Visualizing Research Evolution in E-Commerce Field: Year 2001 to 2020

Yang Bai
School of Information Management, Central China Normal University, China, baiy@mails.ccnu.edu.cn

Hongxiu Li
Department of Information and Knowledge Management, Tampere University, Finland

Jianyao Chen
School of Information Management, Central China Normal University, China

Recommended Citation

<u>**Short Research Paper**</u>

Visualizing Research Evolution in E-Commerce Field: Year 2001 to 2020

Yang Bai[1], Hongxiu Li[2], Jianyao Chen[1]**

[1]School of Information Management, Central China Normal University, China

[2]Department of Information and Knowledge Management, Tampere University, Finland

Abstract: The paper aims to provide a comprehensive understanding of the evolution of the research themes and trends in e-commerce research based on the co-word analysis. 17,417 keywords were collected from 3,289 academic articles published in the selected seven leading journals in the field of e-commerce from 2001 to 2020 to examine the core research themes and trends over the two-time spans of years 2001-2010 and 2011-2022. Some research themes have kept their continuity in 20 years, indicating that the research themes in the e-commerce research have maintained temporal continuity. At the same time, the research themes in the e-commerce field have evolved with technology development and diffusion. This research provides useful suggestions for the future research direction for scholars in the e-commerce field.

Keywords: Co-word analysis, Research trends, Research theme, Research evolution, E-commerce

1.   INTRODUCTION

Electronic commerce (e-commerce) refers to the transaction of goods and services by means of electronic communication [1]. The emergence of e-commerce allows customers to ignore the obstacles of physical distance to shopping, which greatly promotes global commodity transactions. With the fast development of information technologies various types of e-commerce, such as non-business e-commerce, intra-business e-commerce, business-to-consumer (B2C), consumer-to-business (C2B), business-to-business (B2B), consumer-to-consumer (C2C), mobile-commerce, social-commerce, have been developed [2], and attracted great attention from both researchers and practitioners.

Prior research has researched on e-commerce literature to explore the research development status and trend in e-commerce field and to provide a reference for researchers on their research topic decisions in this field. Such as some studies have studied the research trend of e-commerce in a specific theme, including identifying the dimensions of e-commerce to develop a framework for e-commerce [3], reviewing e-commerce research from the perspective of economic analysis [4], the journals and people central to e-commerce research [5], and the literature characteristics and author productivity distribution in e-commerce research [6]. Although prior research has provided an understanding of some specific research areas in e-commerce research, there is a lack of research to provide a comprehensive understanding of the development of research themes in the field based on recent literature, such as what are the dominant research themes in the field and how the research themes in the field have evolved with technology development. Thus, there is a call for research to provide a comprehensive understanding of e-commerce research based on recent literature to provide the knowledge on the core research themes to scholars in the e-commerce field and guide their future research.

To address the above research gap, 3,289 articles published in seven leading journals in the e-commerce field between 2001 and 2020 are analyzed to identify the evolution of research themes in e-commerce research.

The rest of the paper is organized as follows: Section two summarizes the past research in the area of e-commerce to provide the research background for this study. Section three provides a description of the research methods applied in this study. After that, the results of the study are presented. Finally, we discuss the

---

[*] Corresponding author. Email: baiy@mails.ccnu.edu.cn(Yang Bai)

main research findings in this study and summarize the contributions of the current research.

2.   RESEARCH BACKGROUND

In the late 1990s, the Internet had promoted the formation of e-commerce. Later web2.0 has driven the development of platform-based e-commerce such as B2C, B2B, and C2C [7]. In recent years, emerging technologies have scaled e-commerce development, such as social media, cloud computing, big data, and AI [8]. Obviously, e-commerce has been driven by the rapid advancement of technologies, which might have also steered the evolution of research themes in this field.

Some prior research has provided the knowledge structure and research evolution in the field of e-commerce based on literature. Prior research has noticed the interdisciplinary nature of e-commerce based on the review of the research trends in the e-commerce field. Ngai and Wat [9] found that inter-organizational systems, corporate strategy, and security were popular research topics in e-commerce research. Urbaczewski et al. [10] argued that e-commerce research needs cross-disciplinary theoretical support, such as theories in the fields of organization science, economics, technology, social science, behavioral study, and legal studies. DeLone and McLean [11] adapted the well-established DeLone & McLean IS Success Model to investigate the challenges in e-commerce and identified six dimensions as e-commerce success metrics based on e-commerce literature. Wareham et al. [12] studied on 582 academic articles in e-commerce field published in academic journals between 1997 and 2003, and found that B2B, strategy, B2C, trust, and technology adoption were the popular research topics in this field and survey has been a dominant research method in this field. They also posited that the research topics in this field should have been developed accordingly in e-commerce research when new technologies have been continuously applied in the field. Based on articles published at the six leading journals in the e-commerce field between 2006 and 2010, Shiau and Dwivedi [13] conducted a statistical analysis and identified five core research themes in the e-commerce field, including e-markets, acceptance and application of technology, task-related application of e-commerce, identity and evaluation, and trust.

Some scholars have applied bibliometric analysis in research to examine the research themes as well as the research trends in the e-commerce field. Lin et al. [14] reviewed the papers published in the top 10 journals in the e-commerce field and provided a general understanding of e-commerce research via identifying the most influential articles, the intellectual connection between authors and the published articles as well as the main research themes in e-commerce research in information systems (IS) domain. Lee et al [15] conducted a diversity measurement analysis of 1,103 articles in e-commerce, information systems (IS), and marketing journals between 1996 and 2005 and found that IS journals tend to rely more on economic theories whereas e-commerce journals focus more on redefining e-commerce research area. Based on a study on the 4,948 articles published in the Science Citation Index Expanded (SCIE) and 2,875 articles in the Social Science Citation Index (SSCI) from 1999 to 2008, Wang and Chen [16] found that e-commerce research in SCIE focuses more on the computer and information science, whereas that in SSCI database is more business management focused. Based on 5,429 articles in the e-commerce field published from 1996 to 2015, Tsai [6] found that the distribution of author productivity in e-commerce research does not fit Lotka's Law and e-commerce is closely related to disciplines such as economics, engineering, computer science, and information science. By analyzing over 1,000 e-commerce articles published between 1987 and 2017, Yoo and Jang [17] suggested promising research themes for future e-commerce research via a bibliographic survey. Obviously, though previous studies have provided an understanding of the research theme in the e-commerce field, there is a lack of more comprehensive research on recent literature to reflect the overall evolution of research topics and research trends in e-commerce field.

3. RESEARCH METHODS

3.1 Co-word analysis

Co-word analysis is a bibliometric method based on co-occurrence analysis to identify the subject areas that have characterized fundamental research at different time periods [18]. Co-word analysis has advantages in discovering connections between subjects in a specific research field and tracing its scientific development. With the ability to discover knowledge in databases, co-word analysis has been widely applied to identify research topics in a specific research field, including the relationships between research topics, the extent to which these topics are central to the research field as well as are internally structured [19].

Co-word analysis has been widely employed in the literature to detect the knowledge structure in various research fields, such as tourism research [20], e-learning [21], information retrieval [22], library and information science [23], and IS [24], In this study, co-word analysis is applied in line with these studies to evaluate the research themes and knowledge structure of e-commerce research.

3.2 Data

In this study, we collected the research data from 7 leading e-commerce journals. The journals in the "Business, Management, and Accounting" category in SCImago Journal Rank (SJR) 2019 were identified in order to get a complete pool of literature in the e-commerce field. We have excluded the journals which are not associated with e-commerce and finally, 7 journals were included in this study. The articles published between 2001 and 2020 were extracted. In total, 17,417 keywords were obtained from 3,289 articles collected from the 7 journals. More details are presented in Table 1.

Table 1.   E-commerce journals included in this study

Journals	Startingy ear	Keyword availability (year)	Articles collected	Keywords collected
International Journal of Electronic Commerce	1996	2000	408	2,360
Electronic Markets	1991	2000	557	3,382
Electronic Commerce Research and Applications	2002	2002	856	4,892
Electronic Commerce Research	2001	2001	444	2,177
Journal of Electronic Commerce Research	2000	2000	363	981
Journal of Theoretical and Applied Electronic Commerce Research	2006	2006	303	1,698
Journal of Electronic Commerce in Organizations	2003	2003	358	1,927
Total	—	—	3,289	17,417

To obtain more accurate outcomes and to guarantee the diversity of topics, we standardized the keywords by merging synonyms (e.g., online market and electronic market; customer satisfaction and user satisfaction), singular and plural forms of nouns and gerunds (e.g., website and websites), and abbreviations (e.g., word of mouth and WOM; user-generated content and UGC) and filtering out some general keywords which do not represent research topics (e.g., general, online, etc.). In line with previous studies [25], the keyword of "e-commerce" has also been filtered out since "e-commerce" is a common keyword applied in e-commerce articles. The process of keyword merging was conducted by two researchers together.

We split the sample data into two sub-datasets for the time periods of 2001−2010 and 2011−2020, aiming to compare the differences of the research themes in the two different time periods and detect the paradigm changes in the e-commerce field in these 20 years. There are 1,353 articles published between 2001−2010 and 1,936 articles in the period of 2011−2020. More articles have been published in the latter period, indicating that e-commerce has been a growing research field in the last 10 years.

Only the keywords that appeared at least five times in the studied 20 years have been retained to represent the research topics. Finally, 344 keywords (total frequency: 2,167) covering 1,054 (77.90%) of 1,353 articles

were selected for the first period 2001-2010 and 411 keywords (total frequency: 3,436) covering 1,587 (81.97%) of the 1936 articles for the second period 2011-2020. Thus, with less but popular keywords selected from the articles, we have been able to reliably identify the keyword network and research evolution in e-commerce research in the 20 years under study.

3.3 Data analysis methods

The construction of the links between keywords included in research articles helps to detect the knowledge structure of these associated research themes. In this study, only keywords with high frequency were extracted as the valid base in data analysis as the research themes with high frequency represent the research hotspots in a given research area. After that, we constructed a co-word matrix in Python using latent semantic analysis (LSA), where keywords reflect the main semantics of articles and the relationships between keywords represent the structure of knowledge in these articles [26]. The co-occurrence matrix describes the frequency of two specific keywords that appear simultaneously in one article, while different research topics are reflected through co-occurring keyword pairs. With the help of the CorText toolkit (www.cortext.net), we further analyzed the characteristics of the aggregation and evolution of research themes over time in the field of e-commerce research via the co-occurrence matrix.

4.   DATA ANALYSIS RESULTS

4.1 The core themes and changes in e-commerce

We applied WordArt (www.wordart.com), a web toolkit for constructing word clouds to detect the most commonly used keyword in articles for the periods of 2001-2010 and 2011-2020 respectively (See Figures 1 and 2). In the word clouds, the position and the font size of each keyword are proportional to its frequency of occurrence in the corresponding period of time. For example, in the period of 2001-2010, "trust", "online auction", "B2B", "SME" and "eBusiness" have been identified as the most popular keywords, and in 2011-2020, "WOM", "Trust" and "social media" as the most frequently used ones.

Figure 1. The word cloud for keywords in e-commerce research in the first period of 2001-2010

Figure 2. The word cloud for keywords in e-commerce research in the second period of 2011-2020

With regard to the changes of keywords in the studied two periods, 75 of the 411 keywords (18.24%) have been found to be new in the latter period of 2011-2020, suggesting the development of new research themes in addition to traditional major research themes during the past 20 years as the business, technological and social environments have evolved in the last 20 years. Such as the research topics like "social media", "cloud computing", "sentiment analysis" and "big data" are emerging new topics in e-commerce research in the period of 2011-2020, which reflects these topics have gained their importance in e-commerce research [27]-[28].

4.2 The evolution of e-commerce research themes

In this study, we employed CorText to generate evolution maps for research topics in the e-commerce field [29], which helps visualize the details and trajectories of themes in the past two decades (shown in Figures 3 and 4) and clearly present how the research themes have evolved in e-commerce research the studied 20 years.

As shown in Figure 3, online business development and technology application are parts of the identified major research themes which keep their continuous development in the first period of 2001-2010. Online business development embodied in the migration of e-commerce business model development and the digitalization and management in e-commerce as its core elements. For example, "B2C" business keeps as a research topic from 2001 to 2003 and merged with "network effects" and "perceived ease of use" and "perceived usefulness" of technologies in e-commerce research and merged with "online retailing" in 2006 and "accessibility" in 2009. In addition, the "B2B" business model was developed from the research topics of "website" and "internet" in 2005 as a core research topic and further developed as a couple of research themes in the following 5 years, such as "online banking services" and "mobile payment", "online service" and "usability", and "economic analysis" and "information privacy", which are essential in B2B business development. Specifically, "online banking" and its "perceived risk", and "mobile payment" have gradually been emphasized in e-commerce research after 2007 [30]. "C2C" appeared as another business model in 2006 and further developed as the "online auction" business model in 2010. Though the research topics such as "B2C", "B2B", "C2C" are scattered research topics, which reflects the business model development as a core research theme in the e-commerce field.

From the year 2001 to 2010, as shown in Figure 3, various technologies have been studies in e-commerce research. In 2001, some topics in regard to technologies appeared, such as "intelligent agent", "Internet", "online payment" and "machine learning", but these topics have not been developed as main research themes in the e-commerce field yet. In 2002, the topic "technology adoption" gradually became prominent, and new emerging information technologies have constantly been studied in e-commerce research. For example, technology research was divided into "XML" and "search engine" in 2004. With the update of technologies, short messaging service ("SMS"), "automated negotiation system", "blind signature", "recommendation system", "Web 2.0", "multi-agent system" and "intelligent agent" gradually appeared and developed as a dominant research topic in the studied ten years.

In the period of 2011-2020, the e-commerce research has seen a diversification of research themes, but still highlights the convergence of new technology applications. With the development of web2.0 technology, "social media", "online community" and "social network sites" have gradually emerged, and "WOM", "UGC", and "sentiment analysis" have also developed as research themes. As a new business model, "social commerce" emerged in 2011 and gained great attention in research. But these topics have been scattered in e-commerce research in the early period of years 2011-2020 and have not developed as a core research theme yet. Similarly, the application of "big data" also promoted the innovation of e-commerce models (2014-2016). Only in recent years, a couple of core research themes have emerged in e-commerce research. Such as "e-satisfaction" and "sharing economy" has been developed as a core research theme from 2016 to 2020 due to the popularity of "big data", "UGC", and "recommendation systems".
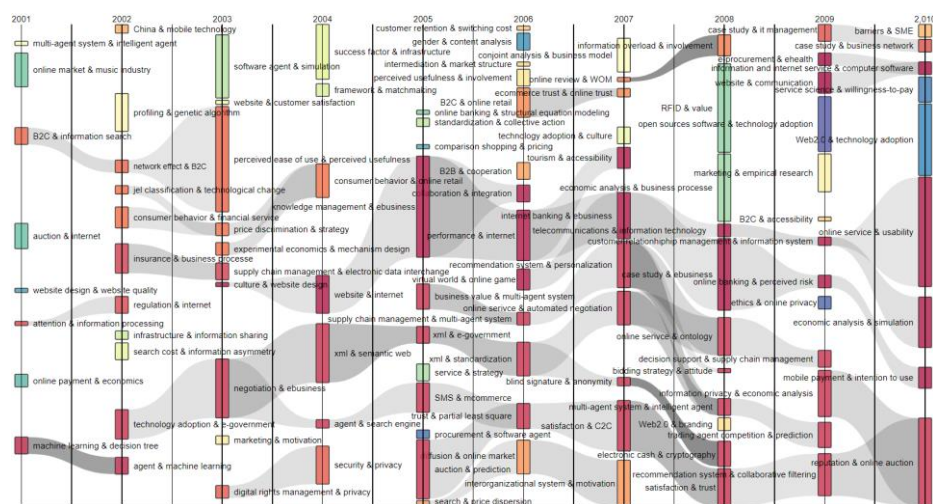
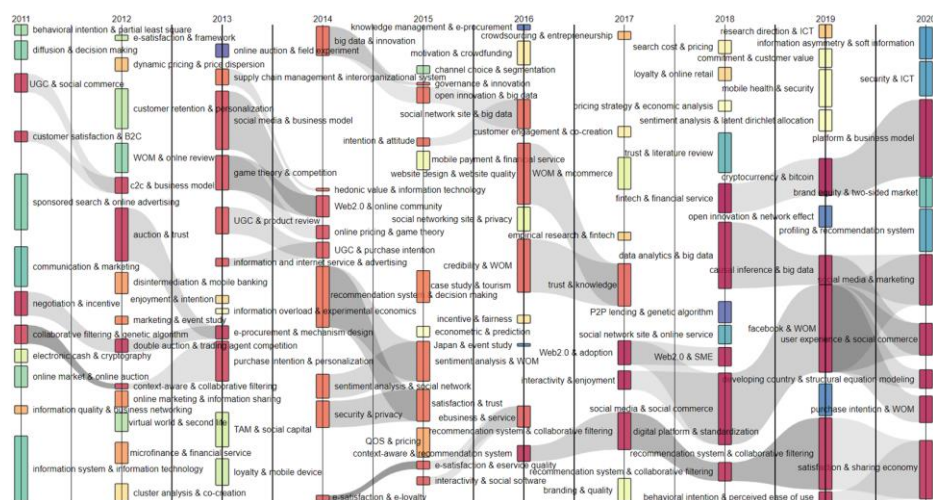**Figure 3.   Research evolution in e-commerce (2001-2010)**

Figure 4.   Research evolution in e-commerce (2011-2020)

Web 2.0 and interaction have meagered as a new research topic of the digital platform and further absorbed the topics of "big data" and "WOM", and developed to a couple of new topics, such as "social media" and "marketing", "user experience" and "social commerce", "WOM" and "purchase intention". From 2018 to 2020, the platform and business model also emerged as a new research topic. As shown in Figure 4, "consumers" has become a research focus on e-commerce, such as different consumer-related research themes are dispersed in the studied period, including "satisfaction", "loyalty", "trust", "purchasing intention", "product review", "WOM", "UGC", "user experience" as well as "security" and "privacy" of users.

5.   DISCUSSION AND CONCLUSIONS

This study identified the major research topics as well as their evolution in e-commerce research from 2001 to 2020 by employing co-word analysis. The research findings in this study provide some insights into the e-commerce field. First, by comparing the research topic evolution during the two periods, we found that some research themes have become a cumulative tradition in the field of e-commerce, such as the research topics of "trust", "recommendation system", "online retail/shopping", "business model", "consumer behavior", "privacy", "security", and "supply chain management". Throughout the 20 years, these research topics have retained their continuity in e-commerce research. The findings indicate that though research themes in e-commerce are also emerging and fading in the past 20 years, there is a temporary continuity of research themes in the research

field.

Simultaneously, the visualization of e-commerce research themes in the two different studied periods shows the characteristics of the research themes at that time. In the first phase, 2001-2010, "e-commerce business model" seemed to receive more attention in e-commerce research, and "B2B", "B2C", and "C2C" research has been in combination with other research themes, while this phenomenon dimmed in 2011-2020. This might be due to the fact that the e-commerce business model has already become mature in 2001-2010 and no need for much research on these topics. This phenomenon also occurs in "XML" technology and "Internet", which have lost their original core position in the last 10 years due to their common application. Instead, the application of new technologies in e-commerce has become a core research theme in the e-commerce field. In 2011-2020, "social media" has become a hot research topic since understanding consumers, such as their behavior, should rely more on their "UGC", "WOM" in social media [31]. In addition, e-commerce is also developing and innovating itself through leading-edge technologies such as "big data", "mobile platforms" and "cloud computing".

In this paper, we applied the co-word analysis method to reveal the distribution of research topics and the evolution process of research themes based on the articles published in the leading e-commerce journals in the past 20 years. The findings in this study imply that new technologies are being integrated into e-commerce and have absorbed into the existing knowledge landscape in e-commerce research to advance the knowledge structure of the field. The findings of the study complement and refine the work on the status of e-commerce research based on recent literature and should help scholars obtain an in-depth understanding of the research in the past 20 years and guide their future research in the e-commerce field.

ACKNOWLEDGEMENT

REFERENCES

[1] Tian, Y., & Stewart, C. (2008). History of e-commerce. In Electronic commerce: concepts, methodologies, tools, and applications. Hershey: IGI Global, 1-8

[2] Esmaeili, L., & Hashemi, G, S. A. (2019). A systematic review on social commerce. Journal of Strategic Marketing, 27(4), 317-355

[3] Michael J. Shaw, David M. Gardner, Howard Thomas (1997). Research opportunities in electronic commerce, 21(3), 149-156

[4] Kauffman, R. J. , & Walden, E. A. . (2001). Economics and electronic commerce: survey and directions for research. International Journal of Electronic Commerce, 5(4), 5-116

[5] Hsu, Chien-Lung, Westland, J. Christopher, Chiang, Chun-Hao (2015). Editorial: Electronic Commerce Research in seven maps. Electronic Commerce Research, 15(2), 147-158

[6] H. Tsai (2015). The research trends forecasted by bibliometric methodology: a case study in e-commerce from 1996 to July 2015. Scientometrics, 105(2), 1079-1089

[7] Yu, L. (2019). E-Commerce Models, Players, and Its Future. In Advanced Methodologies and Technologies in Digital Marketing and Entrepreneurship. Hershey: IGI Global, 193-204

[8] Ilmudeen, A. (2021). Big Data, Artificial Intelligence, and the Internet of Things in Cross-Border E-Commerce. Cross-Border E-Commerce Marketing and Management, 257-272

[9] Ngai, E. W. T., & Wat, F. K. T. (2002). A literature review and classification of electronic commerce research. Information and Management, 39(5), 415-429

[10] Urbaczewski, A., Jessup, L. M., & Wheeler, B. (2002). Electronic commerce research: A taxonomy and synthesis. Journal of Organizational Computing and Electronic Commerce, 12(4), 263-305

[11] DeLone, W. H., & McLean, E. R. (2004). Measuring e-commerce success: Applying the DeLone and McLean Information Systems Success Model. International Journal of Electronic Commerce, 9(1), 31-47

[12] Wareham, J., Zheng, J. G., & Straub, D. (2005). Critical themes in electronic commerce research: A meta-analysis. Journal of Information Technology, 20(1), 1-19

[13] Shiau, W. L., & Dwivedi, Y. K. (2013). Citation and co-citation analysis to identify core and emerging knowledge in electronic commerce research. Scientometrics, 94(3), 1317-1337

[14] Lin, A. J., Hsu, C. L., & Chiang, C. H. (2016). Bibliometric study of Electronic Commerce Research in Information Systems & MIS Journals. Scientometrics, 109(3), 1455-1476

[15] Lee, S. M., Hwang, T., & Kim, J. (2007). An analysis of diversity in electronic commerce research. International Journal of Electronic Commerce, 12(1), 31-67

[16] Wang, C., & Chen, C. (2010). Electronic Commerce Research in Latest Decade: A Literature Review. International Journal of Electronic Commerce Studies, 1(1), 1-14

[17] Yoo, B., & Jang, M. (2019). A bibliographic survey of business models, service relationships, and technology in electronic commerce. Electronic Commerce Research and Applications, 33, 100818

[18] Callon, M., Courtial, J.-P., Turner, W. A., Bauin, S. (1983). From translations to problematic networks: An introduction to co-word analysis. Social Science Information, 22(2), 191-235

[19] He, Q. (1999). Knowledge discovery through co-word analysis. Library Trends, 48(1), 133-159

[20] De la Hoz-Correa, A., Muñoz-Leiva, F., & Bakucz, M. (2018). Past themes and future trends in medical tourism research: A co-word analysis. Tourism Management, 65, 200-211

[21] Bai, Y., Li, H., & Liu, Y. (2021). Visualizing research trends and research theme evolution in E-learning field: 1999–2018. Scientometrics, 126(2), 1389–1414

[22] Ding, Y., Chowdhury, G. G., & Foo, S. (2001). Bibliometric cartography of information retrieval research by using co-word analysis. Information processing & management, 37(6), 817-842

[23] Hu, C. P., Hu, J. M., Deng, S. L., & Liu, Y. (2013). A co-word analysis of library and information science in China. Scientometrics, 97(2), 369-382

[24] Liu, Y., Li, H., Goncalves, J., Kostakos, V., & Xiao, B. (2016). Fragmentation or cohesion? Visualizing the process and consequences of information system diversity, 1993-2012. European Journal of Information Systems, 25(6), 509-533

[25] He, Q., Wang, G., Luo, L., Shi, Q., Xie, J., & Meng, X. (2017). Mapping the managerial areas of Building Information Modeling (BIM) using scientometric analysis. International journal of project management, 35(4), 670-685

[26] Landauer, T. K., Peter W. Foltz, & Darrell Laham. (2009). An Introduction to Latent Semantic Analysis. Behavior Research Methods, 41(3), 944-950

[27] Javid, E., Nazari, M., & Ghaeli, M. (2019). Social media and e-commerce: A scientometrics analysis. International Journal of Data and Network Science, 3(3), 269-290

[28] Norian, J. H., Jama, A. M., Eltaieb, M. H., & Adam, A. A. (2020). Data-Driven E-commerce Techniques and Challenges in the Era of the Fourth Industrial Revolution. Scientific Journal of Informatics, 7(2), 291-302

[29] Leydesdorff, L., & Goldstone, R. L. (2014). Interdisciplinarity at the journal and specialty level: The changing knowledge bases of the journal Cognitive Science. Journal of the Association for Information Science and Technology, 65(1), 164-177

[30] Ngai, E. W., & Gunasekaran, A. (2007). A review for mobile commerce research and applications. Decision support systems, 43(1), 3-15

[31] Zhao, Y., Wang, L., Tang, H., & Zhang, Y. (2020). Electronic word-of-mouth and consumer purchase intentions in social e-commerce. Electronic Commerce Research and Applications, 41, 100980