Journal of Computer Information Systems: Intellectual and Conceptual Structure

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Abstract

This study examines the intellectual and conceptual structure of the *Journal of Computer Information Systems* (*JCIS*) from 1995 to 2021. The evolution of the key topics and the performance of different actors like the key publications, authors, institutions, countries, etc., are reported using a hybrid methodology based upon scientometrics and topic modeling. The latent topics are discovered using structural topic models, and the temporal deviation in the topic prevalences from 1995 to 2021 is visualized. Further, this study reports the most prominent articles, themes, and collaboration patterns using co-citation network analysis, assessment of keywords co-occurrences, and exploration of co-authorship patterns. Finally, the disciplinary influences and knowledge exchange across disciplines are reported. The most significant findings from the study reveal that themes such as "Information Security and Privacy", "Social Commerce and Social Networking Sites", "Social Media, Web Search and User Satisfaction", "Big Data Analytics and Cloud Computing, and "ICT for Economic Development and Empowerment" may become the hotspot for future research. The social exchange of knowledge reveals intra-disciplinarity, where *JCIS* gets most of the knowledge from the information systems domain itself. However, closest associations with the general business domain, computer science, marketing, organization science, and psychology for knowledge inflows make *JCIS* a net knowledge receiver.

Keywords: Scientometric analysis, topic modeling, structural topic models, co-citation analysis, keyword co-occurrence analysis

1. Introduction

Conducting periodic introspective evaluations of scientific disciplines and research outlets is becoming critical to understanding the accumulated knowledge evolution and impact.[1-4] In the recent past, many researchers have confirmed that these critical self-appraisals of domains, disciplines, and outlets often reveal interesting patterns and trends related to the intellectual, conceptual, and social structure of knowledge.[5,6] Moreover, these retrospective "state of the discipline" overviews also set an agenda for future research based on emerging areas of interest.[6] Many previous works have explored the cross-functionality and interdisciplinary nature of information systems research published in outlets such as *Information Systems Frontiers*[7], *Information Systems Research*[5], *European Journal of Information Systems*[8], *Knowledge-Based Systems*[9], *Journal of Enterprise Information Management*[10], and many more. These studies present a retrospective scientometric overview by reporting the publication patterns like the most influential authors, affiliations, and countries, citation structures, research keywords, and the underlying themes, and the co-citation patterns of landmark articles. As a result, scientometrics has become a standard method for measuring and analyzing scholarly literature.[11]

In this rich tradition, this study examines the intellectual and conceptual structure of the *Journal of Computer Information Systems (JCIS)* through an introspective analysis exploring the publication trends, key topics, themes, co-citations of articles, co-authorship network, and the exchange of knowledge between *JCIS* and other disciplines. *JCIS* is a leading journal from the

information systems (IS) domain that exclusively advances IS research by publishing excellence in terms of theoretical, conceptual, and empirical investigations on various aspects of adoption, usage, training, teaching, learning, and management of information technology-based systems. *JCIS* emerged as *Data Processor for Better Business Education* in 1960 and was subsequently renamed to *The Journal of Data Education* in 1969. Later in 1985, it was again renamed as *Journal of Computer Information Systems,* and since then, it has become a flagship journal of the International Association for Computer Information Systems. In the last two decades, *JCIS* has covered a lot of ground to become the most premier journal in the information systems domain with a 3.4 impact factor in 2020 and 3.36 as a five-year impact factor. Because of its unique positioning and being one of the best authoritative outlets of the field, *JCIS* has scored impressively in all journal quality metrics. With an impressive CiteScore of 5.0 in 2020, *JCIS* has maintained a high ranking (in A-category) as per the ranking of journals by the Australian Business Deans Council (ABDC). The growing diversity, multidisciplinarity, and the evolving shift in disciplinary focus in the last 20 to 25 years have motived this study to perform an introspective evaluation on the progress of *JCIS.* Given this objective, this study focuses on exploring the intellectual and conceptual structure of the information system research published in *JCIS.* More specifically, this study addresses the following research questions:

RQ1: What are the dominant topics the *JCIS* scholar's community is interested in, and how do these topics evolve?
RQ2: What are the most influential publications, authors, universities, and countries contributing to developing excellence in research at *JCIS*?
RQ3: What types of networks and associations exist among authors, themes, published articles, and cited articles?
RQ4: How often do other disciplines contribute knowledge to *JCIS,* and how does *JCIS* influences other disciplines?

The results of this study are crucial to identify the disciplinary influence of *JCIS*, map the key research topics and themes, understand the intellectual, social, and conceptual evolution of the subject area from a longitudinal perspective, and predict future research trends. In this way, this research makes a significant contribution to *JCIS* in particular and information systems research in general. By providing an integrated retrospective and prospective overview, the study offers vital insights to the policy-makers, editorial board, and the current and future contributors of *JCIS.* This research is significant and well-timed given the maturing of the information systems domain in the last two decades with increasing complexity and rapid changes in the industry during 1995-2021. The study envisages that the IS area has witnessed an increasing interest of researchers exploring divergent issues after the most significant macro events like the Y2K, Dotcom bubble burst, the emergence of social media, and the prominence of big data analytics in business. The heterogeneous and diversified themes and topics studies by *JCIS* scholars have created fragmentation in the overall epistemological structure. Hence, there is a strong need to assimilate the fragmented knowledge and provide a holistic integrative overview of *JCIS* research to provide a roadmap for future research endeavors.

The rest of the paper is organized as follows: First, the methodology and data used are described. Then, the results from the analyses are presented, followed by a discussion on the results. Finally,

this study provides a conclusion with provisions of future studies and an explanation of the limitations of the current work.

Note that the list of the *JCIS* articles reviewed in the current study appears only in the Appendix. They are not listed in the references section.

2. Methodology

To examine and report the intellectual and conceptual structure of *JCIS*, this study used two popular standard techniques: topic modeling and scientometric analysis.[11-13] The recent advancements in text analytics motivated this study to explore beyond the established approaches for topic modeling based on Latent Dirichlet Allocation (LDA)[14,15] and adapt a more sophisticated extension named Structural Topic Models (STM).[16] STM is generally used in prospective text analytics where the topical trends can be examined and visualized as per document-level metadata (such as the year of publication of the document) that enables researchers to highlight topics of future interest.[13] The scientometric analysis was used to identify the clusters from research keywords co-occurrences[17] and co-citation of references.[18] Finally, a comprehensive overview of the intellectual structure of *JCIS* research is presented by exploring the knowledge inflow and outflow across disciplines. The subsequent subsections offer more specifics of the data and procedures.

2.1. Topic modeling based on STM

A few contemporary studies have efficiently utilized topic modeling techniques such as LDA for exploring the conceptual structure of published literature in research outlets[19-22] and reporting the latent topics from academic disciplines.[11,12] Specifically, Wang *et al.*[21] have documented the most prominent topics and the topical trends from the literature published in the *Journal of Consumer Research.* Similarly, Zhang *et al.*[22] have reconfirmed that topic modeling is potentially useful in discovering the latent themes and reporting the academic hotspots for future exploration from the research published in *Knowledge-based Systems.* The latent thematic structure of research literature assessing online consumer behavior is examined by Vanhala *et al.*,[13] where the authors performed a comparative assessment on LDA and an advanced approach of topic modeling named structured topic models (STM) proposed by Roberts *et al.*[16]. Moreover, Sharma *et al.*[12] have mapped the key themes and topics from information management research using STM. On the same line, the topical coverage of hospitality and maritime transport literature is examined by Park, Chae, and Kwon[23] and Bai *et al.*,[24] respectively.

This study investigates the conceptual structure of *JCIS* by reporting the key topics and topical trends using STM. Roberts *et al.*[16] have extended the basic LDA model by introducing document-specific covariates in the modeling process, which can influence the topic prevalence and topical content. Similar to LDA, STM links semantically associated words in the document corpus to the latent topics and then models each document as a probabilistic mixture of topics based on Logistic-Normal distribution. In contrast to LDA, the topics can be correlated in STM, and the document metadata-based covariate can affect both document-topic proportions and topic-term distributions.[25] Figure 1 illustrates the technical plate representations of LDA and STM for

comparison between the model variables in the probabilistic generative process. The shaded nodes represent the observed model variables, and unshaded nodes denote the latent variables. As evident from the comparative plate notations, the topical prevalence parameter (θ_d) in STM is characterized by the document level topical prevalence covariate (X), and the topic-term distribution's parameter ($\beta_{d,k,v}$) is derived using a generalized linear model characterized by document structure-specific covariate (Y). The document-level covariates enable researchers to examine the variations in topic prevalence and topical content as per the variables specified in the metadata. A complete description of the data generative process is well documented by Roberts *et al.*,[25] and practical implementation in the R programming environment is given by Roberts *et al.*[26]

2.1.1. Data and text preprocessing for topic modeling

All the research articles published in *JCIS*, which are indexed in the Scopus database, are retrieved for the current study. Scopus provides the maximum coverage of *JCIS* content for the period 1995-2021 compared to Web of Science. Hence, the authors retrieved the bibliographic data available at Scopus till August 2021 for the current research. The data preprocessing for topic modeling was performed following the previous studies.[12,13,25,27] The text corpus for the topic modeling included the title, abstract, and keywords from each article. The most common English stopwords, non-English words, and special characters were removed from each text document using an R program based on TM (text mining) and NLP (natural language processing) package. The most frequent bigrams and trigrams were carefully processed by developing an n-gram tokenizer in the R programming environment. Hence, the trigrams such as "big data analytics" and "customer relationship management" were concatenated into unigrams such as "bigdataanalytics" and "customerrelationshipmanagement". Similarly, the frequent bigrams such as "cyber security" and "data mining" were transformed to "cybersecurity" and "datamining". Further, the entire text corpus was converted into lowercase, and sparse terms with frequency less than five in the entire corpus were removed.

The total number of topics was selected empirically after investigating the results with a varying number of topics from 5 to 30. To be consistent with the previous studies, the maximum averaged held-out likelihood measure, semantic coherence values, and exclusivity scores were examined for a different number of topics to get the optimal value for the number of topics.[12,13] As evident from Figure 2, we found the maximum held-out likelihood at K=16 and examined the topic content for further exploration.

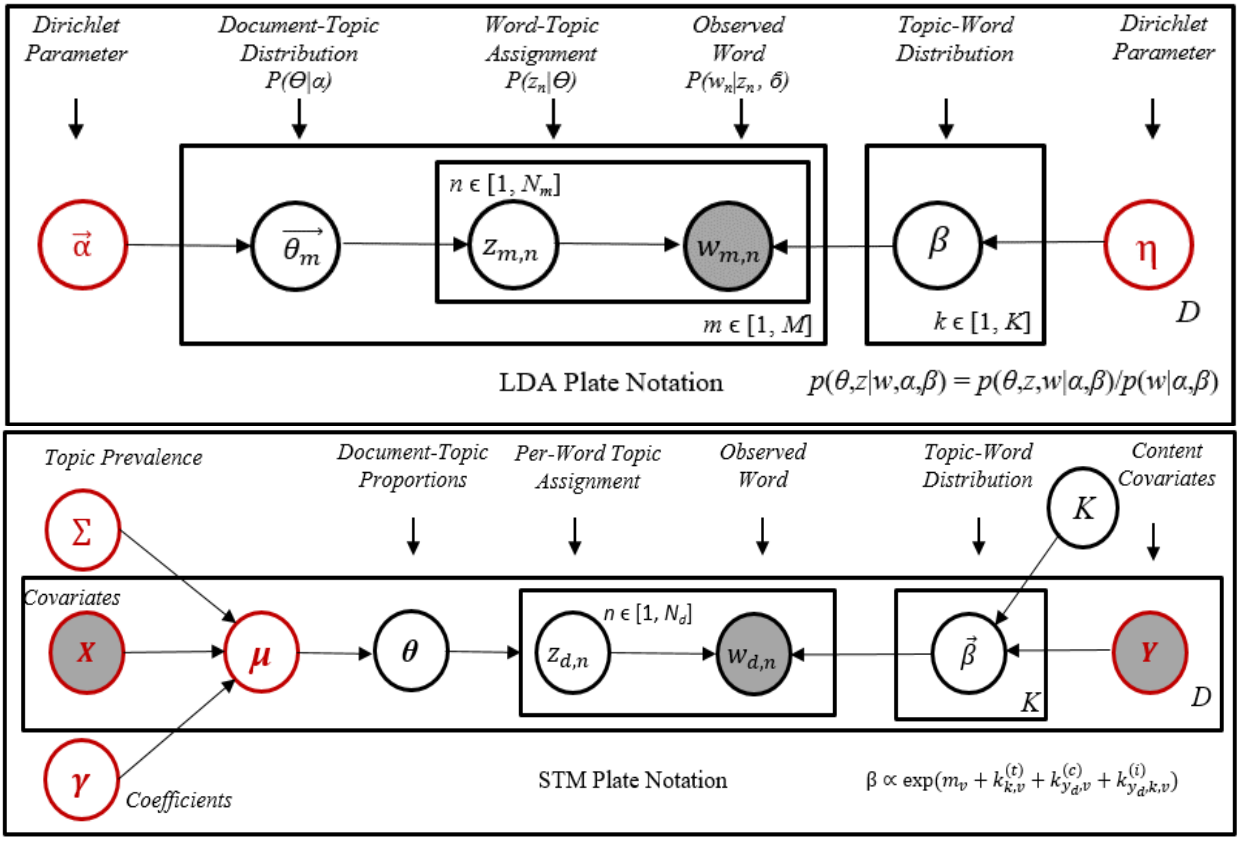

Figure 1. Association between the plate notations of LDA (Source: Blei *et al.*[14]) and STM (Source: Roberts *et al.*[16])

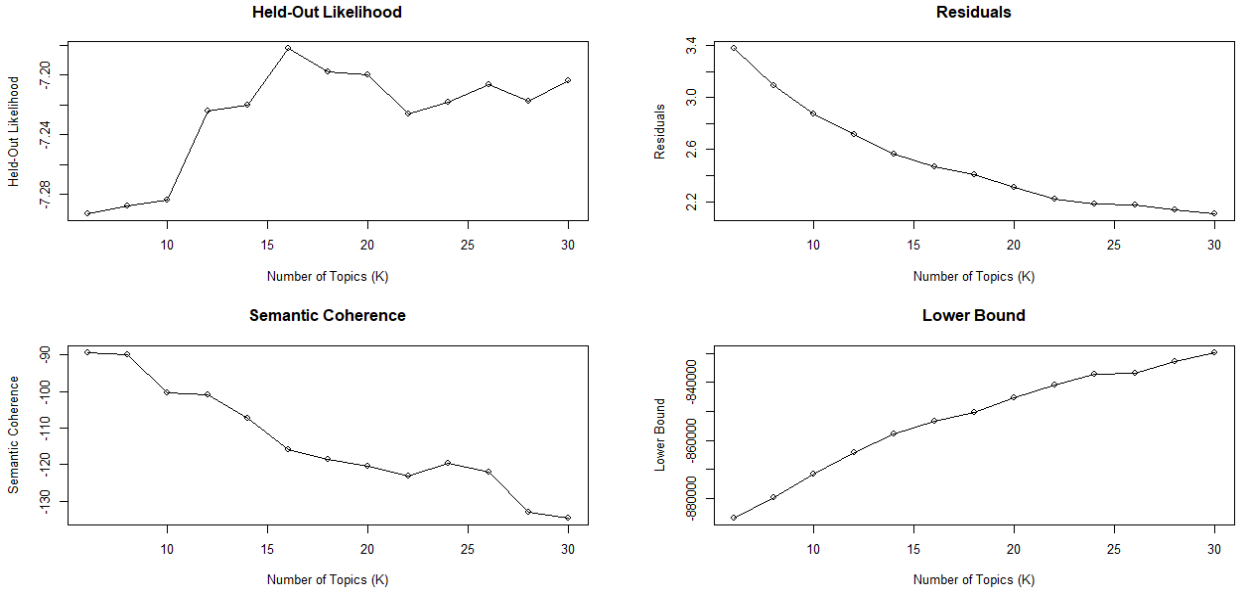

Figure 2. Selection of the number of topics (*K*)

Following the standard STM protocol suggested by Roberts et al. (2019), this study retrieved the top words from the probabilistic distribution of words per topic ($\beta_{d,k,v}$) and the top documents mapped as per topics (θ_d). The top documents that were closed to each topic were examined to

lable the topic and explore the extracted topics further. The other functions available in STM package of R programming environment were used to examine the topic correlation and model the variation on topic content as per publication years.

2.2. Scientometric analysis

The scientometric analysis is a scientific knowledge mapping technique that provides a retrospective quantitative overview of the association among research keywords, most prominent studies, and researchers.[6,11] Hence, the co-occurrence network structure analysis based on the most frequent keywords provides a conceptual overview of the published research.[28] Moreover, the network structure based upon the co-citation of research articles and collaboration among researchers highlights the intellectual overview of the published research.[29] This study has used a combination of two scientometric platforms: VOSviewer[30] and R programming environment with Bibliometrix package.[31]

The citation data for the scientometric analysis were retrieved from the Scopus database in comma-separated values format. Following the recent works,[6,11,12] this study visualized the co-occurrence network based on the most relevant frequent research keywords in *JCIS* published articles. A density visualization is also provided to identify the key themes forming from the research keywords.

To discover the clusters based on the co-citation of articles, we relied on the semantic association between research articles based on the number of the co-citation relationships. The co-citation relationship or co-citation strength between two articles is the frequency with which these articles are cited together by other articles. Hence, the articles in the co-citation clusters are cited together, and they are semantically correlated. The most central articles in these clusters based on the cluster centrality or PageRank measure are called the "landmark" articles that lay the foundation of the research domain and are pivotal to provide the essential theoretical underpinnings, core principles, and doctrines.[11] Hence, this study has identified the "landmark" articles that have supported the research published in *JCIS* to develop and evolve intellectually. Finally, this study has mapped the collaboration among the key contributors of *JCIS* and the disciplinary influence by assessing the knowledge inflow and outflow across different research domains. The knowledge inflow[32] specifies the journals and domains that form the core of the intellectual foundation of *JCIS.*

On the contrary, the knowledge outflow[3] highlights the journals and domains influenced by the research published in *JCIS.* The knowledge inflows ("citing") measure the disciplinary impact on research published in *JCIS*. The knowledge outflows ("cited") represent the impact of *JCIS* on other disciplines. Domain experts performed the disciplinary classification following the guidelines proposed in previous works.[3,5,32] In some cases, we consulted various journal classification databases and services such as Scimago and Scopus.

3. Results

3.1. Descriptive overview of *JCIS*

Table 1 presents a brief overview of the article publication pattern for *JCIS* from 1995 to 2021. The average years of publication for the articles during this duration are 13, and the average citations per document are 16.32. There are 51,265 references used by 1,382 *JCIS* articles, and authors have specified a total of 3,224 research keywords for indexing these articles. As compared to the total number of documents (n=1,382), the number of single-authored articles (n=240) specifies a high collaborative index (1.84) per document. The average number of co-authors per document is 2.43. Figure 3 visualizes the annual publication for the duration 1995-2021 as per data retrieved from Scopus. Substantial growth is clearly visible as per the number of published articles from 2020 to August 2021.

Table 1. An overview of the *JCIS* publications covered in the study

Description	Results
The timespan of *JCIS* articles covered in the current study	1995:2021
Total number of documents	1,382
Average years from publication	13
Average citations per document	16.32
Average citations per year per doc	1.497
References	51,265
Author's keywords	3,224
Total number of unique authors	2,291
Authors of single-authored articles	195
Authors of multi-authored articles	2,096
Articles published by a single author	240
Co-authors per documents	2.43
Collaboration Index	1.84

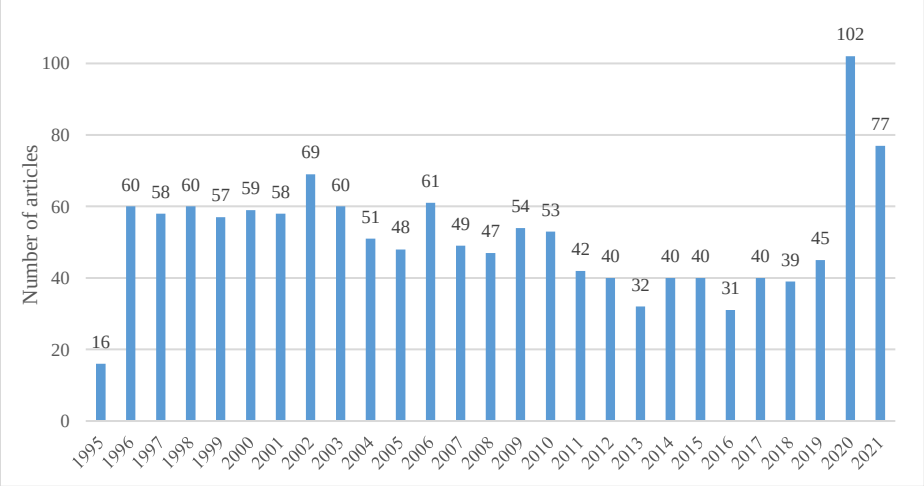

Figure 3. *JCIS* articles published from 1995 to Aug 2021

3.1.1. Author impact assessment

The scholarly impact analysis of different scientific actors from a standard research domain helps in tracking the structure and evolution of knowledge.[6] The most popular methods used for identifying the key researchers of a research outlet are h-index based on citations and publication in an outlet, total citations (TC), and the total number of publications (NP).[4] The readers may note that the citations in proprietary databases like Scopus and Web of Science do vary as compared to other databases like Google Scholar. Table 2 reports the contributed articles by authors from the highest number during the period 1995-2021. However, the total number of contributions in a research outlet by an author shows an active involvement, but it is not an indicator of the quality of research. Hence, the total citations and the starting year of publication (PY_start) provides a rough estimation of the quality and popularity of publications as more citations in fewer years may confirm the wide acceptance of published research

Table 2. Impact assessment of top 25 influential authors of *JCIS* during 1995-2021

Rank	Author	Current Affiliation	h_index	TC	NP	PY_start
1	Binshan Lin	Louisiana State University, USA	10	478	17	1995
2	Joanna Paliszkiewicz	Warsaw University of Life Sciences, Poland	5	82	13	2013
3	James J. Jiang	National Taiwan University, Taiwan	6	88	12	1995
4	Girish H. Subramanian	Pennsylvania State University, USA	6	194	11	1995
5	Xuequn Wang	Edith Cowan University, Australia	7	134	11	2015
6	Keng-Boon Ooi	UCSI University, Malaysia	7	337	11	2009
7	Stuart J. Barnes	King's College London, UK	5	247	11	2004
8	David C. Yen	Miami University, USA	5	317	11	1995
9	Alex Koohang	Middle Georgia State University, USA	5	73	10	2005
10	Keng Siau	University of Nebraska – Lincoln, USA	10	288	10	2002
11	Alain Yee Loong Chong	University of Nottingham Ningbo China	9	413	10	2009
12	Merrill Warkentin	Mississippi State University, USA	6	101	10	2010
13	J. Michael Pearson	Southern Illinois University, USA	7	250	10	1996
14	James J. Cappel	Central Michigan University, USA	5	246	9	1999
15	S. E. Kruck	James Madison University, USA	5	73	9	2000
16	Jay Liebowitz	Seton Hall University, USA	3	104	9	1996
17	William Yeoh	Deakin University, Australia	4	309	9	2010
18	Gary Klein	University of Colorado, Colorado Springs, USA	6	71	9	1996

19	Indrit Troshani	University of Adelaide, Australia	6	125	9	2011
20	Chuleeporn Changchit	Texas A&M University, USA	5	68	8	2003
21	Jeretta Horn Nord	Oklahoma State University, USA	4	37	8	2014
22	Alan R. Peslak	Penn State University, USA	8	147	8	2003
23	Victor R. Prybutok	University of North Texas, USA	6	350	8	1999
24	Kent A. Walstrom	Illinois State University, USA	4	72	8	1996
25	Petter Gottschalk	BI Norwegian Business School, Norway	5	127	7	2002

Note: The complete references of the JCIS articles reviewed in the current study appear only in the Appendix.

3.1.2. Most cited papers of JCIS

The qualitative indicators like total citations and average total citations per year (TC per Year) are standard measures to identify the influential research articles in various outlets of the information systems domain.[7,8,10] Following a similar approach, this study has reported the most cited papers published in *JCIS* in Table 3. Marshall, Cardon, Poddar, & Fontenot (2013), Sledgianowski & Kulviwat (2009), Bhattacherjee, Perols, & Sanford (2008), Nah & Delgado (2006), and Pan & Jang (2008) are the top five research articles published in *JCIS* as per TC ranking. As mentioned earlier, the citations reported in this study are as per the Scopus database only.

Table 3. Impact assessment of top 25 Most cited papers of *JCIS*

Rank	Authors	Title	TC	TC per Year
1	Marshall, Cardon, Poddar, & Fontenot (2013)	Does sample size matter in qualitative research?: A review of qualitative interviews in is research	388	43.11
2	Sledgianowski & Kulviwat (2009)	Using social network sites: The effects of playfulness, critical mass and trust in a hedonic context	380	29.23
3	Bhattacherjee, Perols, & Sanford (2008)	Information technology continuance: A theoretic extension and empirical test	281	20.07
4	Nah & Delgado (2006)	Critical success factors for enterprise resource planning implementation and upgrade	261	16.31
5	Pan & Jang (2008)	Determinants of the adoption of enterprise resource planning within the technology-organization-environment framework: Taiwan's communications industry	254	18.14
6	Yeoh & Koronios (2010)	Critical success factors for business intelligence systems	238	19.83
7	Halawi, McCarthy, & Aronson (2007)	An empirical investigation of knowledge management systems' success	158	10.53
8	Xu (2006)	The influence of personalization in affecting consumer attitudes toward mobile advertising in China	154	9.63
9	Mirchandani & Motwani (2001)	Understanding small business electronic commerce adoption: An empirical analysis	149	7.10
10	Li, Sarathy, & Xu (2010)	Understanding situational online information disclosure as a privacy calculus	142	11.83
11	Wen, Prybutok, & Xu (2011)	An integrated model for customer online repurchase intention	127	11.55
12	Korzaan (2003)	Going with the flow: Predicting online purchase intentions	123	6.47

13	Chong, Lin, Ooi, & Raman (2009)	Factors affecting the adoption level of c-commerce: An empirical study	123	9.46
14	Ling & Yen (2001)	Customer relationship management: An analysis framework and implementation strategies	122	5.81
15	Lee (2004)	Discriminant analysis of technology adoption behavior: A case of Internet technologies in small businesses	120	6.67
16	Kwok & Gao (2005)	Attitude towards knowledge sharing behavior	120	7.06
17	Korzaan & Boswell (2008)	The influence of personality traits and information privacy concerns on behavioral intentions	118	8.43
18	Bajwa, Garcia, & Mooney (2004)	An integrative framework for the assimilation of enterprise resource planning systems: Phases, antecedents, and outcomes	114	6.33
19	Sripalawat, Thongmak, & Ngramyarn (2011)	M-banking in metropolitan Bangkok and a comparison with other countries	110	10.00
20	McCloskey (2003)	Evaluating electronic commerce acceptance with the technology acceptance model	107	5.63
21	Fagan, Neill, & Wooldridge (2008)	Exploring the intention to use computers: An empirical investigation of the role of intrinsic motivation, extrinsic motivation, and perceived ease of use	107	7.64
22	Tan, Cater-Steel, & Toleman (2009)	Implementing it service management: A case study focusing on critical success factors	103	7.92
23	Plant & Willcocks (2007)	Critical success factors in international ERP implementations: A case research approach	102	6.80
24	Fagan, Neill, & Wooldridge (2003)	An empirical investigation into the relationship between computer self-efficacy, anxiety, experience, support, and usage	101	5.32
25	Yee (2013)	Understanding mobile commerce continuance intentions: An empirical analysis of Chinese consumers	101	11.22

Note: The complete references of the JCIS articles reviewed in the current study appear only in the Appendix.

3.1.3. Most productive universities

This study has used the research output to rank the most productive universities publishing in *JCIS*. Table 4 lists the top universities affiliated with the corresponding authors of *JCIS*. It is evident that *JCIS* attracts authors from top universities across the globe which is quite impressive. The top five universities are the University of North Texas, James Madison University, University of Arkansas, Utah State University, and Auburn University. Among the top productive universities, the universities from the USA have a significant share.

Table 4. Top 25 universities affiliated with *JCIS* contributors

Rank	Affiliations	Articles
1	University of North Texas	37
2	James Madison University	23
3	University of Arkansas	22
4	Utah State University	21
5	Auburn University	18
6	Illinois State University	18
7	Miami University	18
8	Middle Tennessee State University	18

9	Mississippi State University	17
10	Baylor University	15
11	Central Michigan University	15
12	Appalachian State University	14
13	Georgia Southern University	14
14	National Cheng Kung University	13
15	Northern Illinois University	13
16	Oklahoma State University	13
17	Penn State University	13
18	Southwest Missouri State University	13
19	University of South Florida	13
20	Murdoch University	12
21	Texas State University	12
22	University of Memphis	12
23	California State University	11
24	National Chung Cheng University	11
25	Virginia Commonwealth University	11

3.1.4. Most productive countries as per corresponding author's region

Table 5 reports the most productive countries as per the corresponding author's region that has contributed to *JCIS*. These countries are spread across continents which confirms the international coverage and dominance of *JCIS*. The top three countries comprise the United States, China, and S. Korea. The number of single country publications (SCPs) and multiple country publications (MCPs) highlights the collaborative native of research across counties. Low MCP ratios indicate that authors from different nationalities don't work as a team. Figure 4 shows the top ten countries contributing research to *JCIS*.

Table 5. Country performance

Rank	Country	Articles	TC	SCP	MCP	MCP_Ratio
1	USA	829	12973	762	67	0.08
2	China	82	1340	58	24	0.29
3	S. Korea	53	783	34	19	0.36
4	Australia	41	798	25	16	0.39
5	Hong Kong	26	439	18	8	0.31
6	Canada	25	447	19	6	0.24
7	United Kingdom	16	336	11	5	0.31
8	Georgia	14	191	12	2	0.14
9	Malaysia	10	396	6	4	0.40
10	Israel	9	216	8	1	0.11
11	Poland	9	83	7	2	0.22
12	Greece	8	74	7	1	0.13
13	Mexico	7	137	5	2	0.29

14	Slovenia	7	104	4	3	0.43
15	France	6	150	5	1	0.17
16	Norway	6	101	5	1	0.17
17	Singapore	6	156	5	1	0.17
18	Finland	5	33	4	1	0.20
19	New Zealand	5	147	4	1	0.20
20	Spain	5	79	4	1	0.20
21	Germany	4	20	4	0	0.00
22	Guinea	4	89	0	4	1.00
23	Saudi Arabia	4	81	4	0	0.00
24	Japan	3	23	3	0	0.00
25	Thailand	3	201	1	2	0.67

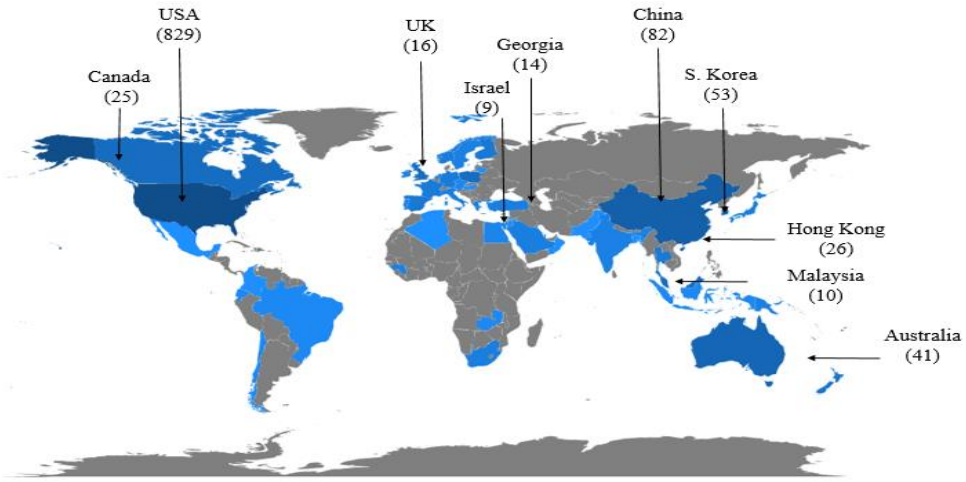

Figure 4. Geographical coverage with most productive countries

3.2. Results from STM based topic modeling

STM uncovers the hidden thematic structure of the text collection and the variation in this structure with respect to the covariates present in text metadata. This study has used article publication year as a covariate to assess the topical trends as per the time dimension. The results disclose that the extant literature published in *JCIS* predominantly concentrates on 16 key topics. This Section presents the content, association, correspondence, and comparative prevalence of these topics.

Table 6 displays the topic content as per the top words based on probability and Frequency–Exclusivity (FREX) scores. The most frequent words representing each topic are given first, and FREX lists the most exclusive words that are recurrent in a topic but not common in other topics. The exemplary studies column provides some representative articles corresponding to each topic. The topic labels are provided by authors after considering the most frequent words, top words as per FREX, and the relevant documents corresponding to each topic.

The word clouds formed from the content of each extracted topic are shown in Figure 5. The word clouds show the top words with the highest occurrence probability. The top representative documents for each topic can be identified using the posterior probabilities from the topic model. Hence, the most relevant documents for each topic are given in Table 6 to label the topic with minimum subjective judgment and explore the topics further. Figure 6 depicts the extracted latent topics and their relative proportions in the document corpus. Topic 9- "Social Commerce and Social Networking Sites" and Topic 7- "IT Skills, E-learning, and Teaching Information Systems" are the most prominent topics representing approximately 19% of the published research in *JCIS*.

Table 6. Topic labels, top words, and exemplary studies

Topic Labels	**Top-10 Words by Probability**	**Top-10 Words by FREX**	**Exemplary Studies**
Topic 1- Information Security and Privacy	Information Security, Privacy, Data Security, Internet, Behavior, Awareness, Cyber Security, Ethical, Ethics, Theory	Privacy, Awareness, Cyber Security, Ethical, Information Security, Phishing, Threat, Protection, Ethics, Information Security Policy	(Besmer, Thomas, & Lipford, 2021; Blackwood-Brown, Levy, & D'Arcy, 2021; Hanus, Wu, & Parrish, 2021; Hu, Hsu, & Zhou, 2021; Hwang, Wakefield, Kim, & Kim, 2021; Jeyaraj & Zadeh, 2021; Sun, Strang, & Pambel, 2020; White, 2021; Yeoh, Huang, Lee, Al Jafari, & Mansson, 2021; Zwilling et al., 2020)
Topic 2- Enterprise Software and Decision Support System	Enterprise Software, Decision Support System, Business Process, Integration, Organization, Technology, Software, Information System, Model, Evaluation	Assimilation, Training, SAP R/3, Certification, Systematic, Readiness, Framework, DSS, Interdisciplinary, Integration	(Avila & Garcés, 2017; Chee, Yeoh, Tan, & Ee, 2016; Delak, Vasilecas, & Bajec, 2017; Eriksson & Ferwerda, 2019; Gulledge & Sommer, 2004; Hayen & Cappel, 2003; Hayen, Holmes, & Cappel, 1999; Iyamu, 2019; Lam, 2005; Mitri, 1999; Shanmugam, Forcht, & Busing, 2000)
Topic 3- Information Systems Course Curriculum	Information System, Hardware, Computer Science, Curriculum, Course, Business, Curricula, Programs, Skills, Courses, Education, Information Technology, Issues, Program,	Curriculum, Curricula, Hardware, CIS, Courses, Computer Science, Information System, Programs, Redesign, Graduates, Graduate, Business Schools, Topics, Course, Faculty, Alumni, Schools,	(Brookshire, Yin, Hunt, & Crews, 2007; Lee, 2008; May & Lending, 2015; Mills, Hauser, & Pratt, 2008; Moshkovich, Mechitov, & Olson, 2005; Pierson, Kruck, & Teer, 2008; Plice & Reinig, 2007; Ryker, Fanguy, & Legendre, 2008; Stevens, Totaro, & Zhu, 2011; Tesch, Crable, & Braun, 2003; Wang & Wang, 2014)
Topic 4- ERP Implementation	Project, ERP Implementation, Enterprise Resource Planning, Project Management, System, Teams, System Development, Performance, Management, Critical Success Factor	ERP Project, Enterprise Resource Planning, Team, Project Success, ERP System, Critical Success Factor, ERP Implementation, Project Management, Team Member, Virtual Teams	(Janssens, van Moorst, Kusters, & Martin, 2020; Kang, Park, & Yang, 2008; Lall & Teyarachakul, 2006; Lea, Mirchandani, Sumner, & Yu, 2020; Peslak, Subramanian, & Clayton, 2007; Plant & Willcocks, 2007; Ram, Corkindale, & Tagg, 2016; Ram, Corkindale, & Wu, 2015; Subramanian & Peslak, 2010; Yeoh & Koronios, 2010; Zviran, Pliskin, & Levin, 2005)
Topic 5- CRM and Strategic Web Services	CRM, Web Services, Business, Strategy, Applications, Management, Global, Alignment, Internet, Social Technologies	Strategic, CRM, Alignment, Web Services, Strategy, Business Strategy, Social Technologies, Customer Relationship	(Du, Shin, & Lee, 2008; Ghosh, Dhumal, & Chawla, 2011; Howell & Wei, 2010; Kuo, 2011; Ling & Yen, 2001; Riemenschneider & McKinney, 2001; Shah & Murtaza, 2005; Tan, Yen, & Fang, 2002; Wei, Van Der Ende, & Lin, 2009; Zhang, 2004)

Topic Labels	Top-10 Words by Probability	Top-10 Words by FREX	Exemplary Studies
		Management, Email, Competition	
Topic 6- System Analysis, Modeling, and Design	Design, Object Oriented Design, Object-Oriented Analysis, Model, Modeling, System, Requirements, UML, Programming, Semantic	Object-Oriented Design, Semantic, UML, Language, Entity Relationship Diagram, Modeling, Database Design, Fuzzy, Verification, OOAD	(Beasley, 1999; Evermann & Wand, 2006; Grant, 2012; Guidry & Stevens, 2014; Johnson, 2002; Lujan-Mora & Trujillo, 2006; Navarro, Letelier, Mocholi, & Ramos, 2006; Perry, 1998; Sim & Wright, 2001; Sugumaran & Park, 2006)
Topic 7- IT Skills, E-learning, and Teaching Information Systems	E-Learning, Student Attitude, Computer, Learning, Course, Skills, Teaching, Education, Technology, Communication	Student, Classroom, Distance Education, Learning, Teaching, Multimedia, IT Skills, Instructors, E-Learning, Job Market, Career	(Alvarez, Mirzoev, Gowan, Henderson, & Kruck, 2019; Chen, Pratt, & Cole, 2016; Chipidza, Green, & Riemenschneider, 2019; Harris, Greer, Morris, & Jeffery Clark, 2012; Jones, Leonard, & Lang, 2018; Lui & Au, 2020; Martz, Hughes, & Braun, 2017; Morrison, Cegielski, & Kelly Rainer, 2012; Prat, 2012; Reychav, Warkentin, & Ndicu, 2016; X. Zhang, Crabtree, Terwilliger, & Redman, 2020)
Topic 8- Agile Software Development	Agile Software Development, Software, Development, Developers, Organization, Effort, System, Software Engineering, Professionals, CASE Tools	Agile, Software Development, Software, Open Source Software, Software Engineering, Developers, Software Design, Spreadsheet, Effort Estimation, Human Capital	(Dattero, Galup, Kan, & Quan, 2017; Tripp & Armstrong, 2018; Fernandez & Fernandez, 2008; Kakar, 2017; Liu, Yang, Klein, & Chen, 2013; Mellis, Loebbecke, & Baskerville, 2013; Setor & Joseph, 2020; Sun, Ha, Teh, & Huang, 2017; Sun & Schmidt, 2018; Tavares, Keil, Sanches da Silva, & de Souza, 2020)
Topic 9- Social Commerce and Social Networking Sites	Social Networking, Social Commerce, SNS, Trust, Perceived Usefulness, Influence, Attitude, Knowledge Sharing, Online, Behavior	Trust, Perceived Usefulness, Brand, Continuance Intention, Social Commerce, eWOM, Social Media, M-Commerce, Technology Acceptance Model, UTAUT	(Çetin, Paliszkiewicz, Güler, Köksal, & Cieciora, 2021; Changchit, Klaus, & Lonkani, 2020; Cutshall, Changchit, & Chuchen, 2021; Cutshall, Changchit, & Pham, 2020; Kock & Moqbel, 2021; Lee, Wang, Yeoh, & Ikasari, 2020; Lee, Zhang, & Mehta, 2020; Lin, Xu, & Wang, 2020; Qiao, Song, & Wang, 2021; Shang & Bao, 2020; Zhang, He, & Peng, 2020)
Topic 10- Knowledge Management System	Knowledge Management System, Knowledge Sharing, Knowledge Management, Network, Organization, Information, Architecture, Collaborative, Organizational Process, Decision Making	Knowledge Management, Knowledge Management System, Knowledge, Knowledge Transfer, Expert System, Knowledge-Based System, GSS, Reasoning, Knowledge Creation, Information Society	(Apostolou, Mentzas, & Abecker, 2008; Bock, Suh, Shin, & Hu, 2009; Chen, Liang, & Lin, 2010; Jeong, Ahn, & Rhee, 2013; Li & Tsai, 2009; Natek & Lesjak, 2013; Pfaff & Hasan, 2011; Prasarnphanich & Wagner, 2009; Schmidt & Sun, 2018; Tsai, Tsai, Li, & Lin, 2012; Wang & Wang, 2021)
Topic 11- E-Commerce, E-Business, and Online Auctions	Online Auctions, Websites, E-Commerce, Product, Customer, e-Business, Internet, Sales, Shopping, Service Quality	E-Commerce, Auctions, Electronic Commerce, Customer Service, Quality, Online Reviews, Customer Satisfaction, Retailers,	(Chen, Ayanso, & Lertwachara, 2018; Chow & O, 2006; Grandon & Mykytyn Jr., 2004; Green & Pearson, 2009; Jones & Leonard, 2014; Kim & Ahn, 2006; Kim, 2005; Lee & Lee, 2005; Lee, Trimi, & Yang, 2018; Pawłowski, 2021)

Topic Labels	Top-10 Words by Probability	Top-10 Words by FREX	Exemplary Studies
		Website Design, Website Quality	
Topic 12- Social Media, Web Search, and User Satisfaction	User, Information, Social Media, Control, Performance, Content, Web Search, Decision Making, User Satisfaction	Social Media, User Satisfaction, Interface, Richness, Experiment, Controls, Reliability, Adaptation, Search Engine, Information Seeking	(Church, Zhao, & Iyer, 2020; Etco, Sénécal, Léger, & Fredette, 2017; Han, 2018; He, Chen, Tian, & Chong, 2016; Kijek, Angowski, & Skrzypek, 2020; Kim, Sabherwal, Bock, & Kim, 2020; Kordzadeh & Young, 2020; Silber-Varod, Winer, & Geri, 2017; Thompson, Wang, & Daya, 2020; Zhang, Shan, & Peng, 2021; Zhang & Cabage, 2017)
Topic 13- Adoption of IT and Information Systems	Adoption, Organization, Information Technology, Innovation, Organizational Factors, Theory, Technology Adoption Model, Usage, Information System, Diffusion	Outsourcing, e-Government, Innovation, Healthcare, Diffusion, Adoption, Commitment, Innovativeness, Initiatives, Technology Adoption	(Bhatnagar, Madden, & Levy, 2017; Doargajudhur & Dell, 2020; Gonzalez, Mitra, & Turel, 2020; Hartzel, Marley, & Spangler, 2016; Lee, Shin, Li, & Kwon, 2016; Lee & Blouin, 2019; Sharif, Troshani, & Davidson, 2015; S. Sun, Cegielski, Jia, & Hall, 2018; Tobler, Colvin, & Rawlins, 2017; Zhou, Chong, Zhen, & Bao, 2018)
Topic 14- Big Data Analytics and Cloud Computing	Big Data Analytics, Network, System, Analysis, Cloud Computing, Data Mining, Clustering, Simulation, Development, Accuracy	Big Data Analytics, Clustering, Data Science, Business Analytics, Cloud Service, Data Mining, Caching, Data Warehousing, Data Analytics, Machine Learning	(Asamoah, 2020; Bedeley, Ghoshal, Iyer, & Bhadury, 2018; Cao, Tian, & Blankson, 2021; Gardiner, Aasheim, Rutner, & Williams, 2018; Jaber & Abbad, 2021; Park & Kim, 2021; Pawłowski, 2021; Sun & Huo, 2021; Sun, Strang, & Firmin, 2017; Sun, Sun, & Strang, 2018; Wang & Jones, 2020)
Topic 15- Firm Performance and Business Value of IT	Information Technology, Firm Performance, Managers, Business Value, Organizational Impact, Financial, Investment, Benefits, Productivity, Capabilities	Firm Performance, Groupware, Manufacturing, Investments, Industry, Managers, Business Value, Capabilities, Organization Environment, Productivity	(Abrahams & MacMillan, 2009; Han, Hsieh, Lai, & Li, 2011; Jaber & Abbad, 2021; Matook, 2014; Meroño-Cerdán, 2008; Ong & Chen, 2016; Ronen, Geri, & Raban, 2015; Wimble, Singh, & Phillips, 2017; Yao, Sutton, & Chan, 2009; Zhang & Huang, 2012)
Topic 16- ICT for Economic Development and Empowerment	Empowerment, Economic Development, ICT, Information System, Gender, Academic, Cultural, Social, Community, Women	Women, Gender, ICT, Cultural, Countries, Differences, Qualitative, Power, Gender Difference, Community	(Çetin, Urich, Paliszkiewicz, Mądra-Sawicka, & Nord, 2021; Erman, Rojko, & Lesjak, 2020; Johnson, Kiser, & Kappelman, 2020; Lee & Watson-Manheim, 2014; Nord, Riggio, & Paliszkiewicz, 2017; Peslak, 2005; Rainer Jr., Laosethakul, & Astone, 2003; Rao, 2003; Ziemba, 2019; Ziemba, Eisenbardt, Mullins, & Dettmer, 2020)

[*Note: The complete references of the JCIS articles reviewed in the current study appear only in the Appendix*]

Topic 1- Information Security and Privacy concerns the research issues related to information security, organizational cybersecurity, and privacy of user information. Privacy and security of information have become the key concerns in the current era of big data (Sun, Strang, & Pambel, 2020) that have motivated researchers to explore the implications of security education and

awareness (Blackwood-Brown, Levy, & D'Arcy, 2021, Hu, Hsu, & Zhou, 2021; Hwang, Wakefield, Kim, & Kim, 2021). The increasing number of cyber-attacks such as Phishing (Hanus, Wu, & Parrish, 2021; Yeoh, Huang, Lee, Al Jafari, & Mansson, 2021) and Spoofing (Kruck & Kruck, 2006) have significantly impacted the research on cyber security awareness (White, 2021) and users knowledge and behavior (Zwilling et al., 2020).

Topic 2- Enterprise Software and Decision Support System addresses the key research related to the selection of enterprise software and systems to support managerial decision-making. Enterprise software adoption requires reengineering of business processes (Shanmugam, Forcht, & Busing, 2000) that leads to management of change at the enterprise level (Avila & Garcés, 2017). Several key research issues related to the adoption of enterprise software such as SAP R/3 have been well studied by several researchers (Gulledge & Sommer, 2004; Hayen & Cappel, 2003; Hayen, Holmes, & Cappel, 1999; Iyamu, 2019) for understanding the complexities associated with these information systems.

Topic 3- Information Systems Course Curriculum represents the research related to development, adoption, and evaluation of information systems course curriculum (Brookshire, Yin, Hunt, & Crews, 2007; May & Lending, 2015; Stevens, Totaro, & Zhu, 2011). Assessing the information technology skills of students and designing a course curriculum to teach information systems as per the dynamic requirements of the industry have been challenging, and several researchers have proposed novel methods to address these challenges (Plice & Reinig, 2007; Ryker, Fanguy, & Legendre, 2008; Tesch, Crable, & Braun, 2003; Wang & Wang, 2014).

Topic 4- ERP Implementation represents the research related to the implementation of enterprise resource planning (ERP) systems. The complexities regarding the implementation and maintenance of ERP systems have motivated researchers to explore organizational readiness (Ram, Corkindale, & Wu, 2015), examine several critical success factors (Plant & Willcocks, 2007), and assess user satisfaction and perceived usefulness (Zviran, Pliskin, & Levin, 2005). The adoption and learning of ERP require assessing personality types (Lea, Mirchandani, Sumner, & Yu, 2020) and implementation of the ERP requires evaluation of user perception differences (Subramanian & Peslak, 2010).

Topic 5- CRM and Strategic Web Services deals with the research related to customer relationship management (CRM) systems and Web services. CRM provides a holistic view of the customer, which helps in managing strategic relationships with the customer and partners (Kuo, 2011; Ling & Yen, 2001; Shah & Murtaza, 2005). In addition, web services enable data and application integration which are crucial for a seamless e-Business (Zhang, 2004) and web-based e-commerce (Riemenschneider & McKinney, 2001).

Topic 6- System Analysis, Modeling and Design deals with issues surrounding requirement analysis (Grant, 2012), requirements specification (Navarro, Letelier, Mocholi, & Ramos, 2006), system modeling (Lujan-Mora & Trujillo, 2006), and design (Johnson, 2002). Contemporary approaches like object-oriented analysis and design (Sim & Wright, 2001) have attracted researchers to address the complexity of system analysis diagrams and models (Rob, 2006).

Topic 7- IT Skills, E-learning, and Teaching Information Systems is more specific to teaching and learning IT and Information Systems. The adoption of IT-based education and use of IT devices while learning has motivated researchers to explore several aspects related to e-learning (Morrison, Cegielski, & Kelly Rainer, 2012), adoption of tablets enabled with smart school websites (Reychav, Warkentin, & Ndicu, 2016), use of simulation games (Cronan & Douglas, 2012), and computer-based assessments (Schneberger, Amoroso, & Durfee, 2007).

Topic 8- Agile Software Development appreciates the adoption of agile methodologies in information systems development. Requirements uncertainties (Mellis, Loebbecke, & Baskerville, 2013) have made software project management a risky affair (Liu, Yang, Klein, & Chen, 2013; Tavares, Keil, Sanches da Silva, & de Souza, 2020), and agile development approaches have proved their worth in achieving business results (Dattero, Galup, Kan, & Quan, 2017; Fernandez & Fernandez, 2008).

Topic 9- Social Commerce and Social Networking Sites represents the research related to the adoption of social commerce (Cutshall, Changchit, & Chuchen, 2021), consumers' participation in social commerce (Cutshall, Changchit, & Pham, 2020), use of social networking site (Kock & Moqbel, 2021), knowledge sharing via user-generated content on social networking sites (Lin, Xu, & Wang, 2020), and usage of user-generated content such as online reviews (Changchit, Klaus, & Lonkani, 2020). Electronic word-of-mouth (EWoM) has been a rich source of subjective opinion that influences the purchase decisions of potential customers in social commerce (Leong, Hew, Ooi, & Lin, 2019).

Topic 10- Knowledge Management System is related to the research on managing knowledge in organizations (Apostolou, Mentzas, & Abecker, 2008) and adoption of knowledge-based systems at the organizational level (Bock, Suh, Shin, & Hu, 2009). Knowledge management requires knowledge capturing (Li & Tsai, 2009), and collaborative knowledge creation facilitates knowledge management in a more democratic way (Pfaff & Hasan, 2011; Prasarnphanich & Wagner, 2009). Moreover, researchers have shown that knowledge management improves organizational capabilities (Tsai, Tsai, Li, & Lin, 2012) and organizational performance (Almashari, Zairi, & Alathari, 2002).

Topic 11- E-Commerce, E-Business, and Online Auctions is related to electronic commerce and IT-enabled businesses. A plethora of research published in *JCIS* on e-commerce and e-business has explored several aspects such as trust in e-shopping (Chow & O, 2006; Jones & Leonard, 2014; Kim & Ahn, 2006), performance impacts of web-enabled retail services (Chen, Ayanso, & Lertwachara, 2018), usage intentions in e-commerce (Grandon & Mykytyn Jr., 2004), service quality in e-commerce (Sullivan & Walstrom, 2001), and effectiveness of e-commerce (Udo & Marquis, 2001).

Topic 12- Social Media, Web Search, and User Satisfaction combines research on online search behavior (Etco, Sénécal, Léger, & Fredette, 2017), consumption of social media, and social media analytics (He, Chen, Tian, & Chong, 2016; Kordzadeh & Young, 2020), adverse effects of social media usage such as social media burnout (Han, 2018) and social media addiction (Turel, 2015), and social media monitoring (Kim, Sabherwal, Bock, & Kim, 2020).

Topic 13- Adoption of IT and Information Systems concerns the research related to the adoption of IT-based systems. The challenges related to the adoption of innovative IT devices and information systems have attracted researchers to explore several aspects concerning motivation, intent to use, user adaptation, and perceived usefulness of IT and Information Systems. For example, organizational adoption of big data (Sun, Cegielski, Jia, & Hall, 2018), adoption of secure medical teleconferencing by patients (Bhatnagar, Madden, & Levy, 2017), adoption of Bring Your Own Device (BYOD) (Doargajudhur & Dell, 2020), usage of health-related social media (Gonzalez, Mitra, & Turel, 2020), adoption of e-supply chain integration (Zhou, Chong, Zhen, & Bao, 2018), etc. have been explored in several scholarly works.

Topic 14- Big Data Analytics and Cloud Computing concerns the research related to data and business analytics (Sun & Huo, 2021) as well as cloud computing. Big data analytics significantly impacts firm capabilities (Cao, Tian, & Blankson, 2021) and firm performance (Jaber & Abbad, 2021). Research has confirmed that big data analytics can enhance business intelligence (Sun, Strang, & Firmin, 2017). However, the adoption of big data analytics and cloud computing require firms to develop analytics capabilities (Liberatore, Pollack-Johnson, & Heller Clain, 2017) and invest in reskilling employees to exploit analytics in a better way (Chen & Jiang, 2020).

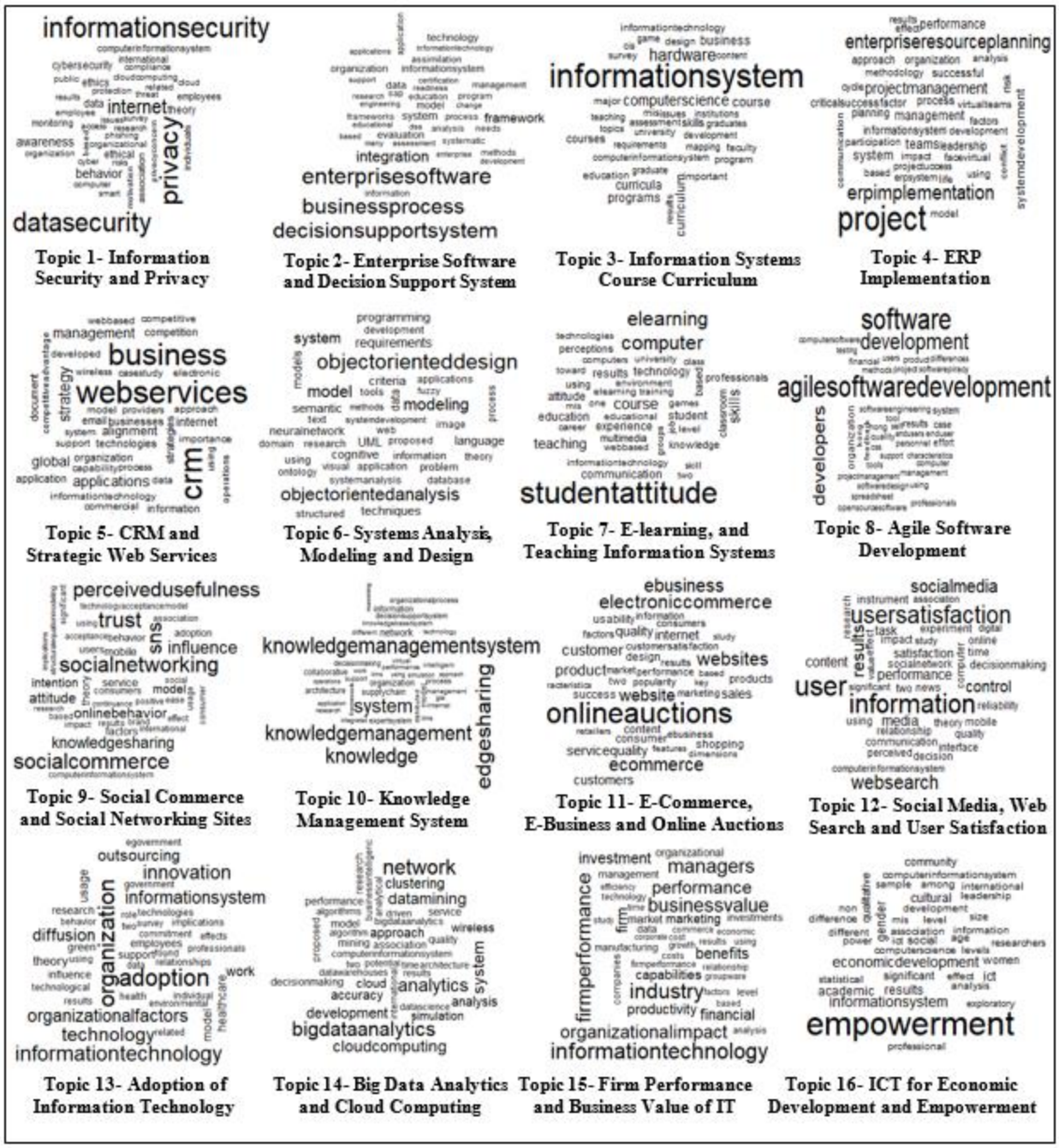

Figure 5. Word clouds emerging from the content of each topic [Note: Top 40 words with the highest occurrence probability are illustrated. The varying font size represents occurrence likelihood. Topics are labeled by considering the top words, FREX words, and the top documents related to each topic]

Topic 15- Firm Performance and Business Value of IT is related to evaluating the performance of IT interventions in businesses (Matook, 2014), assessing economic value from IT projects (Abrahams & MacMillan, 2009), exploring the impact of IT investment on worker productivity (Han, Hsieh, Lai, & Li, 2011), and business value creation from IT (Wimble, Singh, & Phillips, 2017; Yao, Sutton, & Chan, 2009). This topic is also related to examining the influence of IT investments on customer satisfaction and shareholder returns (Dardan, Stylianou, & Kumar, 2006).

Topic 16- ICT for Economic Development and Empowerment represents an important domain that is related to the role of information and communication technology (ICT) in development and empowerment. The impact of ICT on economy (Erman, Rojko, & Lesjak, 2020) and its role in women empowerment (Çetin, Urich, Paliszkiewicz, Mądra-Sawicka, & Nord, 2021) and social development (Nord, Riggio, & Paliszkiewicz, 2017) is well documented by researchers. The contributions of ICT in the sustainable information society (Ziemba, 2019) and rural communities (Rao, 2003) are also studied and documented.

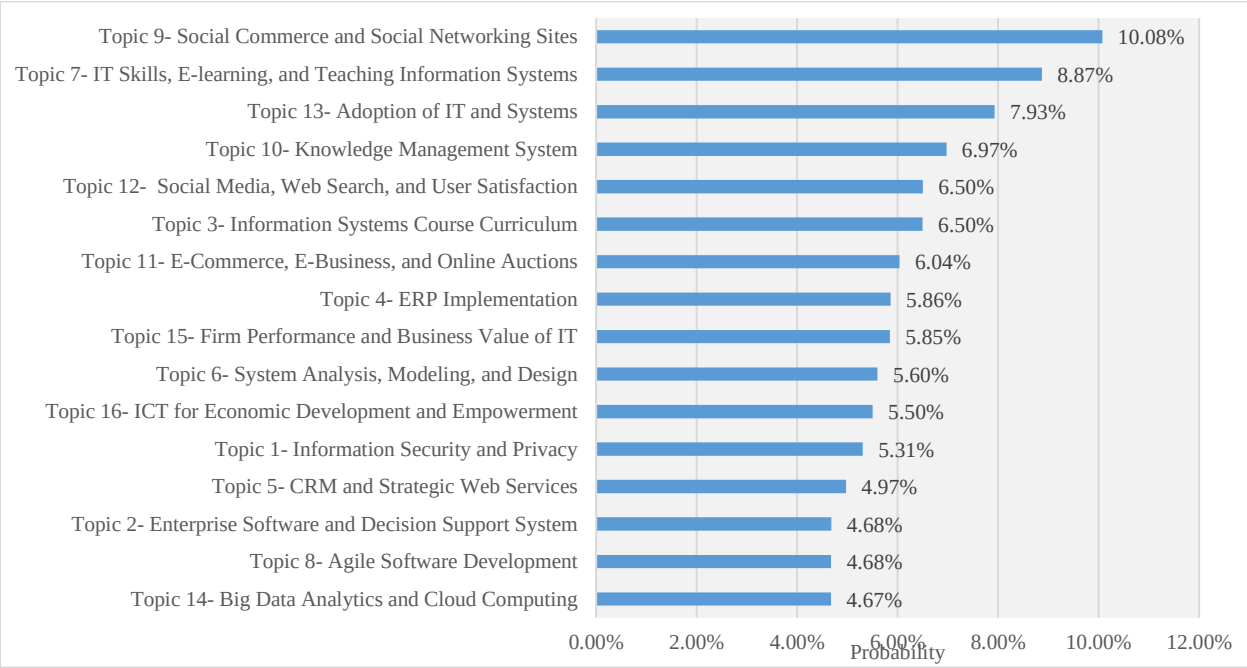

Figure 6. Extracted topics and their proportions

3.3. Results from the scientometric analysis

The scientometric analysis exploits the sophisticated statistical algorithms to find sematic associations in scientific knowledge present in voluminous scholarly literature with any potential subjective bias.[12,13] The following subsections provide the results of various scientometric analyses performed in the current work.

3.3.1. Co-citation clusters

Small[29] suggested co-citation analysis for highlighting the intellectual structure of scholarly domains and disciplines. The basic idea of co-citation-based cluster analysis is to map research documents in different clusters based on the semantic associations among them.[33] Two research articles are semantically associated if these are cited together by other research articles. Hence, this co-citation-based semantic relationship can be used to organize research articles in different clusters that in turn may reveal the most important articles that are crucial in the clusters based on centrality scores.[29] Following the recent extant literature,[6,11,33] this study adopts the Louvain algorithm implemented in the Bibliometrix package[31] to generate a top 50 nodes co-citation network that highlights clusters of research articles in different colors. Figure 7 depicts the co-

citation network with four clusters that can be processed further to discover the subthemes emerging out from this. The research articles in a cluster are cited together, and they form a common theme that is pivotal to the entire research domain. The cluster in red color (Cluster 1) is dominated by articles exploring the technological acceptance of information technology and information systems. The cluster represented in blue color (Cluster 2) represents the studies related to behavioral aspects of information systems such as success and continuance. The green cluster (Cluster 3) is dominated by studies exploring trust in information technology such as online shopping and e-commerce. Finally, the purple-colored cluster (Cluster 4) represents the subtheme of information system usage and utilization for self-efficacy.

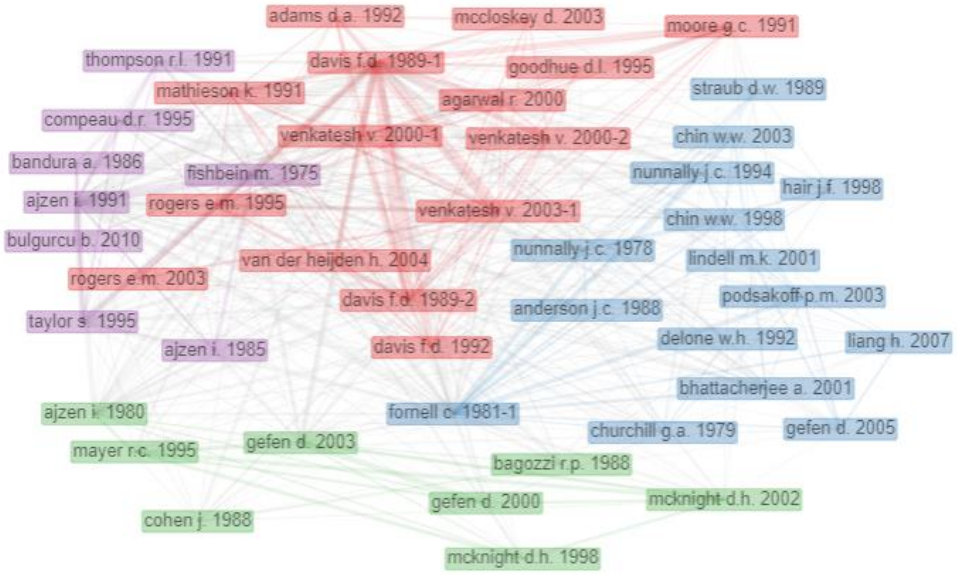

Figure 7. Co-citation clusters formed from *JCIS* articles

Further, the most important articles that have contributed the most to the intellectual development and scholarly evolution of *JCIS* can be discovered from the co-citation clusters following the measures like centrality and PageRank.[11,34] The *betweenness centrality* measures influence of a node in the entire network based upon the distance from other nodes. A few nodes in the co-citation network work as focal nodes that are crucial for overall connectivity and have close links with many other nodes. Hence, these focal nodes have high centrality scores, and other nodes closer to these high-scoring focal nodes have relatively higher scores than other nodes far from focal nodes. This concept is also represented by the PageRank score in a network where relatively higher scores are assigned to those nodes in the network that are connected to other focal nodes. In the co-citation clusters, the centrally located document essential for the overall formation and structure of the network may be identified as landmark articles that strongly influence the extant studies published by *JCIS*. These landmark articles are co-cited by *JCIS* articles and have contributed the most to the formation of knowledge and intellectual structure. Table 7 lists the top 5 studies in each cluster based on centrality and PageRank scores. The readers may observe that these studies are not published in *JCIS* but have influenced the research published in this outlet.

Table 7. Landmark publications discovered from co-citation clusters

Cluster	Author and Year of Publication	Title of the Article	Centrality	PageRank
1	Davis[35]	Perceived usefulness perceived ease of use and user acceptance of information technology	163.03	0.08
1	Davis, Bagozzi, and Warshaw[36]	User acceptance of computer technology: a comparison of two theoretical models	37.68	0.04
1	Venkatesh, Morris, Davis, and Davis[37]	User acceptance of information technology: toward a unified view	30.75	0.04
1	Venkatesh and Davis[38]	A theoretical extension of the technology acceptance model: four longitudinal field studies	8.64	0.03
1	Venkatesh[39]	Determinants of perceived ease of use: integrating control intrinsic motivation and emotion into the technology acceptance model	7.98	0.02
2	Fornell and Larcker[40]	Evaluating structural equation models with unobservable variables and measurement error	156.25	0.05
2	Podsakoff, MacKenzie, Lee, and Podsakoff[41]	Common method biases in behavioral research: a critical review of the literature and recommended remedies	10.60	0.02
2	DeLone and McLean[42]	Information systems success: the quest for the dependent variable	7.82	0.01
2	Bhattacherjee[43]	Understanding information systems continuance: an expectation-confirmation model	4.57	0.02
2	Chin[44]	The partial least squares approach to structural equation modeling	3.75	0.01
3	Gefen, Karahanna, and Straub[45]	Trust and TAM in online shopping: an integrated model	14.28	0.03
3	Mayer, Davis, and Schoorman[46]	An integrative model of organizational trust	5.85	0.02
3	McKnight, Choudhury, and Kacmar[47]	Developing and validating trust measures for e-commerce: an integrative typology	5.72	0.02
3	Gefen[48]	E-commerce: the role of familiarity and trust	2.98	0.01
	McKnight, Cummings, and Chervany[49]	Initial trust formation in new organizational relationships	0.29	0.01
4	Ajzen[50]	The theory of planned behavior	64.57	0.05
4	Taylor and Todd[51]	Understanding information technology usage: a test of competing models	7.17	0.03
4	Mathieson[52]	Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior	4.02	0.02
4	Compeau and Higgins[53]	Computer self-efficacy: development of a measure and initial test	2.35	0.01
4	Thompson, Higgins, and Howell[54]	Personal computing: toward a conceptual model of utilization	0.80	0.01

3.3.2. Density visualization and key themes from research keywords

The conceptual structure analysis of the published research reveals the underlying key concepts, the mutual association among these concepts, and the central themes that form the core of the research landscape. The research keywords density analysis discovers the most prominent concepts from research disciplines and outlets. As evident in Figure 8, the high-density areas

represent the core of the conceptual structure of research published in *JCIS*. The darker and larger bubbles represent important themes based on co-occurrence frequency.[17] To extract the central themes and subthemes, this study considers keywords with a minimum of five occurrences in the extant literature published in *JCIS*. Hence, the central themes discovered using density visualization are "trust", "security", "e-commerce", "technology acceptance model", "knowledge management", "information systems", "information technology", "social media", "project management", "enterprise resource planning", and "business intelligence".

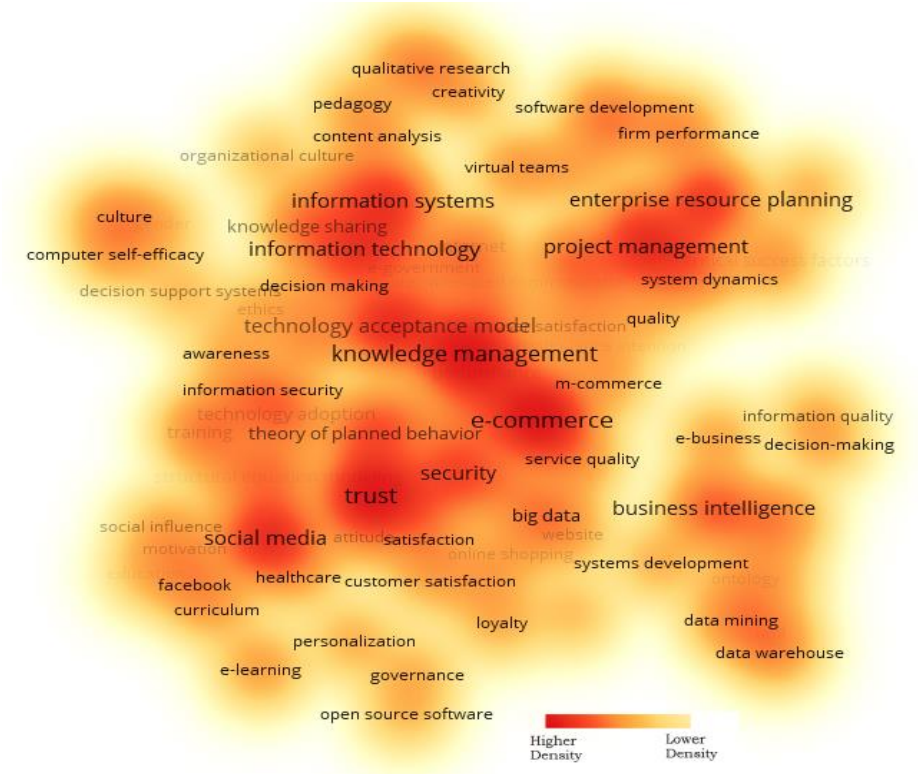

Figure 8. Density visualization of the most frequent research keywords

3.3.3. Keyword co-occurrence analysis

Keyword co-occurrence analysis or co-word analysis shows the association among the most frequent keywords in a network graphically. Each node in the keyword co-occurrence network represents a keyword, and the connecting weighted edge represents the frequency of co-occurrences. The actual keywords that are specified by the contributors are termed as the author keywords that have been analyzed in this study. The central focus areas representing the cumulative knowledge of a discipline can be visualized using this technique.[55] Figure 9 depicts the association among the most frequent research keywords having a minimum of five frequencies in the *JCIS* literature. Table 8 details the content of each cluster and the label given to each cluster based on the content. The cluster labeled as "Trust and Social Media" has generated the maximum average citations, followed by the "Enterprise Resource Planning" cluster.

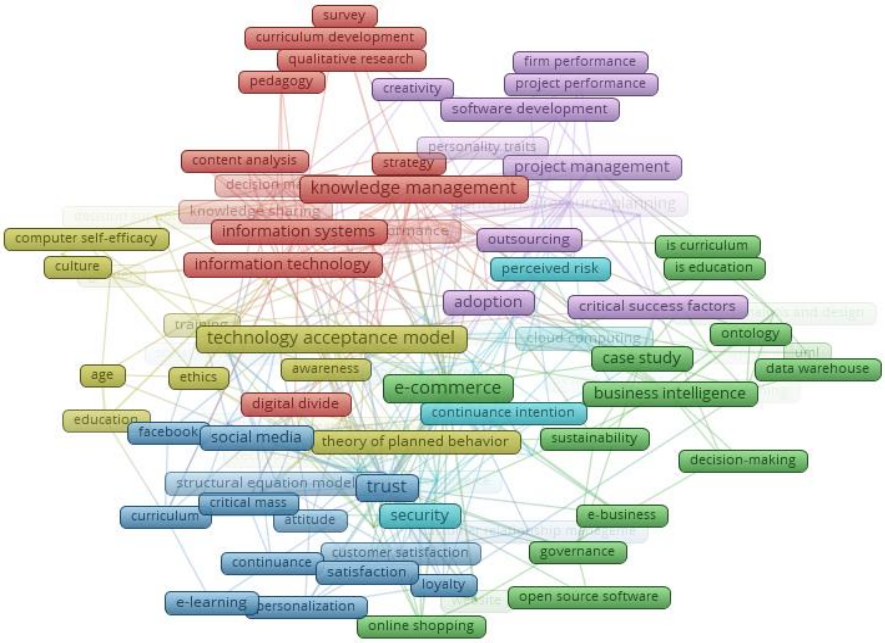

Figure 9. Keyword co-occurrence network

Table 8. Results of keyword co-occurrence analysis

S. No.	Cluster Color	Label	Top-10 Keywords with Frequency	Average Citation
1	Red	Knowledge Management and Information Systems	Knowledge Management (30), Information Technology (22), Information Systems (21), Knowledge Sharing (13), Performance (11), Big Data (10), Internet (10), Digital Divide (9), E-Government (8), Big Data Analytics (7)	17.35
2	Green	Business Intelligence and E-Commerce	E-Commerce (37), Business Intelligence (15), Technology Acceptance (9), Data Mining (8), Data Warehouse (7), E-Business (7), IS Education (7), IS Curriculum (6), Systems Development (6), UML (6)	19.8
3	Blue	Trust and Social Media	Trust (35), Social Media (24), Structural Equation Modeling (10), E-Learning (8), Satisfaction (8), Service Quality (8), Healthcare (7), Facebook (7), Loyalty (6), Personalization (6)	33.98
4	Yellow	Technology Acceptance	Technology Acceptance Model (30), Theory of Planned Behavior (12), Technology Adoption (11), Training (10), Information Security (7), Computer Self-Efficacy (6), Ethics (6), Gender (5), Innovativeness (5), Culture (5)	23.87
5	Purple	Enterprise Resource Planning	Enterprise Resource Planning (27), Project Management (20), Adoption (20), Outsourcing (13), Critical Success Factors (9), Leadership (8), Software Development (8), Virtual Teams (8), Firm Performance (7), Creativity (6)	28.93
6	Light Blue	Security and Privacy	Security (16), Cloud Computing (11), Privacy (9), Perceived Risk (8), Computer-Mediated Communication (6), Social Commerce (6), Social Presence (6), M-Commerce (6), Perceived Usefulness (6), Continuance Intention (5)	23.77

3.3.4. Author collaboration Analysis

The author's collaboration network analysis is shown in Figure 10. The threshold number of co-authored articles was set to three to form the collaboration network. The threshold criteria have discovered a total of 221 contributors (from 2291 unique contributors), out of which only 79 were in a connected network, and the rest were isolated nodes. This study has discovered a total of 8 clusters from the collaboration network. The first cluster (represented in red color) has the most number of authors, and this is anchored by Lee S., whose collaboration has resulted in 6 published *JCIS* articles in this cluster. Similarly, the second cluster (represented in green color) is formed by Li H., who has a total of 4 publications from this collaboration network. Moreover, Lin B. has the most productive collaboration network with 12 collaborators who have co-authored 17 articles for *JCIS*. Table 9 lists the most influential authors in each cluster. Figure 11 shows the country collaboration map. Overall, it is evident that there is a very strong authorship network between the USA and China, the USA and Australia, and the USA and a few European countries.

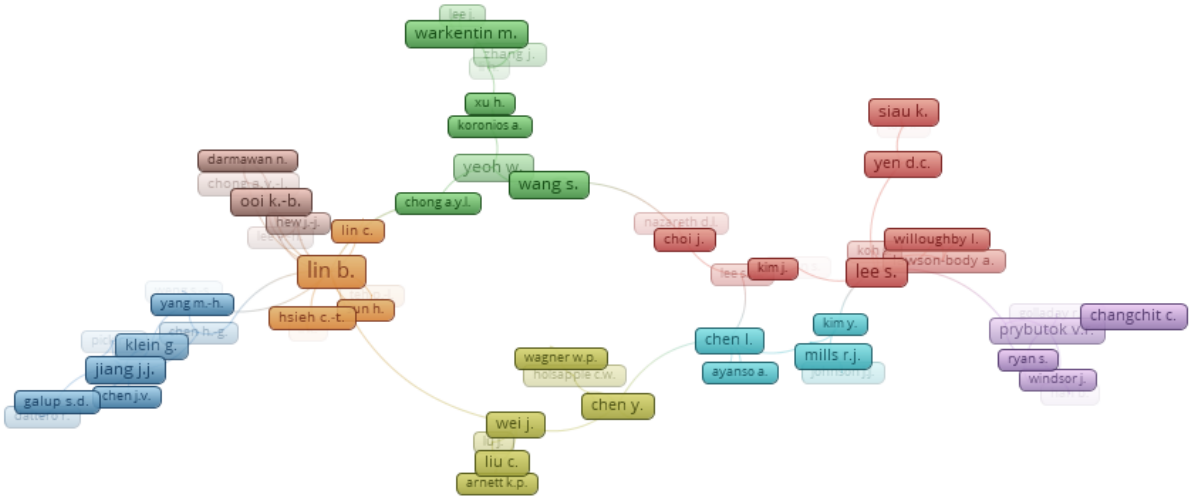

Figure 10. Author collaboration clusters

Table 9. Most influential collaborator in each co-authorship cluster

Cluster	Main Researcher	Affiliation	Links	Link Strength	No. Of Documents	Citations
1	Lee S.	Miami University	7	9	6	120
2	Li H.	Minnesota State University	3	4	4	195
3	Jiang J.J.	Australian National University	6	13	9	73
4	Chen Y.	Auburn University at Montgomery	5	6	7	250
5	Prybutok V.R.	University of North Texas	5	6	8	340
6	Chen L.	University of Wisconsin–Eau Claire	6	6	8	131
7	Lin B.	Louisiana State University	12	19	17	478
8	Ooi K.-B.	UCSI University, Kuala Lumpur	5	16	9	337

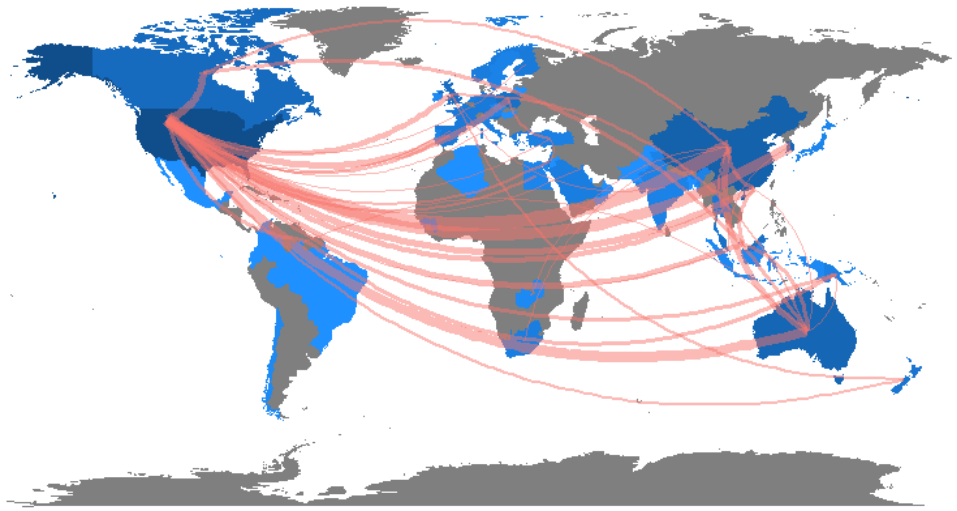

Figure 11. World collaboration network

3.3.5. Disciplinary influence and knowledge exchange across domains

The current study adapts a social exchange model[2] to explore the knowledge diffusion between *JCIS* and other research disciplines. The knowledge flows between a research outlet, and other academic disciplines can be used to discover the social exchange of knowledge, major disciplinary focus, and disciplinary influences.[3,32,56] A broad investigation of *JCIS* published research from 1995 to August 2021 reveals that it has produced 51,265 citations with knowledge inflows from 18,808 unique sources that have been referenced in all the 1,382 articles. Further, we discovered that all the published articles of *JCIS* during the same period had been cited by 17,226 research documents (published in 4,289 unique outlets in number), producing about 22,205 citations. It was found that many documents have cited more than one *JCIS* article that is a common practice. A quick comparison of knowledge inflows to *JCIS* from other sources (51,265 references) and the knowledge outflows from *JCIS* to other sources (22,205 citations) highlights a massive influx of knowledge from other sources to *JCIS*.

Following the data reduction plan proposed by Agarwal[5] and Nunkoo *et al.*,[56] the sources with less than 25 citations received or produced were removed. The data reduction and deduplication resulted in a dataset having 211 unique sources with 21,806 citations from *JCIS* indicating the knowledge inflows. Similarly, the data reduction with threshold criteria of 25 minimum citations produced by each source further resulted in a dataset with 135 sources generating 7,082 citations of *JCIS* articles. The disciplinary classification of these sources was performed following the method suggested by Agarwal.[5]

As illustrated in Figure 12, *JCIS* derived its knowledge from nine distinctive disciplines highlighting the other disciplines' impact. The dominance of the information systems (IS) domain in knowledge inflow (56.21%) is clearly visible. The other significant sources of knowledge for *JCIS* are the general business (GB), computer science (CS), marketing (MK), organization science (OS), and psychology (PY). Disciplines such as general science (SC), sociology (SO), and operations research (OR) have an insubstantial impact on *JCIS* research.

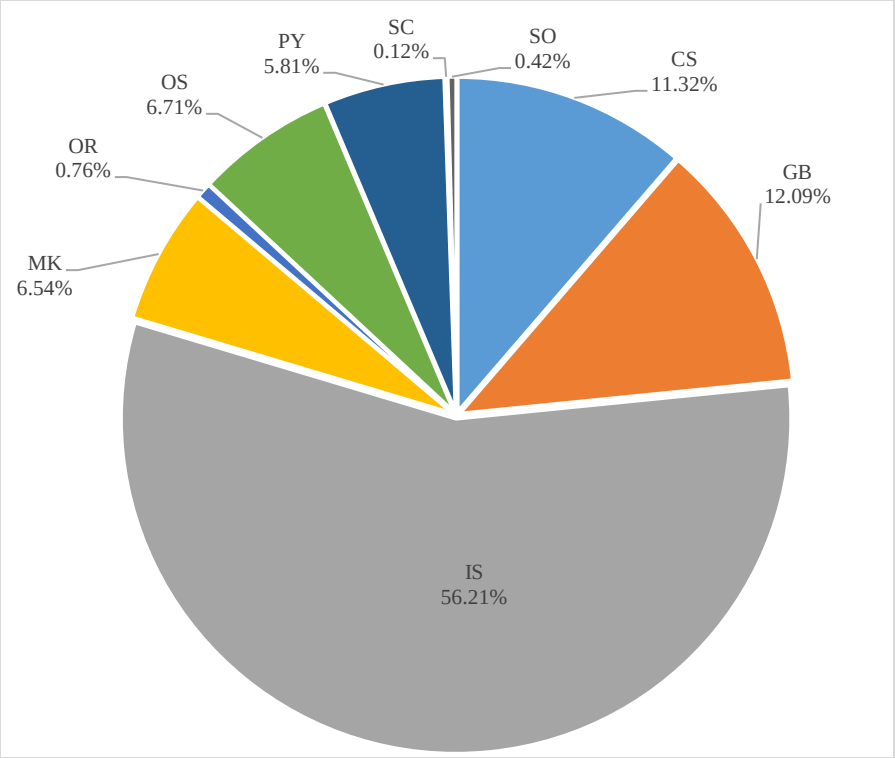

Figure 12. Knowledge inflow to *JCIS* from other domains [CS: Computer Science, GB: General Business, IS: Information Systems, MK: Marketing, OR: Operations Research, OS: Organization Science, PY: Psychology, SC: General Science, SO: Sociology]

By considering the journals and disciplines impacted by *JCIS*, the outflow of knowledge from *JCIS* to other disciplines were assessed. The knowledge outflow pattern given in Figure 13 is very different from the knowledge inflow pattern across disciplines. *JCIS* has contributed a significant amount of knowledge to information systems as its 61.01% citations are from information systems research outlets, including *JCIS* itself. After information systems, the influence of *JCIS* scholarship is the most on computer science (19.37%), followed by general business (8.29%), then marketing (4.93%), and general science (2.46%).

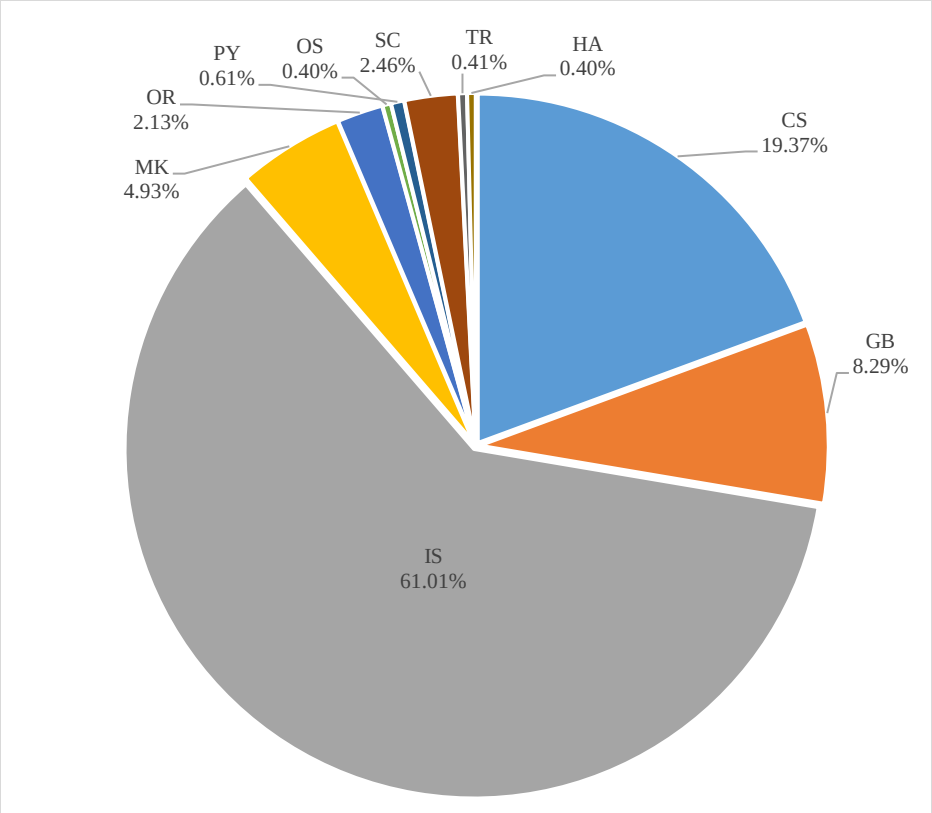

Figure 13. Knowledge inflow to *JCIS* from other domains [CS: Computer Science, GB: General Business, HA: Health Applications, IS: Information Systems, MK: Marketing, OR: Operations Research, OS: Organization Science, PY: Psychology, SC: General Science, SO: Sociology, TR: Tourism]

4. Discussion

4.1. Discussion on the topic modeling results

The first research question (RQ1) concerns the dominant topics of *JCIS* scholars' community interest and the evolution of these topics over time. A total of 16 dominant topics are extracted using topic modeling that were underlying in the literature published in *JCIS*. To examine the semantic quality and intuitiveness of the extracted topics, this study has examined the relative variations in the topical semantic coherence and exclusivity measures following the previous works.[12,24] The average semantic coherence represents the co-occurrence of the top frequent words in each latent topic across the collection of documents.[26] Further, topic exclusivity ensures that the words with a high probability of occurrences in a given topic have low probabilities of occurrences when compared to other topics.[12,26] Figure 14 depicts that on the exclusivity dimension, Topic 2- Enterprise Software and Decision Support System scores relatively low, which indicates that the top words in this topic may be frequent in other topics as well. On the other hand, Topic 14- Big Data Analytics and Cloud Computing scores relatively low on semantic coherence dimension, indicating frequent co-occurrences of corresponding top words in other topics.

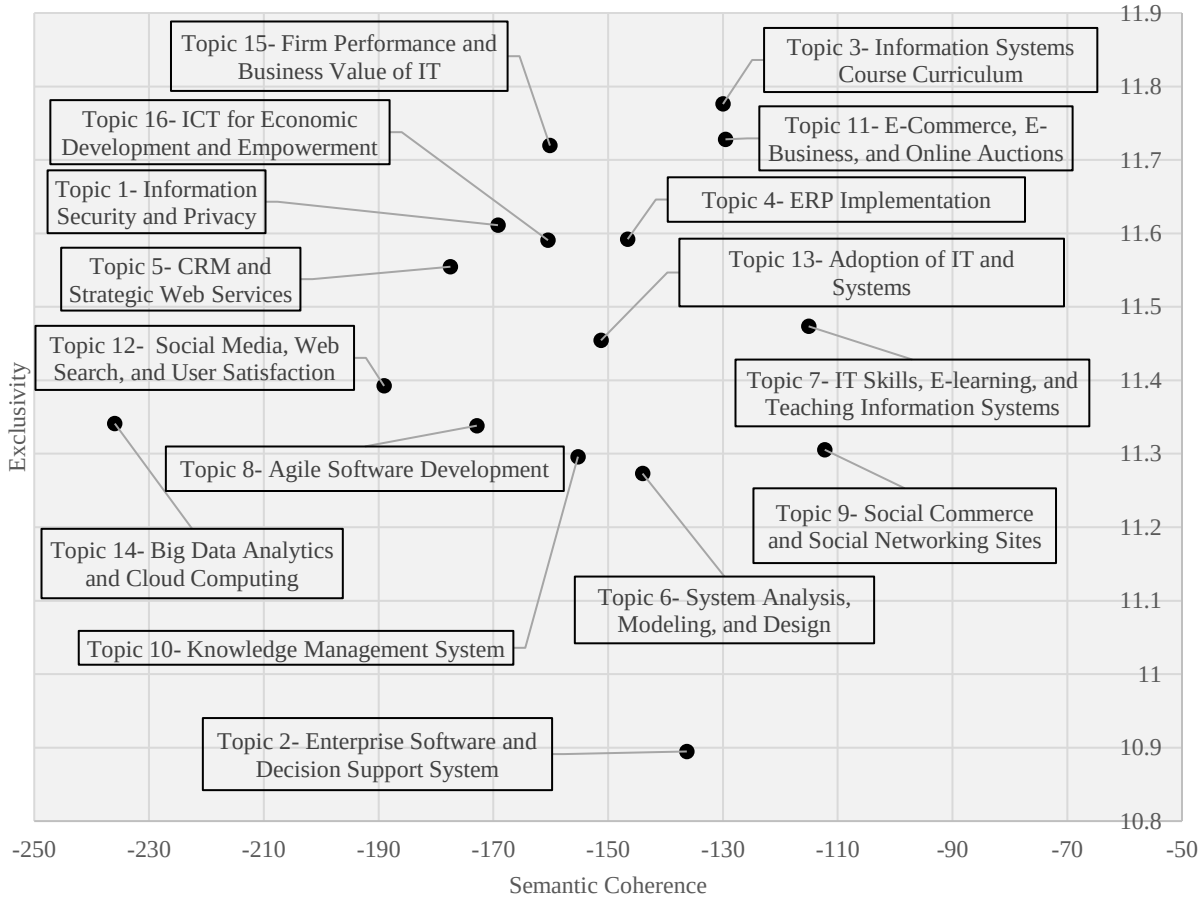

Figure 14. Semantic coherence and topic exclusivity scores for 16 extracted topics

The correlation among topics is evident when two or more topics co-occur in the same document. STM can model and visualize the correlation among topics via a network of correlated topics, as shown in Figure 15. Two topics are connected in the network if they co-occur frequently. The dotted edge between Topic 3- Information Systems Course Curriculum and Topic 7- IT Skills, E-learning, and Teaching Information Systems represents correlation with correlation value as 0.12 (Figure 16). Hence, these two topics are intuitively interrelated because several documents discuss teaching IT skills and developing a course curriculum (Chrysler & Van Auken, 2002; Ramakrishna, 2000; Stevens et al., 2011). Similarly, the correlation between Topic 9- Social Commerce and Social Networking Sites and Topic 11- E-Commerce, E-Business, and Online Auctions confirms that these topics are closely linked and co-occur frequently (Chow & Shi, 2015; Hong, 2020; Nord, Espinosa, Paliszkiewicz, & Mądra-Sawicka, 2020)

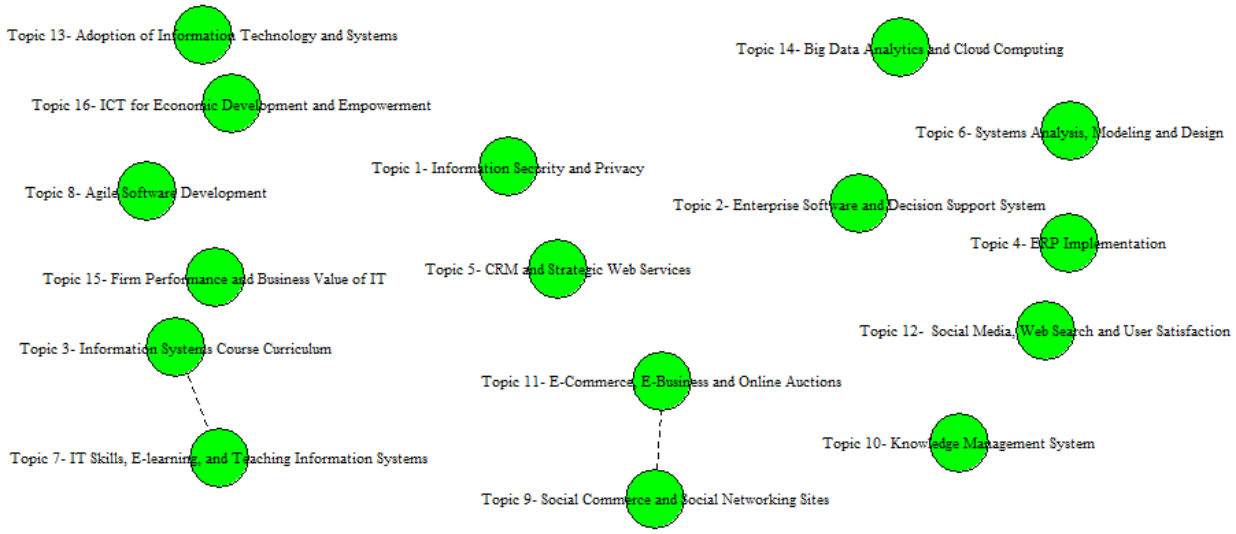

Figure 15. Network of topic correlation

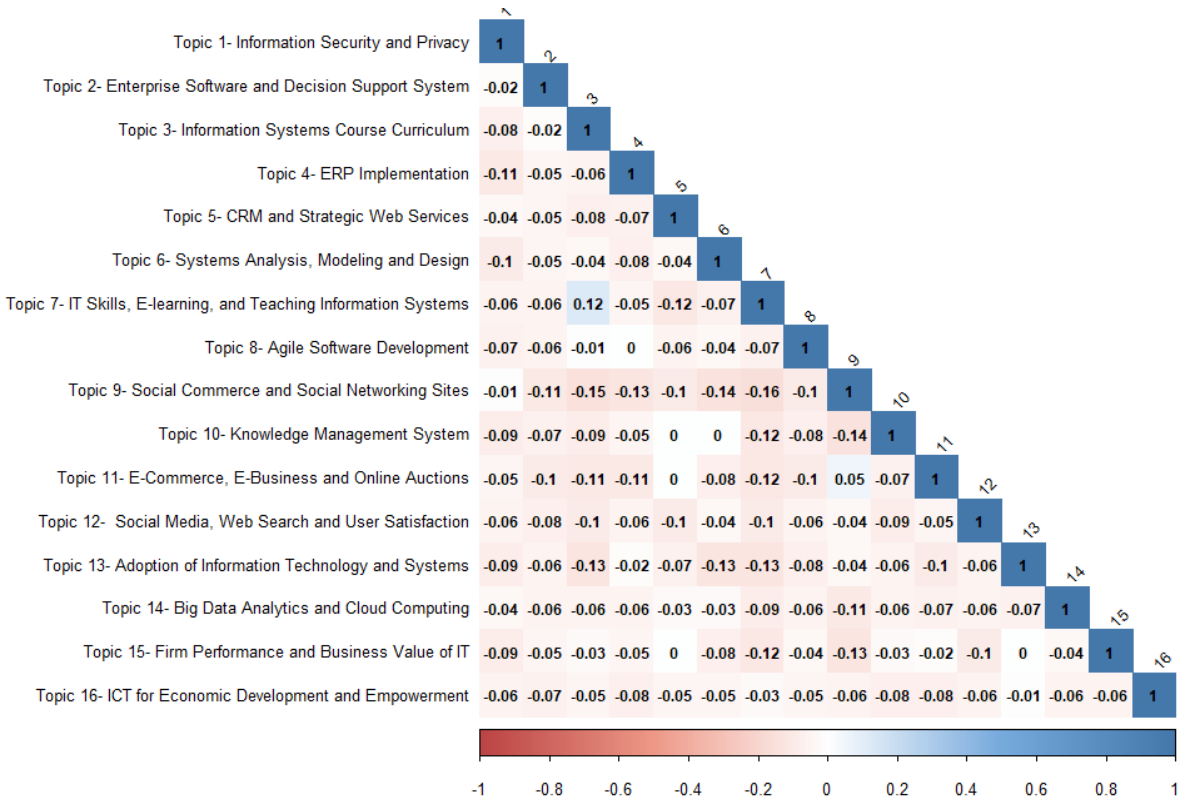

Figure 16. Topic correlation matrix

STM enables researchers to examine the impact of document metadata-based covariates on the topic prevalences.[12] In the current study, the publication year of each research document has been used as a covariate that influences the topic prevalences. In this way, the evolution of each topic from 1995 to 2021 can be visualized to examine the varying temporal popularity of topics. Figure 17 shows the temporal dynamics related to the estimated topic proportion which is dependent on

the publication year set as a metadata-based covariate. The dotted lines around the trending line signify the 95% confidence intervals. The variations in the temporal popularities of each extracted topic are clearly evident. The topics with the increasing trend can be identified as hot topics highlighting areas for future research, and topics with the declining trend can be stated as cold topics.[12,13,24]

The topics with a clear increasing popularity trend are Topic 1- Information Security and Privacy, Topic 9- Social Commerce and Social Networking Sites, Topic 12- Social Media, Web Search, and User Satisfaction, Topic 14- Big Data Analytics and Cloud Computing, and Topic 16- ICT for Economic Development and Empowerment. The gradually rising trends for these topics confirm the growing research interests over the years. These trends are intuitive because themes such as big data analytics and cloud computing are consistently attracting scholars from all over the world.[57] The cumulative research focus of *JCIS* contributors on these topics makes them hotspots research areas for future exploration. On the contrary, Topic 3- Information Systems Course Curriculum, Topic 6- System Analysis, Modeling and Design, Topic 7- IT Skills, E-learning, and Teaching Information Systems, and Topic 10- Knowledge Management System are showing a declining trend for topic popularity among researchers. The downward trends for these topics are reasonable because of the maturity and stability of these topics over the years.

Further, Topic 5- CRM and Strategic Web Services, Topic 11- E-Commerce, E-Business, and Online Auctions, and Topic 13- Adoption of Information Technology and Systems are showing a rising trend till 2010-2012. These topics have registered a slightly declining movement after this period. However, the magnitude of the topic prevalences confirms that these topics are still attracting a significant amount of scholarly interest. The other remaining topics are not showing any trend worth reporting.

4.2. Discussion on the scientometric analysis results

Addressing the second research question (RQ2), the present study offers an overview of the research published in *JCIS* by presenting an evolution of the outlet regarding key publications, authors, affiliations, keywords, etc., and the development of the research themes. The results show that the pertaining research landscape has much evolved during the period from 1995 to 2021, indicating its increasing importance. Specifically, there is an impressive rise in publications after 2018. *JCIS* publications mainly focus on scientific areas such as information systems development and management, acceptance of information systems, information management, business intelligence, and knowledge management.

For a deeper exploration of the third research question (RQ3) about the types of networks and associations among authors, themes, published articles, and cited articles, this study has done network analysis at various levels. Using the co-citation network analysis, this study reveals the most influential works in the information systems domain that have contributed the most to the development and evolution of *JCIS*. This study has presented these works as clusters reflecting schools of thought concerning knowledge development at *JCIS*. This input can aid interested researchers in contemplating more on landmark studies in information systems.

The most frequent keywords discovered from the co-word analysis are “e-commerce”, “trust”, “knowledge management”, “technology acceptance model”, “social media”, “information

technology", "enterprise resource planning", "information systems", "project management", "security", and "business intelligence". As per keyword co-occurrence analysis, this study discovered that the most frequent keywords are organized in six clusters that can be labeled as "knowledge management and information systems", "business intelligence and e-commerce", "trust and social media", "technology acceptance", "enterprise resource planning", "security and privacy".

Finally, the analysis of the disciplinary influence and knowledge exchange addresses the fourth research question (RQ4) concerning the knowledge contribution by other disciplines to *JCIS* and the influences of *JCIS* on other disciplines. The knowledge exchange among disciplines reveals some interesting patterns about the *provider-receiver* relationship between *JCIS* and other disciplines.[58] The knowledge exchange among disciplines and journals can be used to categorize them as "*storers*" or "*feeders*" of knowledge.[59] The "*storers*" tend to store knowledge by citing other journals, but they are less cited by others. On the contrary, "*feeders*" tend to disseminate knowledge because their research is highly cited by other journals and disciplines. This study reports that except for the intra-disciplinary knowledge exchange of *JCIS* with the information systems domain, *JCIS* has the closest association with general business domain, computer science, and marketing. A significant knowledge inflow was observed from organization science and psychology as well. This indicates that the impact of these disciplines on *JCIS* is more than *JCIS'*s influence of these disciplines. Hence, *JCIS* is a knowledge *receiver* or *storer* for these disciplines. A strong self-citation pattern with intra-disciplinary citation practices were also visible during course of the study that *JCIS* editorial board members should be mindful of. However, it will be difficult to determine the optimum level of self-citation and inter- and intra-disciplinary citation patterns.

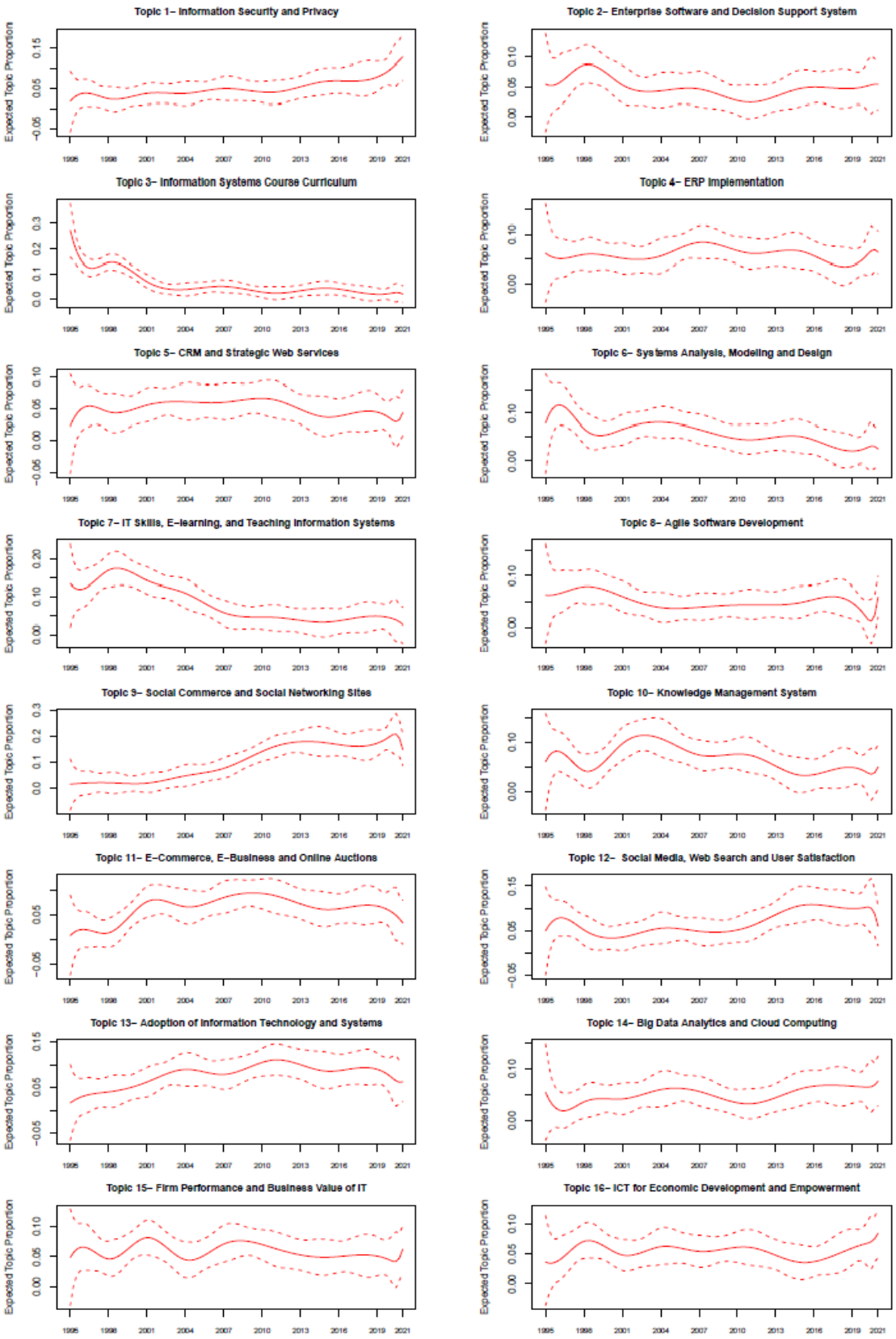

Figure 17. Expected topic prevalences for 1995-2021

4.3. Implications for research

This study uses topic modeling and scientometric for examining the voluminous research without any subjective bias and presents a systematic illustration of knowledge that is very crucial for the current and potential researchers, academics, and practitioners from IS area. Detecting the latent research topics and tracking their evolution to predict the future trends of *JCIS* using a novel statistical text mining-based methodology can greatly benefit the IS research community. This study supports the view that methodological novelties introduce new ways of addressing the complex research problems of IS domain.[60,61] *JCIS* represents a perennial domain of research that is still evolving at a rapid pace. A research endeavor that involves exploration of the evolution of the intellectual and conceptual structure of the IS research published in *JCIS* for more than two decades has significant importance for the community of IS scholars. Hence, the empirical insights from the current study augment the existing IS body of knowledge.

This study uses a hybrid methodology that is based on traditional scientometric analyses and a contemporary text analytics approach utilizing structural topic models. Thus, this study identifies, analyzes, and maps the 16 latent topics on a temporal dimension. The themes like "Information Security and Privacy", "Social Commerce and Social Networking Sites", "Social Media Web Search and User Satisfaction", "Big Data Analytics and Cloud Computing", and "ICT for Economic Development and Empowerment" indicate a rising popularity pattern for the coming years in which case these themes can become the hotspots for future research by the prospective researchers. These future research frontiers will guide the potential researchers to position their research and development efforts in the right direction. Moreover, the proposed methodology should not be limited to academic research articles and may be used to identify the latent topics from the proceedings of reputed conferences as well as other technical documents such as patents, industrial reports, research proposals, and technical white papers. Hence, this study would help future research uncovering and profiling the latent trends of scholarly interest in diverse disciplines and domains.

4.4. Limitations and future research directions

The findings of this study are inevitably limited by the use of a single database for citation and reference data. As we have restricted our scope to Scopus only, future researchers may explore other databases like Web of Science and Google Scholar. Further, this study has restricted its scope to scholarly publications during 1995-2021 only. The existing research in *JCIS* is evolutionary and dynamic in nature, so this study could not embrace the unpublished scholarly works, such as articles "in press" that are available on *JCIS* website but not included by Scopus. Assuming its scholarly leadership and authoritative coverage of IS research, *JCIS* has unswervingly developed in quality and relevance because of which it can represent the discipline to a great extent. However, the authors have not performed a comparative assessment on the knowledge published in *JCIS* and other journals. Future researchers might consider assessing the impact of domain knowledge published in *JCIS* and other similar outlets, books, book chapters, magazines, and reputed conference proceedings. The intellectual structure analysis in the current study inspects the flow of knowledge across disciplines. Future researchers may explore the content of the literature more

thoroughly and assess the fine-grained impacts of specific theories, models, and articles related to information systems domains as a whole and *JCIS* in particular.

5. Conclusion

This study makes several contributions to information systems research. It provides vital knowledge about the conceptual and intellectual structure of *JCIS.* The objective of this study was to trace the scholarly development of *JCIS* by providing a general overview of the most influential authors, studies, affiliations, and countries publishing in *JCIS*. The conceptual structure analysis identifies the emerging topics and visualizes their evolution using topic modeling based on STM. The scientometric analysis is used to develop the knowledge visualizations of co-citation clusters, keywords co-occurrence clusters, and co-authorship clusters based on scientific collaborations. Finally, the social exchange of knowledge from *JCIS* to other disciplines identifies the scholarly impacts of *JCIS,* while the inflows of knowledge from other disciplines to *JCIS* highlight the influence of other disciplines on *JCIS.* Finally, this study identifies directions for future research by listing academic hotspots. The systemic presentation of the conceptual and intellectual structure of *JCIS* will help potential contributors, academics, and practitioners devise future research plans. Further, the *JCIS* policymakers and other IS domain influencers may consider the insights from the current study to shape the future *JCIS* special issues policies to advances the IS research.

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Appendix

List of *JCIS* articles reviewed in the current study

1	Abrahams, A. S., & MacMillan, I. C. (2009). IT-DDP: A novel methodology for assuring economic value from entrepreneurial information technology projects. *JCIS*, *49*(3), 1–10.
2	Alain Yee-, L. C. (2013). Understanding mobile commerce continuance intentions: An empirical analysis of Chinese consumers. *JCIS*, *53*(4), 22–30. https://doi.org/10.1080/08874417.2013.11645647
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6	Asamoah, D. A. (2020). Utilizing a Simulation Approach for Data Analytics Pedagogy. *JCIS*. https://doi.org/10.1080/08874417.2020.1848482
7	Avila, O., & Garcés, K. (2017). Change management support to preserve business-information technology alignment. *JCIS*, *57*(3), 218–228. https://doi.org/10.1080/08874417.2016.1184006
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17	Cao, G., Tian, N., & Blankson, C. (2021). Big Data, Marketing Analytics, and Firm Marketing Capabilities. *JCIS*. https://doi.org/10.1080/08874417.2020.1842270
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22	Chen, C., & Jiang, H. (2020). Important Skills for Data Scientists in China: Two Delphi Studies. *JCIS*, *60*(3), 287–296. https://doi.org/10.1080/08874417.2018.1472047
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69	Jaber, F., & Abbad, M. (2021). Big Data and Firm Performance: An Outside-in Approach. *JCIS*. https://doi.org/10.1080/08874417.2021.1927240
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