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Critical factors of e-government in the last 20 years: a study through content analysis and keyword co-occurrence

Fatores críticos do e-governo nos últimos 20 anos: estudo por meio da análise de conteúdo e da coocorrência de palavras-chave

Factores críticos del gobierno electrónico en los últimos 20 años: estudio mediante análisis de contenido y co-ocurrencia de palabras clave

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Abstract
About 20 years have passed since the implementation of e-government as a tool that offers services and helps citizens, until today. Thus, the objective of this study is to raise the most frequent critical factors to understand the focus of study of researchers over the years on the subject, helping to identify trends. Therefore, a content analysis study was carried out on a sample of articles and a bibliometric analysis of the co-occurrence of the keywords from 2001 to 2022. As a result, the most relevant critical factors are the Digital Divide, the Implementation of Services that depend on infrastructure, studies on E-services, followed by Safety and Quality requirements, and finally, research on the Adoption/acceptance and trust of this user concerning the electronic system.
Keywords: E-government; Critical factors; Bibliometrics; Content analysis.

Resumo
Cerca de 20 anos se passaram da implementação do e-governo, como ferramenta que oferta serviços e auxilia o cidadão, até os dias de hoje. Assim, o objetivo desse estudo é levantar os fatores críticos mais frequentes para entender o foco de estudo dos pesquisadores com o passar dos anos sobre a temática, auxiliando na identificação de tendências. Para isso foi realizado um estudo de análise de conteúdo em uma amostra de artigos, bem como uma análise bibliométrica de coocorreria das palavras-chaves de 2001 a 2022. Como resultados, os fatores críticos mais relevantes são a Digital Divide, a Implementação dos Serviços que dependem de infraestrutura, os estudos sobre E-serviços, seguidos dos requisitos de Segurança e Qualidade e finalmente, as pesquisas sobre Adoção/aceitação e Confiança desse usuário em relação ao sistema eletrônico.
Palavras-chave: E-governo; Fatores Críticos; Bibliometria; Análise de conteúdo.

Resumen
Cerca de 20 anos se passaram da implementação do e-governo, como ferramenta que oferta serviços e auxilia o cidadão, até os dias de hoje. Assim, o objetivo desse estudo é levantar os fatores críticos mais frequentes para entender o foco de estudo dos pesquisadores com o passar dos anos sobre a temática, auxiliando na identificação de tendências. Para isso foi realizado um estudo de análise de conteúdo em uma amostra de artigos, bem como uma análise bibliométrica de coocorreria das palavras-chaves de 2001 a 2022. Como resultados, os fatores críticos mais relevantes são a Digital Divide, a Implementação dos Serviços que dependem de infraestrutura, os estudos sobre E-serviços, seguidos dos requisitos de Segurança e Qualidade e finalmente, as pesquisas sobre Adoção/aceitação e Confiança desse usuário em relação ao sistema eletrônico.
Palabras clave: Gobierno electrónico; Factores críticos; bibliometría; Análisis de contenido.

1. Introduction

Although amplified by the COVID-19 pandemic, the e-gov implementation process began about 20 years ago. This historical digitization started with the government data processing stage, intending to organize information for better decisions

(Mueller, 1975). Next, went through the online government movement, which established the first public databases (Williams, 1986) until arriving at e-governance, almost in the 1990s, when the benefits of IT to provide information sharing services between government departments began the discussed (Chakravarti & Krishnan, 1998).

In the 2000s, with the popularization of the internet, the first discussions took place about the e-government, which is defined as an initiative linked to a partnership between the government and the public. Such as citizens, administrative bodies, and constitutional institutions to offer services from an integrated, open, and extensible platform (Tambouris, 2001; Wassenaar, 2000). The e-government, almost a decade later, is the combined use of ICTs and the internet as a public management tool. To offer quality and maximize efficiency in the provision of public service, allowing effective participation of citizens in political processes (Chadwick, 2011; Lima Filho & Peixe, 2021).

From its implementation until the post-covid days, e-government gained strength in discussing critical fundamental factors such as the Digital Divide and its sociological questions about poverty and access to technology (Lepadatu, 2013; Wong & Ho, 2022), to more recent discussions, such as intelligent and sustainable cities (Darmawan et al., 2020; Strielkowski et al., 2022).

About 20 years have passed since its implementation as a tool that offers services and helps citizens, until today. Aspects such as exclusion, adoption, deployment, and security of e-government were some critical factors widely debated over these years. However, systematically understanding the critical factors pointed out by researchers on the subject throughout this period will be essential to visualize what still plagues the theme and what is evolving as a negative factor of e-government.

In this sense, we have the question that guides this study: What are the most studied critical factors of e-government in the last 20 years? The objective is to raise the most frequent critical themes to understand the focus of study of researchers over the years, helping to identify trends or even to validate structural problems related to the theme.

A content analysis study will carry out a sample of articles on e-government that mention critical factors and a bibliometric analysis of the co-occurrence of keywords in the last 20 years of indexed publications on the subject.

After the pandemic, technology has become an alternative resource for providing various services, including the public sphere. Thus, the social justificative of this work is the growing movement of social digitization in the world. Scientifically, the research establishes the evolutionary parameters of the theme. There occurs by mapping the frequency of critical factors found in a timeline, seeking to understand e-government since its implementation.

This work has a Methodology in which the procedures for collecting and analyzing articles, Results, and Discussions, part of the document that will discuss the research findings, will be described. Furthermore, finally, the conclusions section will present an overview of the critical factors most discussed over the years about e-government.

2. Methodology

According to its purpose, this study is classified as applied research since it aimed to seek the critical factors related to e-government (Gil, 2008). On the other hand, according to its objectives, it is exploratory research, as it will seek to understand and delimit the critical factors of e-government in the last 20 years in the analyzed bibliography. Thus, it is bibliographic research based on articles indexed in international databases.

This research used Bibliometric techniques (Yu et al., 2020) and Content Analysis (Bardin, 1991; Hsieh & Shannon, 2005) to reach its results. With the Bibliometric technique, it was possible to map the principal authors on the e-government theme and critical factors and carry out a historical series of the themes from the co-occurrence of the keywords of the selected texts.

Content Analysis, on the other hand, uses the Summative approach, which Hsieh and Shannon (2005) describe as counting and comparisons, usually of keywords or content, followed by the interpretation of the underlying context of the

researcher. As a result, the researchers created categories and subcategories of studies from reading selected texts, quantifying the critical factors over the 20 years researched.

Thus, a search was carried out in three different databases to understand what these critical factors related to e-government are: IEEE, Scopus, and Web Of Science (WoS). The authors have chosen the Scopus and WoS multidisciplinary databases for their indexing, updating, coverage, h-index criteria, and multiple languages (Mariano, Ari Melo; Rocha, 2017). Furthermore, the IEEE was included in the collection since it is the journal that indexes the most articles and conferences on the researched topic.

The period considered for the search occurred between 2001 and 2022. The performed search was in the three databases mentioned on August 6, 2022, with the following search string: E-gov OR Egov OR e-government OR e-government OR" Electronic government" OR "e-government services" OR "digital government" OR "government data processing" OR "electronic governance" OR "Connected Government" OR "Electronic Administration" OR "e-Administration" OR "Internet Governance" OR "m -Government" OR "Mobile Government" OR "Online Government." The authors elaborated the search string from an article dedicated to this theme, approved by the 12th Scientific Congress of the National Science and Technology Week at IFSP – CONSISTEC 2022, which took place in October 2022 (Santos, Maíra Rocha; Gomes, 2022).

From the results reported in each database, the descriptor "critical factors" was inserted, retrieving the following amounts of files in each analyzed database: 762 documents in Scopus, 69 in WoS, and 22 in IEEE.

The documents were imported to the Rayyan platform (https://rayyan.ai) to systematize the findings. It is a free web and mobile application that helps in the initial screening of abstracts and titles using a semi-automation process, helping to visualize duplications, abstracts, and various categorizations and optimizing the researcher's work (Ouzzani et al., 2016).

The samples together made up a total of 853 documents. After removing the duplicates, the sample obtained 785 valid documents. From this selection, the term "critical factors" was filtered by the Rayyan platform in the "Keyword for include" option, which reported the amount of 157 articles. We subtracted 20 documents because they were Annals of Congress, Books, Literature Reviews, or were out of the theme. The final sample has 137 articles.

Thus, the metadata of the articles that constituted the final sample was exported from Rayyan and inserted into VOSviewer (version 1.6.10) to find the Bibliometric result of the main keywords by co-occurrence. The software is perfect for analyzing themes over the years. Two standard weight attributes were applied, defined as the "Full-strength attribute of the link" and "Occurrences" for the definition of the theme priority (Yu et al., 2020).

Finally, the researchers analyzed each document and, through content analysis (Bardin, 1991), mapped and categorized the main critical factors of e-government.

The results of Bibliometrics by the co-occurrence of Content Analysis performed by the authors can be seen in this research's Results and Discussions section.

3. Results and Discussion

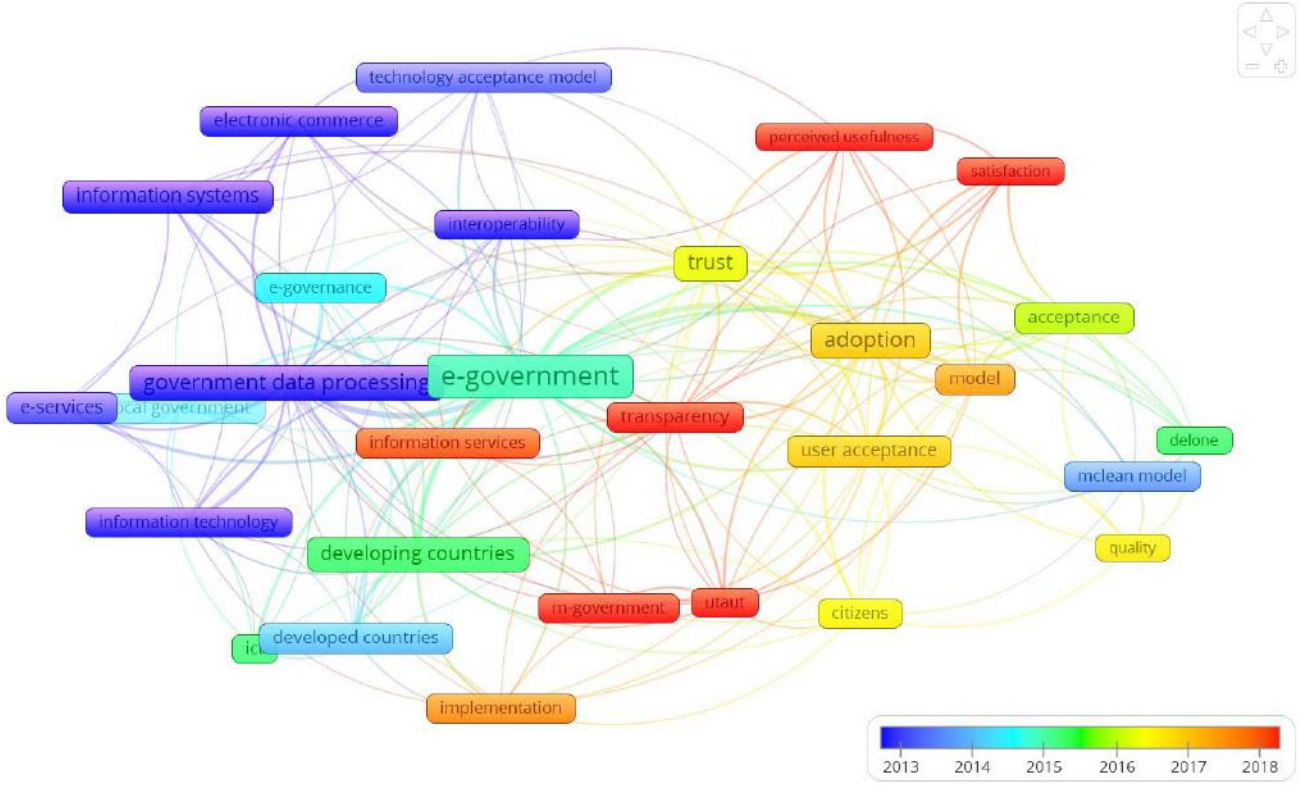
3.1 Bibliometric Analysis – Co-occurrence of keywords

From the metadata of the 137 selected articles, it was possible to trace a timeline of the most critical themes via the co-occurrence of the keywords designated by the authors. The co-occurrence of keywords demonstrates how the authors are interested in research, as well as locating this knowledge in a timeline from the publication dates of each article.

Through the study carried out in VOSviewer, it was possible to find the themes of e-government in the cut of the critical factors, which were of interest to a higher number of authors about the researched sample. Only keywords that occurred more than four times in the sample were selected. Figure 1 represents these search results. It is possible to observe the themes

that co-occurred and in which periods. Note that the blue color marks the initial studies of the themes (2013), and the red color shows the most recent themes (2018).

Figure 1—Keyword Co-occurrence Map.



Source: Authors.

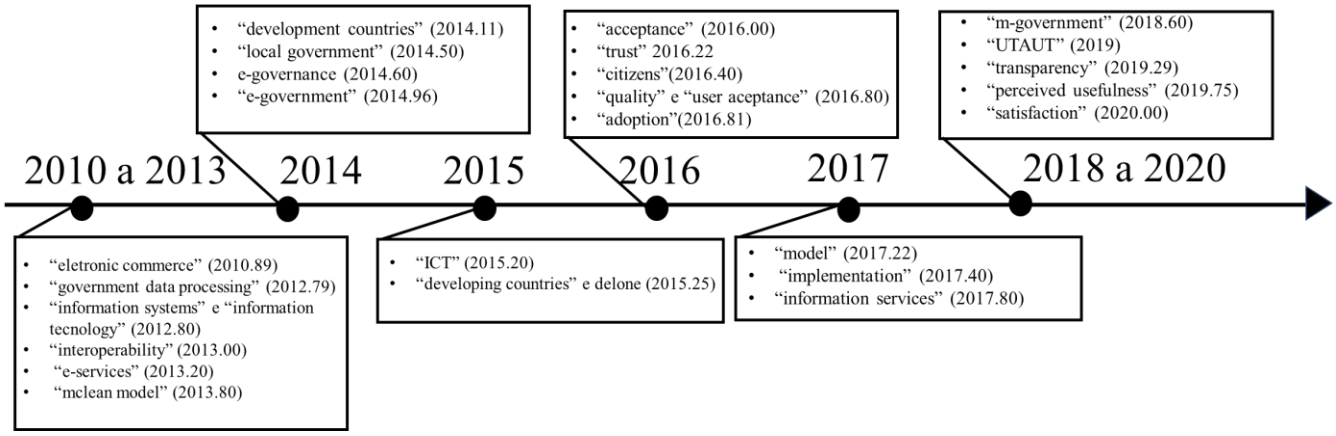
It is interesting to analyze that although the temporal cut of the articles was made from 2001, it was only in 2010 that the keywords began to co-occur, showing the common interests of the researchers. In the selected sample, the first common theme, marked in purple on the map, was "electronic commerce" (2010.89), followed by "government data processing" (2012.79), "information systems" and "information technology" (2012.80), "interoperability" (2013.00), "e-services" (2013.20) and "McLean model" (2013.80), closing the initial studies in purple.

In light blue appear the studies in "development countries" (2014.11), followed by the studies of "local government" (2014.50), e-governance (2014.60), and the beginning of the studies of "e-government" (2014.96), which has already begun to be displayed in green, for the analyzed sample.

In green are studies on "ICT" (2015.20), followed by those on "developing countries" and Delone (2015.25), already in transition to yellow with "acceptance" (2016.00).

In yellow, "trust" was the interest of researchers in 2016.22, followed by "citizens" (2016.40), "quality" and "user acceptance" (2016.80), and "adoption" (2016.81). Finally, the words "model" (2017.22), "implementation" (2017.40), and "information services" (2017.80) appear in orange. In red, the most recent studies, "m-government" (2018.60), "UTAUT" (2019), "transparency" (2019.29), "perceived usefulness" (2019.75), and "satisfaction" (2020.00) appear. Figure 2 shows the organization of the findings in a timeline.

Figure 2 – Timeline with the main keywords found from 2010 to 2022.



Source: Authors.

From the results, it is possible to infer that the topics of interest to researchers about e-government and critical factors began to be inspired by the functioning of electronic commerce. Moreover, they were followed by their modes of operation, such as government data processing, information and technology systems, and the provision of e-services. Finally, their interoperability, that is, the ability of a system to communicate transparently with another system, also appeared in the initial studies.

Research with mathematical models such as the McLean model (DeLone, & McLean, 2003) was also concerned about critical factors in 2013. This model, called the Information Systems Success Model, was already concerned with constructs such as quality, quality system, and quality service, implying satisfaction and intent to use.

Then, the first critical studies on e-government began, and the presence of the word "governance" marked the period, revealing the scope and complexity of this system that should also meet the management principles of the state public machine, and the keywords "developed countries" and "local government," probably the first to test information systems with a focus on governance (Santana, 2020; Souza et al., 2021).

Subsequently, studies on communication and information technologies are strengthened, and the acceptance of e-government in developing countries has become the focus of studies. In addition, research on truth, quality, use, and adoption focused on citizens began in 2016. Finally, in 2017, questions about the system's implementation began to draw researchers' attention, as well as the adoption of models for the analyses carried out.

Finally, there are studies on mobile government, the theory of acceptance and usability of technology, transparency, perceived use, and satisfaction as the most current topics on critical factors (Barbosa & Mota, 2022; Venkatesh, 2003).

3.2 Content Analysis

From the sample of articles organized on the Rayyan integrative platform, the documents underwent a textual analysis using the content analysis technique (Bardin, 1991), and an Excel table was created with the categories addressed in the sample studies. A new category is inserted into the table for each additional critical factor listed in the text. It is pertinent to note that each article can appear in more than one category; therefore, the final sample has a greater than 137. It is also possible to discuss transparency, usability, cost, and security in an article about adoption.

In this sense, we found 41 categories within the discussions of the articles studied. From these categories, it was possible to divide the approaches of the articles into three umbrella categories. In "Technological aspects," articles discuss e-government technology, including the population's access to e-government, its implementation, information sharing, and even

technologies for buying and selling. This category covered 16 critical factors in the studies, with Digital Divide and Implementation studies accounting for almost 52.3% of the analyzed works. On a smaller scale, in this same category are the studies of Artificial Intelligence, Identity Authentication, Electronic Court E-openness, and E-Readiness, representing 4.5% of the total sample.

The "Government Organization" category included factors related to quality, transparency, privacy, service provision, security, and cost, among other requirements to which the government needs to be attentive to ensure the proper functioning of this system with the citizen. In it, studies on e-services appear in the first place, e with 25.3% as a critical factor. Quality and Safety appear in second place, tied with 14.1%, adding up to 28.2% of the studies carried out. Business Intelligence appears with less frequency thematic representing only 1% of studies in this category.

Finally, the "Public-Centered" category concerns the public's acceptance of its adoption, satisfaction, use, and trust, as well as its need for participation in democracy and user profile studies. In this category, the most relevant theme is the adoption/acceptance of e-government with 29.2% of the surveys, followed by the trust with 21.4%. The last representative theme of the category is Accessibility, with only 0.6% of the targeted studies. Table 1 shows the umbrella categories with their critical factors in frequency and percentage.

Table 1 - Categories and Critical Factors in Percentage.

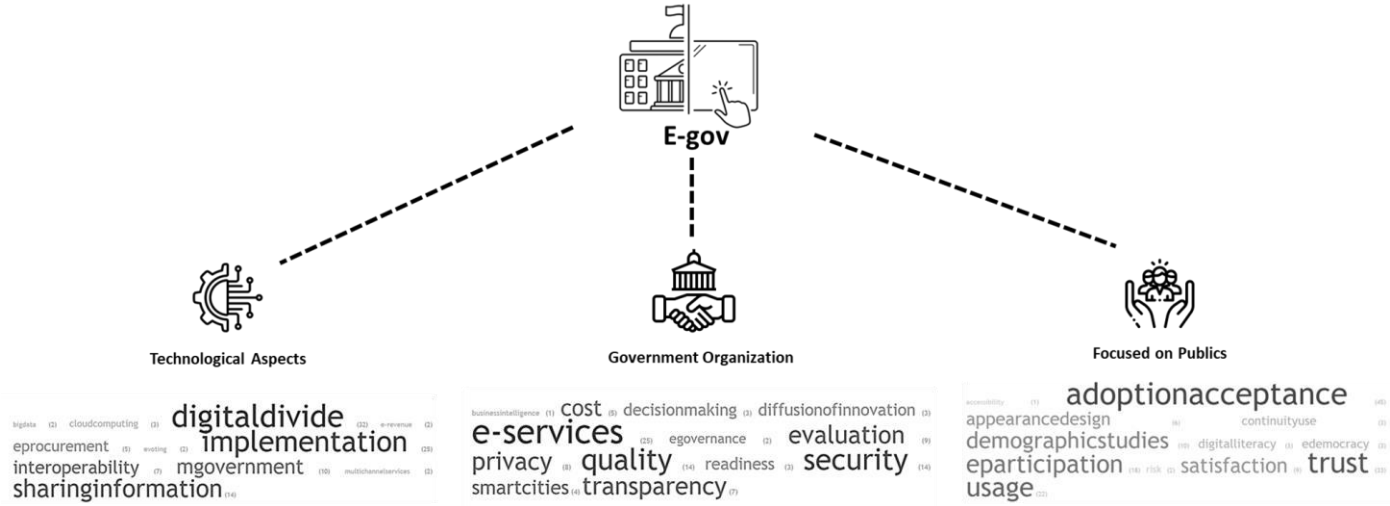
Technological Aspects	f	%	**Government Organization**	f	%	**Focus on the Public**	f	%
Digital Divide	32	29,4%	**e-services**	25	25,3%	**Adoption/Acceptance**	45	29,2%
Implementation	25	22,9%	Quality	14	14,1%	**Trust**	33	21,4%
Information Sharing	14	12,8%	Security	14	14,1%	Usage	22	14,3%
m-government	10	9,2%	Evaluation	9	9,1%	e-participation	18	11,7%
Interoperability	7	6,4%	Privacy	8	8,1%	Demographic Studies (gender, age, education, nationality)	10	6,5%
e-procurement	5	4,6%	Transparency	7	7,1%	Satisfaction	9	5,8%
Cloud Computing	3	2,8%	Cost	5	5,1%	Appearance/Design	6	3,9%
Big Data	2	1,8%	Smart and Sustainable Cities	4	4,0%	Digital Literacy	3	1,9%
Electronic voting	2	1,8%	Electronic government readiness	4	4,0%	Continuity of Use	3	1,9%
e-Revenue	2	1,8%	Diffusion of Innovation (DOI))	3	3,0%	e-democracy	3	1,9%
Multichannel Services	2	1,8%	Decision Making	3	3,0%	Risk	2	1,3%
Artificial intelligence	1	0,9%	e-governance	2	2,0%	Accessibility	1	0,6%
Identity Authentication	1	0,9%	Business Intelligence	1	1,0%			
e-court	1	0,9%						
e-openness	1	0,9%						
e-Readiness	1	0,9%						
TOTAL	**109**	**100%**	**TOTAL**	**99**	**100%**	**TOTAL**	**154**	**100%**

Source: Authors.

It is reinforced that the critical factors found and categorized by the authors aim to quantify and delimit the main

critical factors presented in the discussions based on Content Analysis. Figure 3 summarizes the findings and displays the frequencies of each category's most relevant critical factors.

Figure 3 – Critical Factors of e-Government in the last 20 years from three categories of analysis: Technological Aspects, Government Organization, and Focus on the Public.



Source: Authors.

Thus, considering the results found, it is possible to say that the critical factors of the government in the last 20 years can be divided into three significant categories of study, namely: "Technological Aspects," "Government Organization," and "Public-centric." Highlighting the Digital Divide, which makes the technology inaccessible to many people around the globe, the supply of e-services, and the adoption of this technology, respectively, are the main critical factors of e-government.

4. Conclusions

Based on the results, it is possible to answer the research question that guides this study. The most relevant critical factors for researchers in the analyzed period are the Digital Divide, a problem that plagues most e-government users worldwide due to the different economic and technological factors. Structures that vary from country to country, the Implementation of Services that depend on this infrastructure, studies on E-services, followed by Safety and Quality requirements, and finally, research on the Adoption/Acceptance and Trust of this user concerning the electronic system according to the authors' content analysis.

It is interesting to point out that the critical factors mentioned if compared with the keywords of the articles placed on the timeline, the first concern of these documents, according to the co-occurrence results, were linked to studies on "e-services" (2013.20). Then, the themes of acceptance, quality, and adoption started in 2016, with research until 2016.81. Finally, the implementation of e-gov services only became a concern of the researchers who published the articles as of 2017.40 according to the analyzed sample.

This order of publications reveals that the initial research concerns were linked to e-service and centered on the "Government Organization" category, as classified in this study. Subsequently, the studies turned to the public that used the service through surveys of adoption and acceptance of these available services located in the "Public-Centered" category. Moreover, finally, the studies on implementation that appeared more recently are part of the "Public Centered" category. Next,

the author suggested the technological aspects of e-government. This panorama makes it possible to understand the discussions about these critical factors. Then, it started in the governmental sphere, internally expanding to the interest of the population that would use this service and, finally, the technical issue that could also be one of the obstacles to the functioning of this digital government.

As described in this study, understanding the researchers' focus on the main critical factors over the 20 years helps to identify trends. However, it also enables new e-government researchers to understand the past and the present, providing a stronger focus in their research.

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