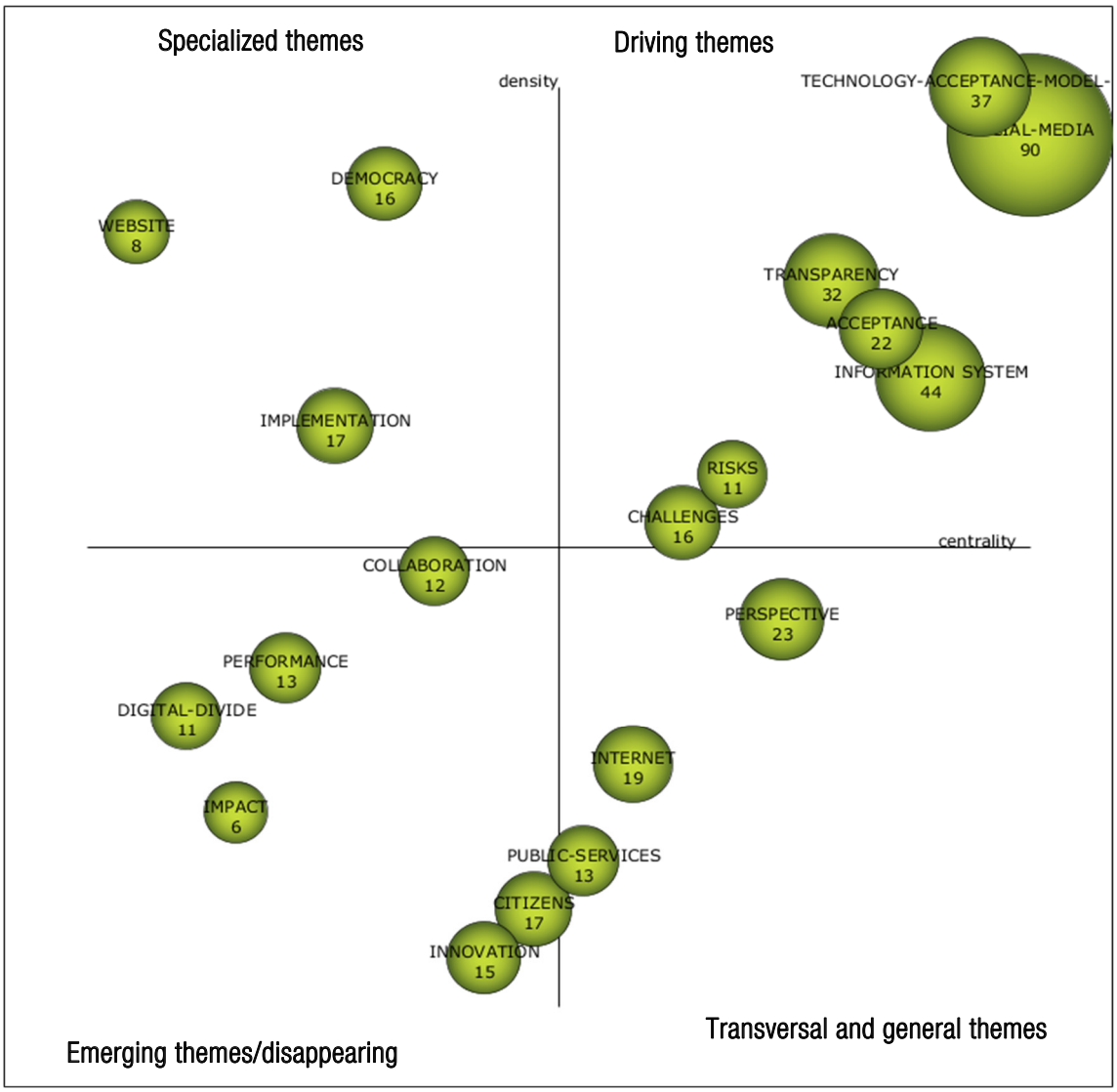
Democracy, website, and implementation appear as specialized themes; perspective, internet, and public services as transversal themes that need to be further developed. Collaboration, performance, digital divide, and impact are themes that are emerging or no longer researched.

When viewing figures 5 and 6 together, we can see the continued presence of some clusters. TAM and social media remain as driving themes, besides assuming greater density and centrality on the map. Information system and risks also continue as driving topics, occupying a similar position as in the previous period (Figure 5). Website and public services remain in the same location, while digital divide leaves the position between the upper and lower right quadrants and moves to the lower left quadrant, becoming a declining topic.

We notice, in the five strategic maps, that several clusters are repeated over the periods, and their location in the quadrants may vary, as in the case of digital divide (lower right quadrant in the period 2011-2015, and lower left quadrant in the period 2016-2018). We also found that different terms related to driving clusters change quadrants from period to period, indicating variations in the main directions of the studies in each period. Hence, in some periods, a given cluster can be a driver and, in another, it can be in a different quadrant, such as performance, which is a driving cluster in period 3, and an emerging or disappearing theme in period 5.

As explained at the beginning of the data analysis section, we present the map that shows the temporal evolution of the research themes, here called the evolutionary map, which is based on the analysis of word co-citation.

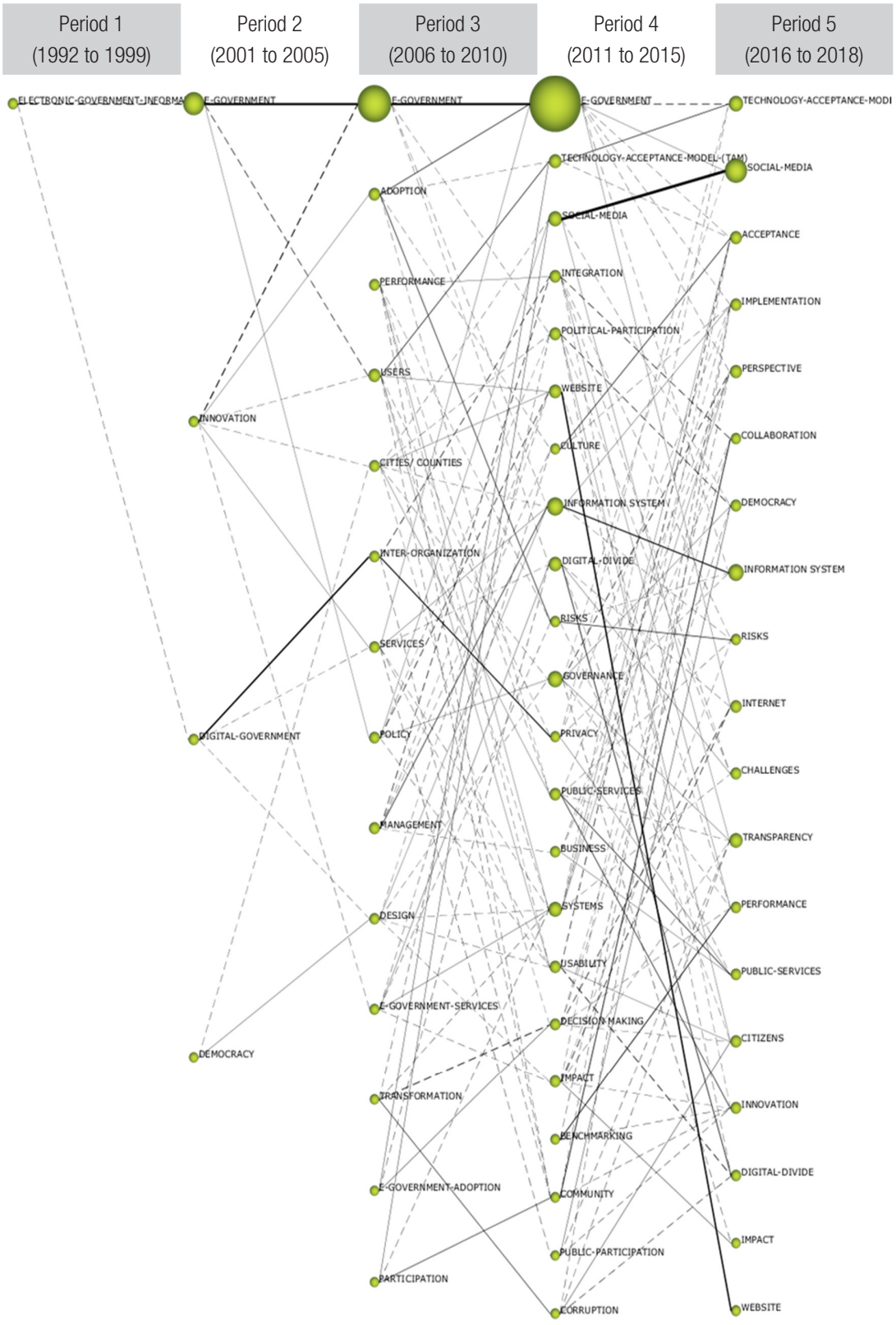
FIGURE 6 STRATEGIC MAP FOR THE PERIOD 2016-2018



Source: Elaborated by the authors.

However, to analyze the evolutionary map, we need to make some considerations. The density of the lines shows the strength of the relationship between the clusters - the denser the line, the greater the strength of their relationship. Solid lines show that clusters share a main element (usually the most significant of the cluster), and dotted lines indicate that the themes share common elements, but not the main element (Cobo et al., 2011, 2012). For measuring the relationship between clusters, we use the inclusion index, which checks the common elements between two themes (Cobo et al., 2011). Figure 7 shows the theme clusters and the evolution over the periods.

FIGURE 7 THEMATIC EVOLUTION OF THE RESEARCH FIELD ON E-GOVERNMENT



Source: Elaborated by the authors.

Figure 7 allows viewing relationships between clusters. In the first period, 1992-1999, the term 'electronic government information' stood out in 15 articles. It is important to emphasize that, in the 1990s, the discussion on e-government began, especially due to internet advancement (Ali et al., 2019), which explains the small number of papers included in the sample, and the presence of only one cluster.

In the second period, 2001-2005, with 155 articles, we found four clusters, and in two of them (e-government and digital government), there were elements from the electronic government information cluster, from the first period.

From 2006 to 2010, third period, with 331 articles, there was a significant increase in the number of clusters, as well as the emergence of themes like performance, management, transformation, e-government adoption, and participation, without elements shared with previous clusters.

Period 4, 2011-2015, with 542 works, presents the largest number of clusters, 22. Among them, benchmarking is the only that does not share elements with clusters from the previous period. In period 5, 2016-2018, with 473 works, all 19 clusters share elements with the clusters of the fourth period.

By examining the thematic evolution of the e-government field, we observed that none of the clusters appeared in all five periods, and that e-government was the most frequent, in periods 2, 3 and 4.

In period 1, the only cluster present – electronic government information – shares elements with e-government and digital government clusters. In periods 2, 3 and 4, the e-government cluster shares the main element period by period, while in period 5 it ceases to exist and starts to share main elements with the social media and internet clusters, although with little strength. Such a change may indicate the distribution of e-gov among different themes.

Digital government ceases to exist in period 3, but shares the main element in a moderate relationship with the inter-organization cluster, and this one, equally, with the privacy cluster. This shares the main element, in a weak relationship, with the public services cluster.

Innovation, in period 2, shares main elements with the clusters services and adoption of period 3. Adoption shares main elements with the clusters e-government (weak relationship) and risks (moderate relationship) in period 4. The latter remains present in period 5. Social media (period 4) shares main elements with the clusters policy and participation, from period 3. Social media (period 4) shares the main element with social media (period 5) and transparency (period 5).

In period 3, cluster participation is present, and shares the main element with both the community cluster (period 4) and the social media cluster. Community, in turn, shares the main element (average strength relationship) with the collaboration cluster.

There is a great variety of themes studied within the scope of the e-gov research area, involving the most different research fronts. We notice an evolution in the number of themes explored on e-gov. It had an initial focus on government-to-government (G2G) communication, then it added services to entrepreneurs (Government to Business - G2B) and citizens (Government to Citizens - G2C), with the aim of providing better services to these audiences (Ali et al., 2019). Therefore, by expanding the variety of related actors, it also expanded the related themes.

In addition, the analyses of strategic maps strengthens that e-gov is a multidisciplinary field and covers a wide variety of research topics (Alcaide-Muñoz et al., 2017; Coelho et al., 2016; Dias, 2019; Rodríguez-Bolivar et al., 2016).

6. RESULT DISCUSSION

We identified that the prominent themes that will structure and shape the e-gov field of knowledge in the coming years are the technology acceptance model (TAM), social media, transparency, acceptance, and information systems, showing the intention to investigate aspects like trust, ease of use, possibilities of adoption, as well as planned behavior regarding the service. This front of studies is important; despite existing different advantages in providing e-gov services, the number of citizens who use them is essential to assess their effectiveness (Kurfalı, Arifoğlu, Tokdemir & Paçin, 2017).

The social media topic, within the context of e-gov, stands out in the period covered by this study, showing that governments must pay attention to communication through digital media, as it overtakes, each day, the traditional media (Valaei & Baroto, 2017), and facilitates the interaction, participation, and engagement of citizens in governmental issues, at their different levels (federal, state, and local).

The term 'acceptance', related to intention, attitudes, behavior, quality, systems, and UTAUT (theoretical framework also frequently used in different studies on Information Systems), stood out in the evolution of studies on e-gov in the period 2016-2018. During that period, we could identify, in the analysis of users' intentions, attitudes, and behaviors regarding e-gov, a trend towards service quality, both in government's internal context (employees) and external (society in general).

Studies on information system representing technology, identity, management, citizen satisfaction, public administration, projects, and courts, as well as social media, became denser in the final period of our research. Hence, we inferred that they seek to analyze relationships between the success of information systems and citizens' satisfaction, which may also be linked to the acceptance of e-gov services.

We also identified, quite often, studies focused on electronic identification (e-ID), which are based on the citizens' characteristics, following a more technical line, trying to capture the perception of users of e-gov services, since there are concerns about security and privacy (Melin, Axelsson & Söderström, 2016).

Still, in the final period covered by the research, the term transparency, associated with accountability, governance, political trust, open government, local government, and municipalities, assumes a central position, pointing to a trend of studies on the use of ICTs by governments to expand the dissemination of public information and materials to as many people as possible. Another line of study involves anti-corruption movements within e-gov strategies, open government initiatives, and transparency efforts in terms of data, information, and political processes. For Nam (2018), e-gov has a significant potential for controlling corruption through transparency.

Additionally, topics such as internet and public service proved to be important for the field – which we identified as transversal and general themes -, since e-gov provides services through electronic means and, among these, the internet is the most popular.

During the last period, 2016-2018, associated themes such as co-production, government, privacy, online services, future, business, and rural stood out, expanding the trend of studies that highlight the relationship between e-gov and co-production of public services, as well as the influence of different e-gov fronts on co-production (for example, social media, wikis, and websites, and the co-production of public services). This also leads to studies on how the expansion of e-gov (online services) affects society's perception on the improvement of public services, or the perception of employees and public servants on a given e-gov solution.

7. FINAL CONSIDERATIONS

We achieved the objective of this article – to study the scientific production in the area of e-government, through the analysis of scientific papers published in journals indexed in the WoS database –through bibliometric analysis of co-citation of words and of cluster, using the SciMAT software. Examining the thematic evolution of the e-gov research field over 26 years, in 1,516 selected publications (from 1992 to 2018), allowed us to view, through a longitudinal analysis, the development, as well as the conceptual structure of the field (Cobo et al., 2012). Furthermore, we detected changes and evolution, as well as trends and interrelationships between the relevant topics of this field of study.

The results led to the conclusion that e-gov is a well-studied scientific area, which we noticed by the gradual increase in the number of studies published in journals since 1992. Confirming and strengthening the findings of previous studies (Rodríguez-Bolivar et al., 2016), we can consider the e-gov research field eclectic and interdisciplinary, involving different disciplines and methodologies, each contributing to specific theories and approaches. There is a large number of new themes in each period, especially topics that do not recur, which may indicate that the field is not mature yet, thus allowing different fronts of analysis within the theme.

7.1 Study Limitations

There are some limitations in the study. The collection of articles, carried out in early December 2018m may not have included texts published in that same month or not available in the platform at that time. We also mention the possibility that the defined set of keywords did not represent all published research, since it is a wide and multidisciplinary area of study, and we only used a single database (WoS).

7.2 An agenda for future studies

The results pointed to the most prominent themes that will structure and shape the e-gov field of knowledge in the coming years: TAM, social media, transparency, acceptance, and information systems. Based on these large thematic groups, we can mention possibilities for future studies.

In the context of the TAM theoretical framework, we can think of future research focused on the service user, and aimed at investigating aspects such as trust, ease of use, adoption possibilities, planned service behavior, as well as showing which elements influence the adoption of different e-gov services. Regarding the term "acceptance", there is room to explore the theme both in technological terms and in terms of service quality, linking it to the UTAUT framework.

Another valid research path relates to social media, which have gained prominence in the e-gov context (Gao & Lee, 2017). It is possible to deepen it in studies on how governments use social networks, such as Twitter and Facebook, and how they can facilitate the interaction, participation, and engagement of citizens in government issues. Another route id to analyze how social media complements existing e-gov services, and which social media tools best fit the different types of e-gov services provided (Gao & Lee, 2017; Valaei & Baroto, 2017).

Regarding the theme "information systems", future research may examine how the public administration manages its e-gov projects, and how the specifics of each agency or sphere can affect the results achieved in light of what was planned.

We provide some suggestions for research, such as a comparative analysis between Brazilian and international studies. Alternatively, the use of a larger number of databases. Or even a separate analysis of the relationships between clusters that share main elements over the periods, and their change over time. In addition, the analysis of the scientific production after 2018, by using other key terms to search for more articles associated with the theme.

In addition, we can think of studies that explore the meaning of the term "electronic government", if it encompasses different areas of knowledge and research themes, including a critical perspective, in order to build this field of knowledge.

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