Using CiteSpace to Visualize the Intellectual Structure of e-Service Research

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Abstract: The extant review studies in the field of e-service generally focus on a single subfield. The only two comprehensive reviews are out-of-date and haven't covered the whole field of e-service, so they cannot reflect the recent development of e-service research comprehensively and systematically. This paper identifies the most significant authors, the most important journals, the landmark articles in the field of e-service by using CiteSpace software. The contributions of this paper include identifying the important authors and journals, and integrating four indicators to determine the landmark articles.

1. Introduction

Because of the novelty of e-service practice and academic research [1], the research topics are relatively diversified. For researchers of this field, especially novices, it is very difficult to quickly and systematically understand the status of e-service research. Therefore, during the development of e-service research, it is necessary to review these relevant literatures. At present, the review studies in the field of e-service generally cover only one research topic, such as e-health [2], e-government [3], e-service quality[4], e-banking[5] and etc., and mainly adopt qualitative methods. The only two comprehensive reviews [1, 4] are out-of-date and haven't covered the whole field of e-service. So they cannot present the complete picture of e-service research. In order to fill the research gap, this paper uses the science mapping method to review the progress of e-service research. The main tasks include identifying the important authors, journals, and landmark articles in this field.

2. Method and Data

Because of the explosive growth of literatures in various fields, it is inevitable to use computer visualization technology to analyze literatures, and this technology is called the science mapping. Now, a large number of science mapping softwares have emerged, such as CiteSpace, UCINET, VOSviewer, Bibexcel, Histcite and etc. This paper uses CiteSpace software to review literatures of e-service field. It is necessary to build the retrieval strategy of literatures when using the science mapping method to quantitatively and visually analyze the literatures of e-service. This paper takes the SSCI database as the target for retrieval. The time span is from 1993 to 2021. The search item is set to "topic" and the search term combination is "TS = (e-service* or electronic service* or eservice* or digital service* or mobile service* or m-service*)". The language item is set to English. Finally, we obtain a total of 8327 valid records.

3. Empirical Results

3.1. Author Co-citation Analysis

One main goal of author co-citation analysis is to identify the highly cited authors. The initial setting of the CiteSpace software is as follows: Time Slicing is set to From 1993 To 2021, 2 Years Per Slice, because taking 2 years as a slice is a common practice [6]; Node Types is set to Cited Author; Selection Criteria is set to g-index and scale factor k is set to 9 (in CiteSpace, the g-index

proposed by Egghe [7] is added with a parameter k to control the size of the generated network); Pathfinder and Pruning sliced networks are selected for improving the calculation efficiency and deleting the redundant connections so as to make the network map of author co-citation present the most important information [6]; other parameters are set to default values.

The generated network map contains 550 nodes and 959 links, where a node refers to a co-cited author and a link refers to a relation that the two authors are co-cited one time. The result of the preliminary processing needs to be further adjusted. The main problem existing is the inconsistent writing of the author's name. For example, Davis Fred D and Davis FD will be recognized as two different authors. We can manually make CiteSpace treat the two names as the same one. After solving this problem, we get the citation frequencies of the different authors and the top 20 are listed in Table 1. They can be viewed as the most influential scholars in e-service research field.

Table 1 Top 20 of highly cited authors.

No	Author	Fre	C	BC	sigma	No.	Author	Fre	CB	BC	sigma
1	Davis FD	633		0.14	1	11	Agarwal R	256		0.0	1
2	Fornell C	607		0.13	1	12	Oliver RL	251		0.0	1
3	Venkatesh V	574		0.09	1	13	Bhattacherjee	249		0.0	1
4	Ajzen I	465		0.04	1	14	Podsakoff PM	245		0.0	1
5	Zeithaml VA	459		0.09	1	15	Pavlou PA	245		0.0	1
6	Parasuraman	454	5	0.04	1.24	16	WHO	242	9.85	0	1
7	Gefen D	427		0.17	1	17	Delone WH	228		0.0	1
8	Bagozzi RP	321		0.05	1	18	Chin WW	226		0.0	1
9	Hair JF	308		0.01	1	19	Rogers	226	13.0	0.0	1.26
10	Anderson JC	297		0.02	1	20	Taylor S	207		0.0	1

In Table 1, the top 20 authors' strength of citation burst (CB), betweenness centrality (BC) and sigma are also listed. The citation burst refers to a sharp increase of the citation frequency of a node (i.e., an author). The increase strength is indicated by the CB value which is calculated according to the revised burst-detection algorithm [8]. The betweenness centrality (BC) is proposed by Freeman [9] and used to measure the importance of a node in the process of knowledge diffusion across fields [6]. The higher the BC value of a node is, the more important it is. The sigma is used for measuring both BC and CB [10]. Although the indicator BC×CB that Zhu and Hua [11] developed is slightly different from the sigma in calculation formula, they are the same in essence. The top five authors with highest citation frequency are Davis FD, Fornell C, Venkatesh V, Ajzen I, Zeithaml VA; the top five authors with highest BC are Porter ME, Gefen D, Davis FD, Hoffman DL, Eisenhardt KM; the top five authors with highest CB are Tenopir C, Bakos, Malone TW, Hoffman DL, Nicholas D; the top five authors with highest sigma are Bakos JY, Hoffman DL, Porter ME, Tenopir C, Grover V. It is noteworthy that Hoffman DL ranks the top 20 in three indicators and his citation frequency is 200 times and ranks 21st.

3.2. Journal Co-citation Analysis

Similar to author co-citation analysis, the main goal of journal co-citation analysis is to identify highly cited journals. Change Node Types from Cited Author to Cited Journal and other parameters are the same as before. The spelling errors of journal names and other obvious errors need to be eliminated from the generated results. For example, WORKING PAPER is recognized as a journal name and need to be removed from the statistical results. Finally, we get a journal co-citation network with 651 nodes and 1036 links, in which a node refers to a cited journal and a link refers to a relation that the two journals are co-cited one time.

The 651 journals are ranked according to the citation frequency, and the top 20 journals are listed in Table 2. In addition, according to CB, the top 5 journals are COMMUN ACM, HARVARD BUS REV, J AM SOC INFORM SCI, SLOAN MANAGE REV, COLL RES LIBR; according to BC, the top 5 journals are MANAGE SCI, GERONTOLOGIST, J MARKETING, ACAD MANAGE REV, MIS QUART; according to sigma, the top 5 journals are MANAGE SCI, HARVARD BUS REV,

COMMUN ACM, J AM SOC INFORM SCI, B MED LIBR ASSOC. Taken together, MANAGE SCI and HARVARD BUS REV each achieve high rankings in three indicators, which indicate that they are very significant. The background colors of these two journals are marked with gray in Table 2.

Table 2 Top 20 of highly cited journals.

No	Fre	CB	BC	Sigma	Cited Journal
1	1440		0.12	1	MIS QUART
2	1329	36.0	0.24	2506.2	MANAGE SCI
3	1315	8.77	0.13	2.96	J MARKETING
4	1247	3.81	0.05	1.19	J MARKETING RES
5	1206		0.04	1	INFORM SYST RES
6	1150	78.1	0.04	22.6	COMMUN ACM
7	989		0.03	1	J ACAD MARKET SCI
8	923		0.03	1	INFORM
9	879		0	1	J BUS RES
10	847	10.8	0.05	1.65	JAMA-J AM MED ASSOC
11	829	62.3	0.05	26.62	HARVARD BUS REV
12	795		0.01	1	J RETAILING
13	792		0.01	1	DECIS SUPPORT SYST
14	746	10.4	0.08	2.3	BRIT MED J
15	719		0.02	1	J CONSUM RES
16	678	7.68	0.01	1.11	INT J ELECTRON COMM
17	652		0	1	J MANAGE INFORM
18	632		0.09	1	J AM MED INFORM
19	629		0.05	1	COMPUT HUM BEHAV
20	606	4.85	0.01	1.05	NEW ENGL J MED

3.3. Reference Co-citation Analysis

The Intellectual base is consisted of a group of highly co-cited references in a research field [6], and these references can also be called the landmark articles. Keep the settings of CiteSpace unchanged and visualize the running results, and we can get the reference co-citation network as shown in Figure 1. Each node is shown as a treering, and the size of a treering is proportional to the cited frequencies of the node. The ring color of a treering represents the time slice within which the node was co-cited, and the innermost ring of a treering represents the initial co-cited year, and the thickness of a ring represents the cited frequencies of the node within the corresponding time slice. As the landmark articles, the top 10 references in citation frequency are shown in Figure 1. The significance of a reference can also be presented by CB and BC besides the citation frequency. The rings of many nodes are painted in red all or mostly, which indicates that each of these nodes has citation burst within the time slice corresponding to the red ring. The outermost rings of a few nodes are purple, which means that the BC values of these nodes are very high. These nodes play important roles in connecting different clusters and they are likely to be pivotal points of paradigm shift [6]. In Figure 1, the four nodes with the highest BC values are pointed out by arrows.
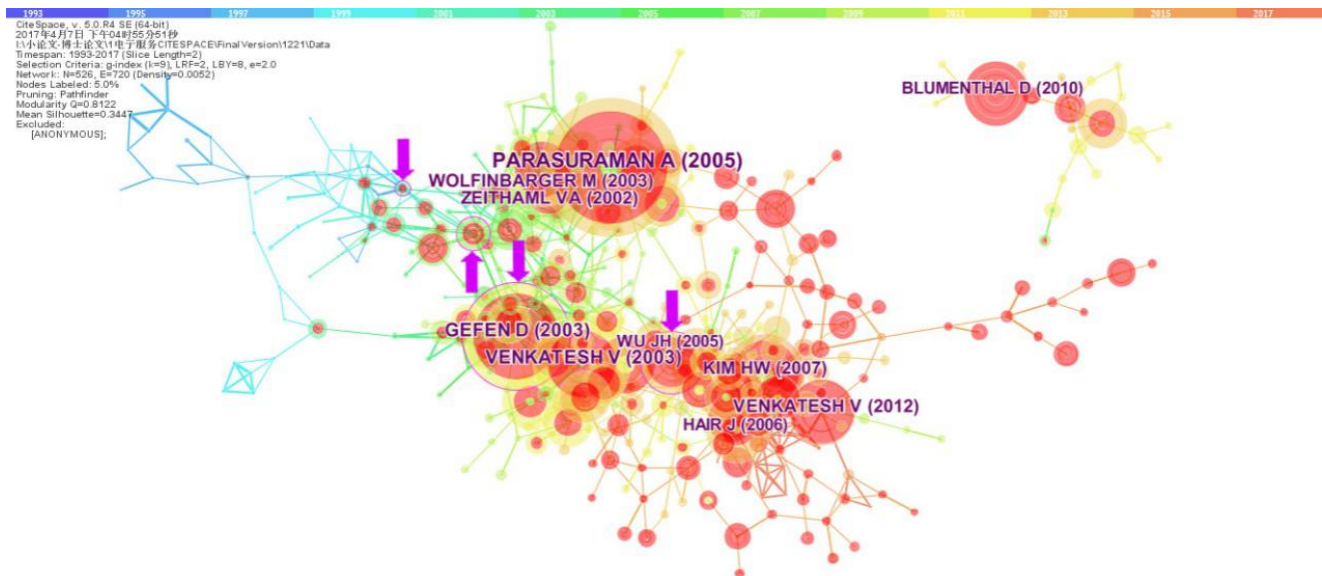
Figure 1 Visualization of landmark articles.

In order to ensure the selected landmark articles are representative, we use citation frequency, BC, CB, and sigma to identify the landmark articles together [12]. The final result is shown in Table 3, which contains a total of 20 landmark articles. These references rank the top 20 in at least two indicators, and the corresponding cell is painted in different levels of gray (dark gray means that a reference ranks the top 20 in four indicators; gray means that a reference ranks the top 20 in three indicators; light gray means that a reference ranks the top 20 in two indicators).

These landmark articles were published from 2000 to 2012. Although they are highly cited, the yearly citation frequencies of some, such as Wu and Wang [13], maybe decrease in recent years, which means the aging of knowledge.

Table 3 Landmark articles of e-service research.

Landmark article	Freq	Centrality	Burst	sigma
Parasuraman, et al.(2005)	126	0.08	18.77	4.22
Gefen, et al.(2003)	96	0.19	24.53	73.03
Wolfinbarger and Gilly (2003)	68	0.05	18.94	2.44
DeLone and McLean(2003)	51	0.05	17.33	2.26
Venkatesh, et al.(2003)	88	0.04	27.37	3.14
Zeithaml, et al.(2002)	68	0.04	24.8	2.48
Venkatesh, et al.(2012)	60	0.04	21.64	2.11
Pavlou (2003)	46	0.04	15.44	1.87
Wu and Wang(2005)	56	0.14	8.27	3.01
Kim, et al.(2007)	72	0.09	8.22	2.07
Reichheld and Schefter (2000)	30	0.2	14.4	13.18
Brynjolfsson and Smith (2000)	33	0.05	15.55	2.2
Blumenthal and Tavenner (2010)	58	0	13.12	1.01
Podsakoff, et al.(2003)	45	0.01	16.38	1.13
Chaudhry, et al.(2006)	45	0	15.53	1.02
Kim, et al.(2008)	52	0.08	5.34	1.53
Kuo, et al.(2009)	42	0.09	8.24	2.02
Mallat, et al.(2009)	41	0.08	8.02	1.9
van der Heijden (2004)	31	0.09	7.61	1.87
Devaraj, et al.(2002)	23	0.09	8.56	2.03

4. Conclusion

Because of lacking a comprehensive and systematic review of e-service research, this paper employed the science mapping method to explore the intellectual base of e-service research. First, through author co-citation analysis, we identified the major authors in this field. For example, the top five authors with highest citation frequencies are Davis FD, Fornell C, Venkatesh V, Ajzen I, and Zeithaml VA. Second, we found the important journals in this field through journal co-citation analysis. The most influential journals are MANAGE SCI and HARVARD BUS REV. Third, through the integrated use of the four indicators, i.e., citation frequency, CB, BC and sigma, we identified the landmark articles that constituted the intellectual base of this field. The contributions of this paper are as follows: firstly, this paper used science mapping software to conduct a comprehensive and systematic review of e-service researches; secondly, we integrated the four indicators, i.e., citation frequency, strength of citation burst, betweenness centrality and sigma, to determine the landmark articles that constituted the intellectual base of this field.

Inevitably, there are limitations in this paper. For instance, we could not manually recognize and eliminate the noise data completely, such as the aliases of many authors and journals. The basic principle coping with this problem is to ensure that the names of important authors and journals are spelled in a unified form so that the main analyses are not disturbed.

References

[1] Guardo M. C. D., Galvagno M., and Cabiddu F., *Analysing the Intellectual Structure of E-Service Research*, International Journal of E-Services and Mobile Applications. 2012, 4(2):19-36.

[2] Dainton C., and Chu C. H., "*A review of electronic medical record keeping on mobile medical service trips in austere settings*", International Journal of Medical Informatics. 2017, 98(Feb): 33-40.

[3] Hassan H. S., Shehab E., and Peppard J., "*Recent advances in e-service in the public sector: state-of-the-art and future trends*", Business Process Management Journal. 2011, 17(3): 526-545.

[4] Rowley J., "*An analysis of the e-service literature: towards a research agenda*", Internet Research. 2006, 16(3): 339-359.

[5] Shaikh A. A., and Karjaluoto H., "*Mobile banking adoption: A literature review*", Telematics and Informatics. 2015, 32(1): 129-142.

[6] Chen C., "*CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature*", Journal of the Association for Information Science and Technology. 2006, 57(3): 359-377.

[7] Egghe L., "*Theory and practise of the g-index*", Scientometrics. 2006, 69(1): 131-152.

[8] Kleinberg J., "*Bursty and Hierarchical Structure in Streams*", Data Mining and Knowledge Discovery. 2003, 7(4):373-397.

[9] Freeman L. C., "*Centrality in Social Networks: I. Conceptual Clarification*", Social Networks. 1979, 1(3): 215-239.

[10] Chen C., Hu Z., Liu S., and H. Tseng, "*Emerging trends in regenerative medicine: a scientometric analysis in CiteSpace*", Expert Opinion on Biological Therapy. 2012, 12(5): 593.

[11] Zhu J., and Hua W., "*Visualizing the knowledge domain of sustainable development research between 1987 and 2015: a bibliometric analysis*", Scientometrics. 2017, 110(2): 893-914.

[12] Zhu Y., Kim M. C., and Chen C., "An investigation of the intellectual structure of opinion mining research", *Information Research*. 2017, 22(1): 739.

[13] Wu J. H., and Wang S. C., "*What drives mobile commerce? An empirical evaluation of the revised technology acceptance model*", Information & Management. 2005, 42(5): 719-729.