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MAPPING COLLABORATION NETWORK ON ELECTRONIC GOVERNMENT RESEARCH IN THE LAST TWO DECADE: A BIBLIOMETRIC ANALYSIS OF CO-AUTHORSHIP AND CITATION

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Abstract

Purpose: The purpose of this research is to look at the bibliographic characteristics and contents of electronic government publications published in Scopus-indexed journals in 2000-2021. **Method:** We gathered data from Scopus database on August 9, 2021. The keyword is "Electronic Government" which is limited to the article titles, abstracts, and keywords. We got 21.447 articles. Then we filtered the data based on numerous criteria. To perform further analysis, the data were exported into Comma Separated Values (CSV) file format and then analyzed using the VOS viewer application program with co-authorship and citation analysis types. **Result:** Following the protocol for bibliometric research, we found 1.153 articles with 2.433 authors. As a result of the analysis, we found 22 authors who met the threshold. Based on the co-authorship analysis, 14 authors collaborated, while 8 authors did not collaborate. Meanwhile, based on the results of citation analysis, we found the 9 most active authors cite each other. **Conclusion:** Based on the results of our analysis, there are 3 authors who are most actively collaborating and cite other authors. Meanwhile, there are 2 countries that collaborate the most so that the authors are often referred to by other authors.

Keywords: Electronic Government; Scopus; Bibliometric; VOS Viewer

INTRODUCTION

Background: E-government is the application to assist governments in communicating with a variety of stakeholders, including employees, enterprises, and other government agencies [1–6]. The emergence of e-government in the mid-1990s was largely driven by the rise and development of internet-based technologies and electronic commerce. Countries such as the United States, the United Kingdom, and Australia are at the forefront of making intergovernmental communication faster and more effective [7]. The transformative power of e-government has received much attention in the twenty-first century. In the e-government sector, terms such as e-voting, e-governance, e-democracy, and m-government emerged as essential evolutionary constituents [3]. E-government has become a popular research subject, and there have been a number of e-government conferences [8]. Electronic government, often known as e-government, improves citizens' convenience and access to government services and information [9]. Every government or country is now aware of the importance of the development of information technology. Information technology is intended to meet the needs of the community in public services, making it more effective, efficient, and transparent (6,10].

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The government's commitment to using electronic government is getting stronger to repair and improve the quality of public services in line with the development of the New Public Service paradigm. Thus, the mapping of research published on the theme of electronic government becomes important to identify the network of researchers who have developed the research in the last two decades.

Objective: This study aims to conduct a bibliographic analysis of electronic government articles published in Scopus-indexed articles from 2000 to 2021, written by researchers from throughout the world. This analysis was carried out through the VOSviewer application with co-authorship and citation types of analysis. This article provides data from authors who have collaborated over the last two decades and are often used as references in electronic government research. This article identifies a network of authors who have developed electronic government research in the last two decades.

METHODS

Statement of Ethic: This research does not conflict with the principles of research ethics. In the data collection process, the data source is in the form of literature and does not use humans as research subjects. **Study Design:** Descriptive type based on literature database.

Data Source: We use the Scopus database as a data source. We use the keyword electronic government in the search for articles that are limited to the article titles, abstracts, and keywords from 2000 to 2021.

Analysis Method: We use bibliometric analysis on 1.153 electronic government articles that we found on Scopus in 2000-2021. In the first stage, we search the Scopus data-base on August 9, 2021, at 10:58 am with the article title, abstract, and keyword used is electronic government. We limit the year from 2000 to 2021. At this stage, we found 21.447 articles. In the second stage, we applied many filters, including subject area, publication stage, source, language, and keywords. We only limited to the subject areas of; computer science, social sciences, and business and management. The keywords are limited to E-government, Electronic government, E-Government, Information Technology, Information Systems, Organization and management, public administration, ICT, E-government services, and public services. At this stage, we got 1.153 articles. Next, we downloaded the data in Comma Separated Values (CSV) format.

Visualization: In the third stage, we analyzed the downloaded data using the VOSviewer_1.6.15_exe program. We used all keywords during the analysis process. Then, we performed a co-authorship analysis with the authors and countries as the unit of analysis. During the analysis, we used all the keywords. The authors and nations were then used as the unit of analysis in a co-authorship analysis. In addition, we conducted citation analysis using authors and nations as the unit of analysis. The top 10 writers who collaborate with each other with the most citations and network strengths, as well as the top 10 authors who cite with the most network citations and strengths, are presented next. Finally, we compared and made conclusions from the two analysis.

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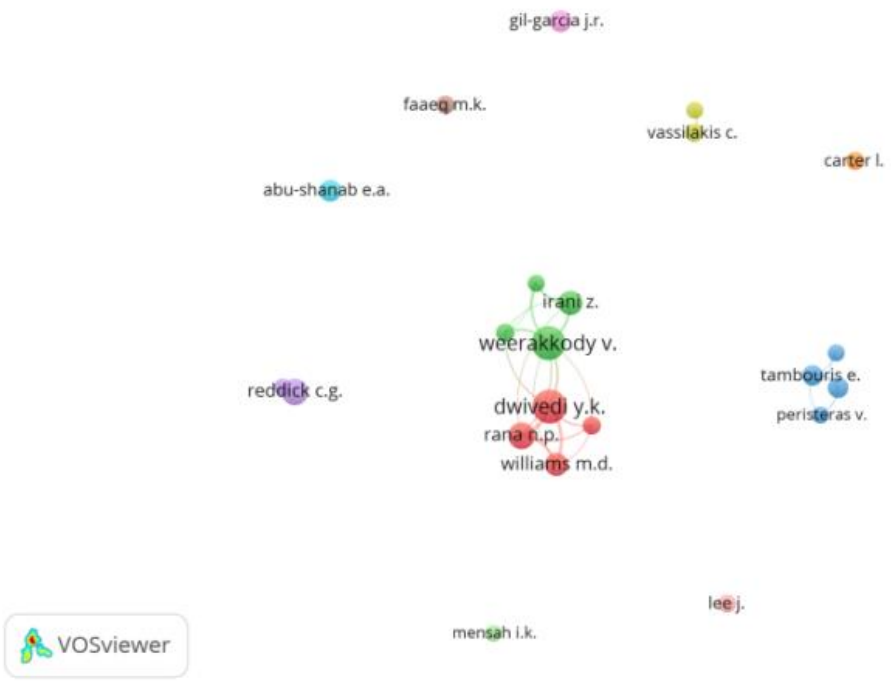
RESULTS

Co-Authorship Analysis with Unit Analysis Authors

The VOSviewer analysis, which uses the co-authorship type of analysis and the authors' unit of analysis, is the first. We use the "all keyword" analysis and the "full counting approach" to conduct the research. We also have a maximum of 25 writers and a minimum of 5 authors per article, with no minimum citation requirement. There are 22 authors out of 2.433 who meet the threshold. The results of this analysis are shown in Figure 1.

Figure 1: Network Visualization of Co-authors of Authors on Electronic Government in the Scopus Database from 2000 to 2021



Based on the network visualization analysis (Figure 1), there are 11 clusters and 4 active collaborating clusters. Cluster 1 (red) consists of 4 authors, namely Dwivedi, Janssen, Rana, and William. Cluster 2 (green) consists of 4 authors, namely Weerakkody V, El Haddadeh, Irani Z, and Lee H. Cluster 3 (blue) consists of 4 authors, namely Costupoulou, Peristeras , Tambouris, and Tarabanis K. Cluster 4 (yellow) consists of 2 authors, namely Lepouras G and Vassilakis C. The remaining 7 clusters do not collaborate.

At this stage, there are 8 authors who collaborate with each other. They are the authors in the red and green clusters. The authors in the blue cluster only collaborate among the authors in the blue cluster. The authors in the yellow cluster only collaborate with the authors in the yellow cluster. The other 8 authors do not collaborate. We present the top 10 authors who have collaborated in conducting electronic government research (Table 1).

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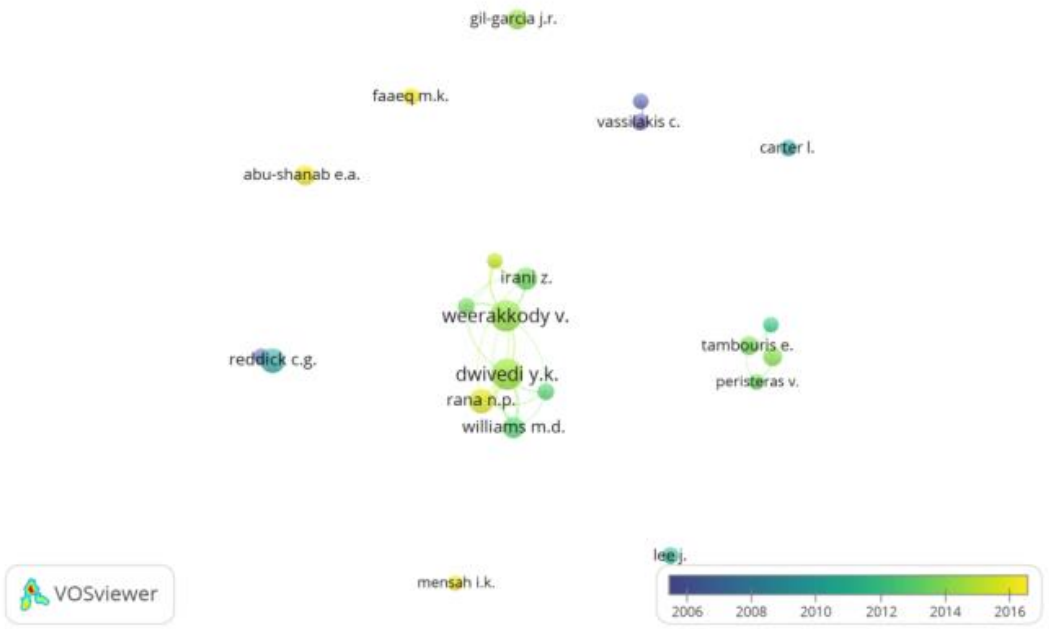
Table 1: Top 10 Authors Collaborate on Electronic Government Article

No	Authors	Documents	Citation	Network Strength
1	Dwivedi Y.K.	19	1194	28
2	Weerakkody V	20	924	26
3	Rana N.P.	12	877	22
4	Wiiliams M.D.	9	698	16
5	Irani Z.	10	545	14
6	Lee H.	5	126	11
7	El-haddadeh R.	6	257	10
8	Tarabanis K.	7	79	9
9	Tambouris E.	7	84	8
10	Janssen M.	6	621	7

In Table 1, the top 3 authors who are the most active in collaborating with the largest number of citations and the strength of the network are Dwivedi YK, Weerakkody V, and Rana NP. Based on the overlay visualization analysis (Figure 2), the articles written by the 22 authors started from 2006 to 2016. In 2006, the articles were written by Norris DF, Lepouras G, and Vassilakis, while the most recent article was written in 2016 by Rana NP, Lee H, Abu Shanab EA, Faeeq MK, and Mensah IK.

Figure 2: Overlay Visualization of Co-authors of Authors on Electronic Government in the Scopus database from 2000 to 2021



Based on the density visualization analysis (Figure 3), we found 3 authors who were the most active in collaborating. They are Dwivedi YK, Weerakkody V, and Rana NP.

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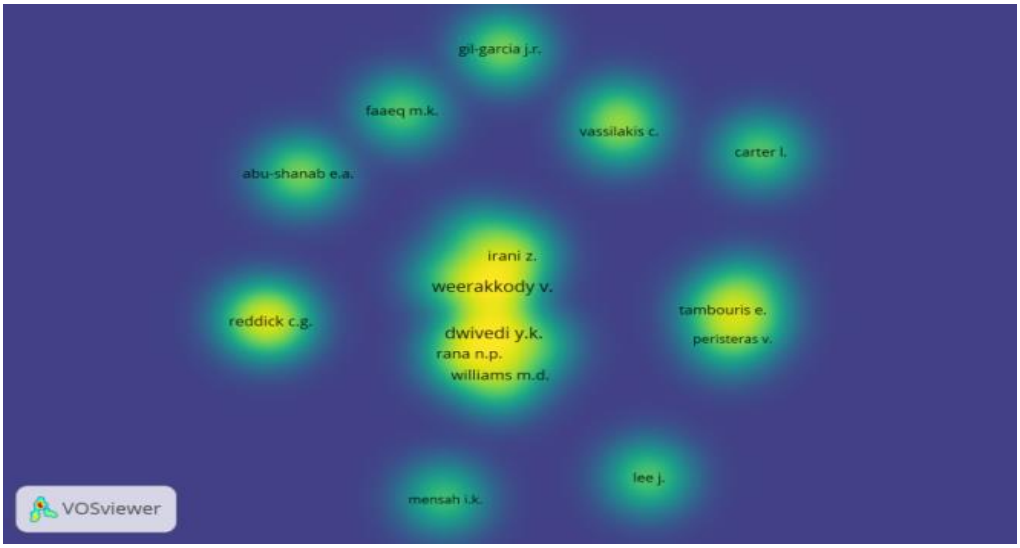
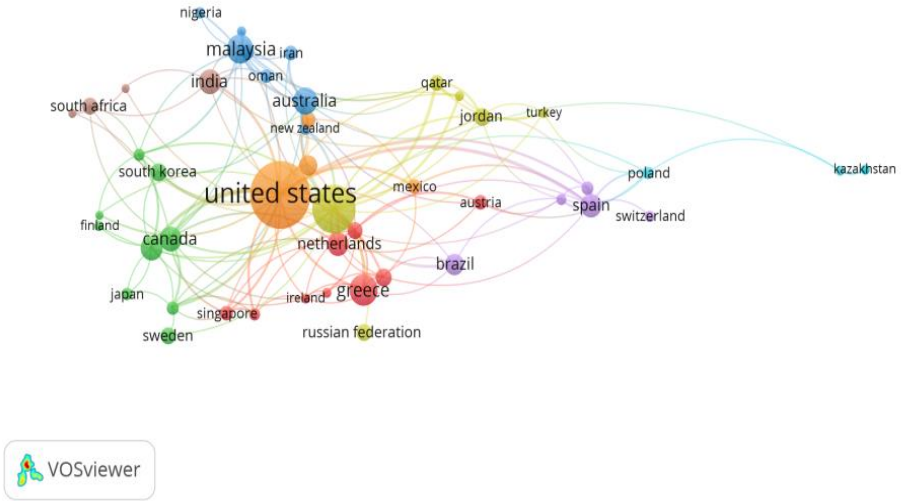
Figure 3: Density Visualization of Co-authors of Authors on Electronic Government in the Scopus database from 2000 to 2021



Co-Authorship Analysis with Unit Analysis Countries

The second analysis is the VOSviewer analysis using the co-authorship type of analysis and the unit of analysis countries. We limit the maximum number of 25 authors and the minimum number of 5 authors in one article and there is no minimum citation. Of the 132 countries, there are 51 countries that meet the threshold, and only 49 countries collaborate on electronic government research. The results of this analysis are shown in Figure 4.

Figure 4: Network Visualization of co-authors of countries on Electronic Government in the Scopus database from 2000 to 2021



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Based on the network visualization analysis (Figure 4), we found 8 clusters with 49 countries. Cluster 1 (red) consists of 9 countries, namely Austria, Belgium, France, Germany, Greece, Ireland, Italy, the Netherlands, and Singapore. Cluster 2 (green) consists of 9 countries, namely Canada, China, Finland, Hong Kong, Japan, Pakistan, South Korea, Sweden, and Thailand. Cluster 3 (blue) consists of 8 countries, namely Australia, Iran, Iraq, Malaysia, New Zealand, Nigeria, Oman, and Saudi Arabia. Cluster 4 (yellow) consists of 6 countries, namely Jordan, Lebanon, Qatar, Russian Federation, Turkey, and the United Kingdom. Cluster 5 (purple) consists of 5 countries, namely Argentina, Brazil, Portugal, Spain, and Switzerland. Cluster 6 (tosca) consists of 4 countries, namely the Czech Republic, Kazakhstan, Poland, and Slovakia. Cluster 7 (orange) consists of 4 countries, namely Indonesia, Mexico, Taiwan, and the United States. Cluster 8 (brown) consists of 4 countries, namely Ghana, India, Norway, and South Africa. Of the 8 clusters, there are several countries that have the strongest networks in their clusters, namely Greece (red cluster), Canada and China (green cluster), Australia and Malaysia (blue cluster), the United Kingdom (yellow cluster), Spain (purple cluster), United States (orange cluster) and India (brown cluster). Authors in these countries have very strong networks in collaborating on electronic government research. The following are top 10 countries that collaborate in conducting electronic government research (Table 2).

Table 2: Top 10 Countries Collaborating on Electronic Government Articles

No	Country	Documents	Citation	Network Strength
1	United States	272	11659	66
2	United Kingdom	140	4577	53
3	Canada	39	912	22
4	Spain	36	569	22
5	Malaysia	54	417	21
6	Qatar	15	171	20
7	Australia	45	1567	19
8	China	39	277	15
9	Greece	59	828	15
10	Hongkong	12	848	14

Based on the overlay visualization analysis (Figure 5), countries conducted research on electronic government from 2010 to 2016 can be explained. The United States was the first country to conduct research on electronic government, followed by the United Kingdom in 2010. In 2016, research on electronic government in other countries have started including Malaysia, Spain, and South Africa.

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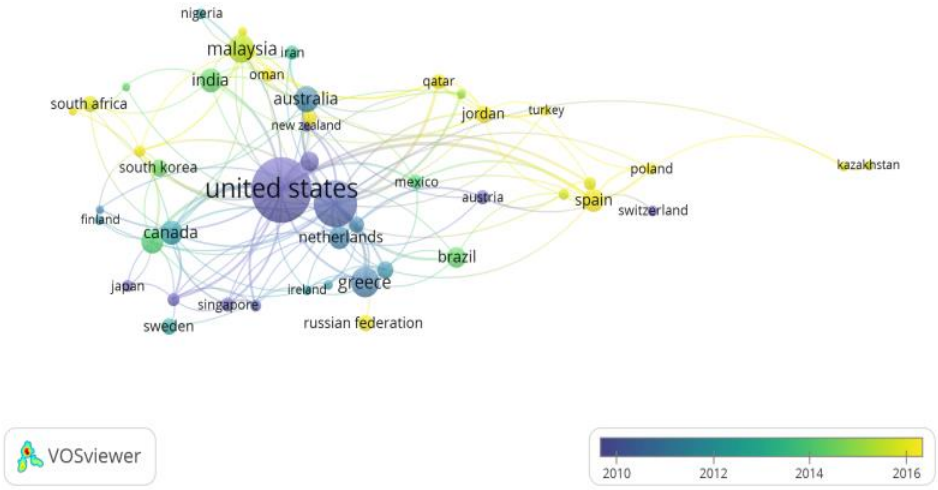
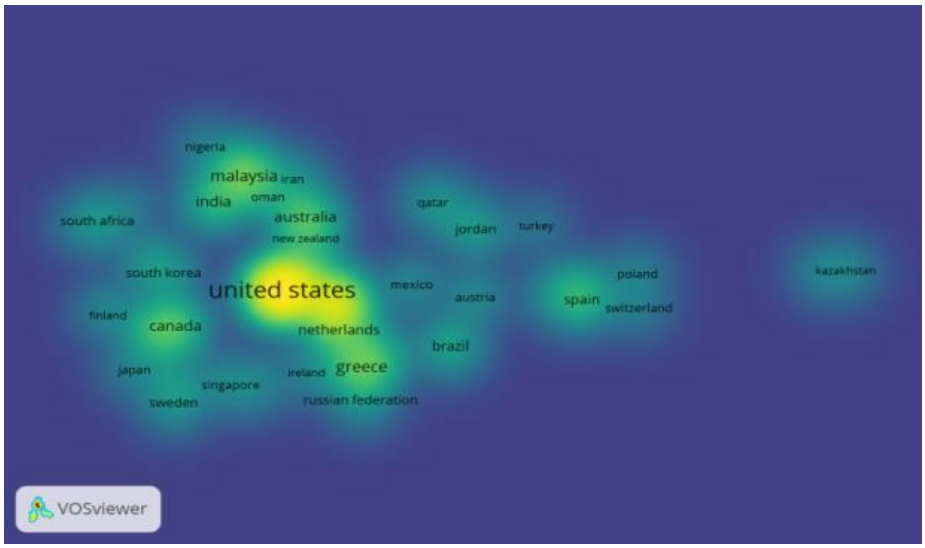
Figure 5: Overlay Visualization of Co-authors of Countries on Electronic Government in the Scopus database from 2000 to 2021



Based on the density visualization analysis (Figure 6), The United States is the country with the most collaboration in the field of electronic government research. A lack of active participation in doing electronic government research in countries occurs outside of that group.

Figure 6: Density Visualization of Co-authors of Countries on Electronic Government in the Scopus database from 2000 to 2021



Citation Analysis with Unit Analysis Authors

The third analysis is VOSviewer analysis using citation analysis type and authors unit of analysis. We also limit the maximum number of 25 authors and the minimum number of 5

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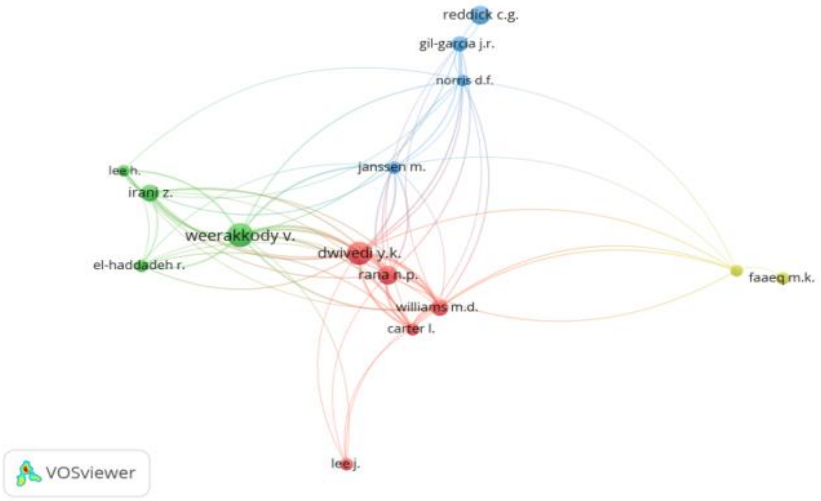
authors in one article and there is no minimum citation. Of the 2.433 authors, there are 22 authors who meet the threshold. The results of this analysis are shown in Figure 7.

Figure 7: Network Visualization of Citation of Authors on Electronic Government in the Scopus database from 2000 to 2021



Based on the network visualization analysis (Figure 7), there are 4 clusters, namely Cluster 1 (red) consisting of 5 authors namely Carter, Dwivedi, Lee J, Rana NP, and Williams MD, Cluster 2 (green) consisting of 4 authors namely El Haddadeh R, Irani Z, Lee H, and Weerakkody V, Cluster 3 (blue) consisting of 4 authors, namely Gil-Garcia JR, Janssen M, Norris DF, and Reddick CG, and Cluster 4 (yellow) consisting of 2 authors, namely Faaeq MK and Mensah IK. Based on the results of the analysis, the authors in the red and blue clusters cite many of the authors in all clusters. While the authors in the green cluster only cite authors in the red and blue clusters, while the authors in the yellow cluster only cite authors in the blue and red clusters. In the following, we present the 10 authors who cite the most other authors (Table 3).

Table 3: Top 10 Authors Cite on Electronic Government Article

No	Authors	Documents	Citation	Network Strength
1	Dwivedi Y.K.	19	1194	73
2	Rana N.P	12	877	63
3	Weerakkody	20	927	52
4	Wiiliams M.D.	9	698	45
5	Carter I	6	2035	38
6	Irani	10	545	28
7	Janssen M..	6	621	24
8	Lee H.	5	126	16
9	Norris DF	5	389	15
10	El Haddadeh	66	257	14

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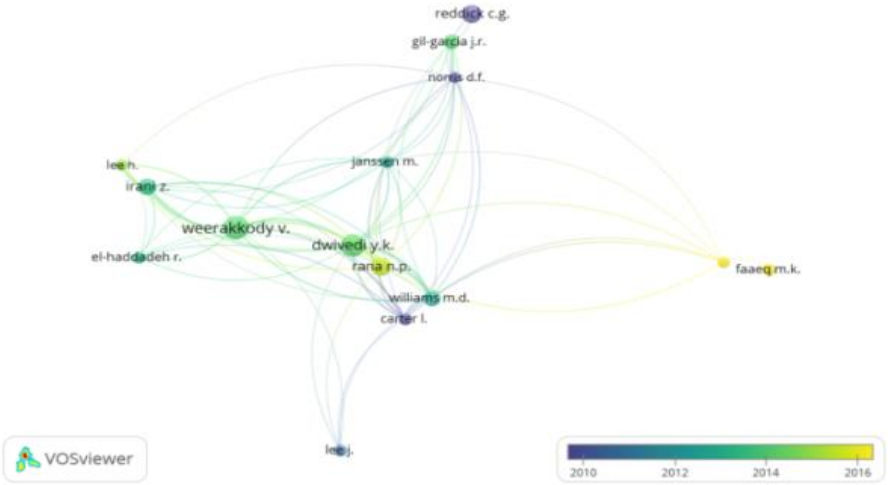
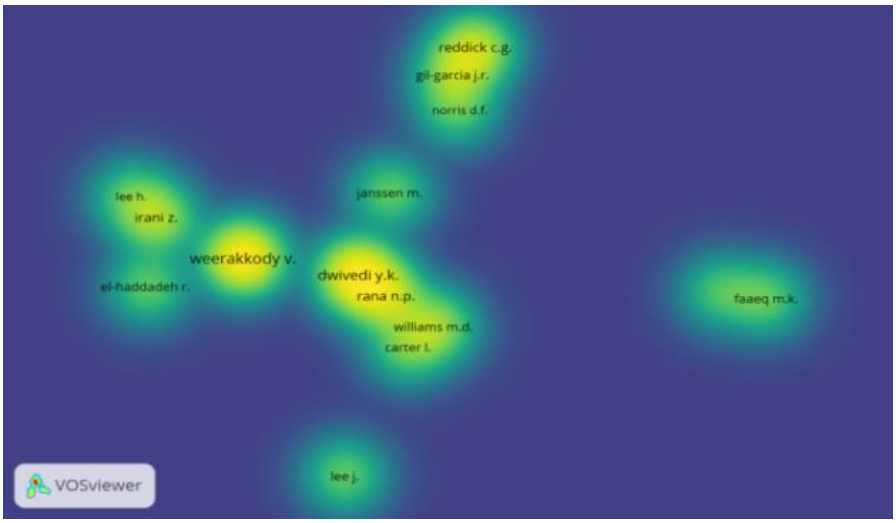
In Table 3, there are 3 authors who cite the most each other, namely Dwivedi YK, Rana NP and Weerakkody V. They have the largest number of citations and network strength. Based on the overlay visualization analysis (Figure 8), the articles written by the 22 authors started from 2010 to 2016. In 2010, the article on electronic government was written by Lee J, while the most recent article was written in 2016 by Faeeq MK, Mensah IK and Rana NP.

Figure 8: Overlay Visualization of Citation of authors on Electronic Government in the Scopus database from 2000 to 2021



Based on the density visualization analysis (Figure 9), we found 5 writers who appeared most frequently and actively cite, namely Dwivedi YK, Weerakkody V, Rana NP, Reddick CG and Gil-Garcia JR.

Figure 9: Density Visualization of Citation of Authors on Electronic Government in the Scopus database from 2000 to 2021



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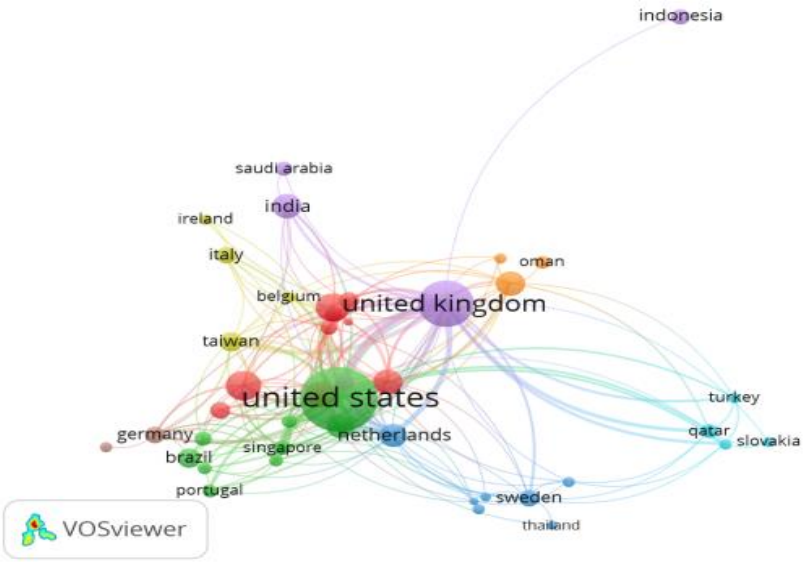
Citation Analysis with Unit Analysis Countries

The fourth analysis is VOSviewer analysis using citation analysis type and countries analysis unit. We also limit the maximum number of 25 authors and the minimum number of 5 authors in one article, and there is no minimum citation. Of the 132 countries, there are 51 countries that meet the threshold, and only 43 countries are interconnected. The results of this analysis are displayed in Figure 10.

Figure 10: Network Visualization of Citation of Countries on Electronic Government in the Scopus database from 2000 to 2021



Based on the network visualization analysis (Figure 10), we found 9 clusters. Cluster 1 (red) consists of 9 countries, namely Australia, Canada, Ghana, Greece, Iran, Malaysia, Mexico, South Africa, and South Korea. Cluster 2 (green) consists of 9 countries, namely Argentina, Austria, Brazil, France, Hong Kong, Portugal, Singapore, Spain, and the United States. Cluster 3 (blue) consists of 7 countries namely Czech Republic, Kazakhstan, the Netherlands, Slovenia, Sweden, Thailand, and Ukraine. Cluster 4 (yellow) consists of 4 countries namely Belgium, Ireland, Italy and Taiwan. Cluster 5 (purple) consists of 4 countries, namely India, Indonesia, Saudi Arabia, and the United Kingdom. Cluster 6 (tosca) consists of 4 countries, namely Lebanon, Qatar, Slovakia, and Turkey. Cluster 7 (orange) consists of 3 countries, namely China, New Zealand, and Oman. Cluster 8 (brown) consists of 2 countries, namely Finland and Germany. Meanwhile, cluster 9 (pink) only consists of 1 country, namely Jordan. Of the 9 clusters, there are several countries that have the strongest networks in their clusters, namely Greece, Malaysia, and Australia (red cluster), United States (green cluster), the Netherlands (blue cluster), the United Kingdom (purple cluster), and China (orange cluster). Authors in these countries have very strong networks in citing electronic government articles. The following is a list of the top 10 countries that cite the most authors in other countries (Table 4). clusters, there are several countries that have the strongest networks in their clusters, namely Greece, Malaysia, and Australia (red cluster), United States (green cluster), the Netherlands

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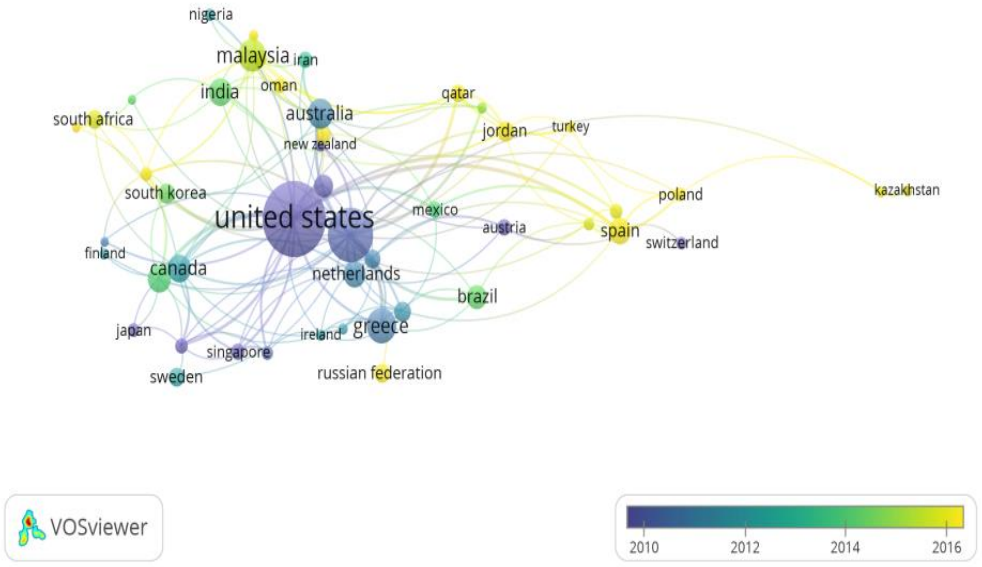
(blue cluster), the United Kingdom (purple cluster), and China (orange cluster). Authors in these countries have very strong networks in citing electronic government articles. The following is a list of the top 10 countries that cite the most authors in other countries (Table 4).

Table 4: Top 10 Countries Cite on Electronic Government Article

No	Country	Documents	Citation	Network Strength
1	United States	272	11659	227
2	United Kingdom	140	4577	208
3	Netherlands	35	2027	64
4	Jordan	20	215	47
5	Taiwan	26	1049	45
6	Canada	39	912	40
7	Mexico	13	1172	38
8	Singapore	13	1473	32
9	France	10	896	31
10	Australia	45	1567	30

Figure 11: Overlay Visualization of Co-authors of Countries on Electronic Government in the Scopus database from 2000 to 2021



The United States is the country that does the most electronic government research, according to the density visualization analysis (Figure 12). Outside of that, electronic government research is still uncommon.

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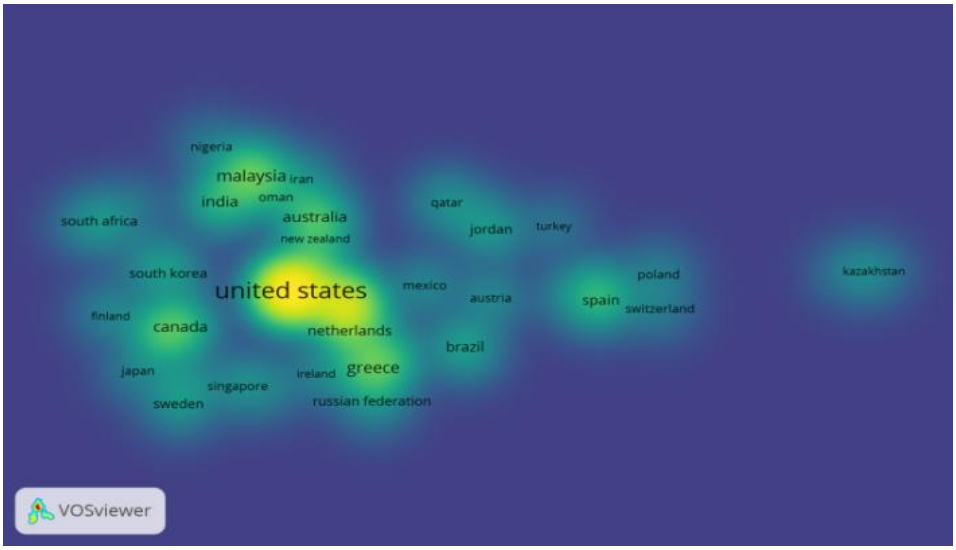
Figure 12: Density Visualization of Co-authors of Countries on Electronic Government in the Scopus database from 2000 to 2021



Comparison of Co-authorship and Citation Analysis

Based on the results of the co-authorship and citation analysis, we found that of the 10 highest authors from the co-authorship analysis and the 10 highest authors from the citation analysis, there were 8 authors who belonged to these 2 categories. They are Dwivedi YK, Weerakkody V, Rana NP, Williams MD, Irani Z, Lee H, El Haddadeh R. and Janssen. We present the data in Table 5.

Table 5: Comparison of Top 10 Authors Collaborate -Top 10 Authors Cite on Electronic Government Article

No	Co-authorship -author	Citation-author	Conclusion
1	Dwivedi Y.K.	Dwivedi Y.K.	Dwivedi
2	Weerakkody V	Rana N.P	Weerakkody
3	Rana N.P.	Weerakkody	Rana
4	Wiiliams M.D.	Wiiliams M.D.	Wiiliams
5	Irani Z.	Carter I	Irani
6	Lee H.	Irani	Lee H
7	El-haddadeh R.	Janssen M..	El Haddadeh
8	Tarabanis K.	Lee H.	Janssen
9	Tambouris E.	Norris DF	
10	Janssen M.	El Haddadeh	

Meanwhile, of the 10 countries with the highest co-authorship analysis results and the 10 highest countries with citation analysis results, there are 4 countries that fall into these 2 categories, namely the United States, the United Kingdom, Canada, and Australia. We present the data in Table 6.

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Table 6: Comparison of Top 10 Countries Collaborating- Countries Cite on Electronic Government Articles

No	Co-authorship -countries	Citation-countries	Conclusion
1	United States	United States	United States
2	United Kingdom	United Kingdom	United Kingdom
3	Canada	Netherlands	Canada
4	Spain	Jordan	Australia
5	Malaysia	Taiwan	
6	Qatar	Canada	
7	Australia	Mexico	
8	China	Singapore	
9	Greece	France	
10	Hongkong	Australia	

DISCUSSION

Interpretation: Some information is discovered using Scopus data, as well as co-authorship and citation analysis. The top 10 authors whose results are different are the results of the co-authorship and citation analysis in the author's analysis unit. Based on the co-authorship and citation analysis in the countries analysis unit, there are top 10 countries whose results are also different. However, from these results, there are several similarities that strengthen the authors' position as authors who are the most active in collaborating and the most active in citations. Besides that, it also strengthens the position of countries as the countries that appear the most and are actively collaborating and actively citing.

Limitation: Many limitations remain in this study. The data we use is only Scopus data, we do not get data from other sources. We also only perform analysis on certain types of analysis and units of analysis. We hope that bibliometric research on this topic will continue to develop to enrich further research.

Conclusion: Based on the results of the analysis, we found 8 authors who are actively collaborating and actively citing. From these 8 authors, we conclude that there are top 3 authors who are most actively collaborating and actively citing in conducting research on electronic government, namely Dwivedi YK, Weerakkody V, and Rana NP. These three authors have the most documents and citations and the greatest network strength. These three authors are often used as references by other authors when conducting electronic government research, so that they get a lot of insight into the development of electronic government research. Meanwhile, we found 4 countries that are included in both categories as well as the 10 countries with the highest co-authorship analysis results and the 10 highest countries with citation analysis results. From these 4 countries, we conclude that there are top 2 countries that collaborate the most in electronic government research so that the authors are often referred to by other authors, namely the United States and the United Kingdom. These two countries produce the most documents, as well as the largest citations and network strengths. Other countries outside of those still have great opportunities to conduct electronic government research.

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Dataset 1

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