20 years of Electronic Commerce Research

Satish Kumar1 · Weng Marc Lim2,3 · Nitesh Pandey1 · J. Christopher Westland4

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Abstract
2021 marks the 20th anniversary of the founding of Electronic Commerce Research (ECR). The journal has changed substantially over its life, reflecting the wider changes in the tools and commercial focus of electronic commerce. ECR’s early focus was telecommunications and electronic commerce. After reorganization and new editorship in 2014, that focus expanded to embrace emerging tools, business models, and applications in electronic commerce, with an emphasis on the innovations and the vibrant growth of electronic commerce in Asia. Over this time, ECR’s impact and volume of publications have grown rapidly, and ECR is considered one of the premier journals in its discipline. This invited research summarizes the evolution of ECR’s research focus over its history.

Keywords Electronic commerce research · Bibliometric analysis · Performance analysis · Co-authorship analysis · Bibliographic coupling · Temporal keyword analysis

Satish Kumar
skumar.dms@mnit.ac.in

Weng Marc Lim
lim@wengmarc.com; marclim@swin.edu.au; wlim@swinburne.edu.my

Nitesh Pandey
2018RBM9016@mnit.ac.in

J. Christopher Westland
westland@uic.edu

1 Department of Management Studies, Malaviya National Institute of Technology, Jaipur, Rajasthan 302017, India
2 Swinburne Business School, Swinburne University of Technology, John Street, Hawthorn, Victoria 3122, Australia
3 School of Business, Swinburne University of Technology, Jalan Simpang Tiga, 93350 Kuching, Sarawak, Malaysia
4 Department of Information and Decision Sciences, University of Illinois – Chicago, 601 S. Morgan Street, Chicago, Illinois 60607-7124, USA
1 Introduction

The year 2021 marks the 20th anniversary of the founding of Electronic Commerce Research (ECR). The journal has changed substantially over its life, reflecting the wider changes in the tools and commercial focus of electronic commerce. ECR’s early focus was on telecommunications and electronic commerce. After reorganization and new editorship in 2014, that focus expanded to embrace emerging tools, business models, and applications in electronic commerce, with an emphasis on emerging technologies and the vibrant growth of electronic commerce in Asia. Over these years, ECR has steadily improved its stature and impact, as evidenced through various quantitative (e.g., citations, impact factors) and qualitative (e.g., peer-informed journal ranks) measures. According to Clarivate Analytics, ECR’s impact factor in 2019 was 2.507,1 which means that articles published in ECR between 2017 and 2018 received an average of 2.507 citations from journals indexed in Web of Science in 2019. The five-year impact factor of ECR was 2.643,1 which indicates that articles published in ECR between 2014 and 2018 received an average of 2.643 citations from Web of Science-indexed journals in 2019. According to Scopus, ECR’s CiteScore was 4.3,2 which implies that articles published in ECR between 2016 and 2019 received an average of 4.3 citations from journals indexed in Scopus in 2019. The source normalized impact per paper (SNIP) of ECR was 1.962, which suggests that the average citations received by articles in the journal is 1.962 times the average citations received by articles in the same subject area of Scopus-indexed journals in 2019. Apart from these quantitative measures, ECR has also been rated highly by peers in the field, as seen through journal quality lists. For example, ECR has been consistently ranked as an “A” journal by the Excellence in Research for Australia (ERA 2010) and the Australian Business Deans Council (ABDC 2013, 2016, 2019) journal ranking lists.

This research presents a 20-year retrospective bibliometric analysis of the evolution of context and focus of ECR’s articles [1–5]. To curate a rich bibliometric overview of ECR’s scientific achievements, this study explores seven research questions (RQ) which are commonly asked by both authors and our Editorial Board members:

RQ1. What is the trend of publication and citation in ECR?
RQ2. Who are the most prolific contributors (authors, institutions, and countries) in ECR?
RQ3. What are the most influential publications in ECR?
RQ4. Where have ECR publications been cited the most?
RQ5. What is the trend of collaboration in ECR?
RQ6. Who are the most important constituents of the collaboration network in ECR?
RQ7. What are the major research themes in ECR?

1 Web of Science single-year and five-year impact factors for ECR: https://www.springer.com/journal/10660.
2 Scopus CiteScore and SNIP for ECR: https://www.scopus.com/sourceid/145669.
A bibliometric analysis can offer a broad, systematic overview of the literature to delineate the evolution of electronic commerce technologies, and point the direction to trending topics and methodologies [5–14]. Our research is organized as follows. Section 2 outlines our bibliometric methodology. Section 3 goes on to perform analysis to uncover contributor and journal performance trends (RQ1–RQ4), the co-authorship analysis performed to unpack collaboration and constituent characteristics (RQ5–RQ6), and the bibliometric coupling and keyword analyses used to reveal the major themes and trends within the ECR corpus (RQ7). Section 4 applies graph theoretic analysis. Section 5 applies cluster analysis. Section 6 applies thematic analysis. Finally, we conclude the study with key takeaways from this retrospective.

2 Methodology

Bibliometric methodologies apply graph theoretic and statistical tools for analysis of bibliographic data [15] and include performance analysis and science mapping [16]. To answer research question 1 to research question 4, this study uses performance analysis to measure the output of authors’ productivity and impact, with productivity measured using publications per year, and impact measured using citations per year. We begin by measuring the productivity and impact of ECR, and then the productivity and impact of authors, institutions, and countries using both publications and citations per year metrics on top of ancillary measures such as citations per publication and h-index. Finally, we measure the impact of ECR articles using citations and shed light on prominent publication outlets citing ECR articles.

To answer research question 5 to research question 7, this study uses co-authorship, bibliographic coupling, and keyword analyses. We begin by conducting a co-authorship analysis, which is a network-based analysis that scrutinizes the relationships among journal contributors [17]. Next, we perform bibliographic coupling to obtain the major themes within the ECR corpus. The assumption of bibliographic coupling connotes that two documents would be similar in content if they share similar references [18, 19]. Using article references, a network was created, wherein shared references were assigned with edge weights and documents were denoted with nodes. The documents were divided into thematic clusters using the Newman and Girvan [20] algorithm. Finally, we track the development of themes throughout different time periods using a temporal keyword analysis. The assumption of this analysis suggest that keywords are representative of the author’s intent [21] and thus important for understanding the prominence of themes pursued by authors across different time periods. Indeed, we found that these bibliometric methods complement each other relatively well, as bibliographic coupling was useful to locate general themes while keywords were useful to understand specific topics.

To acquire bibliographic data of ECR articles for the bibliometric analyses mentioned above, this study uses the Scopus database, which is one of the largest academic database that is almost 60% larger than the Web of Science [21]. Past research has also indicated that the citations presented within the Scopus database correlate more with expert judgement as compared to Google Scholar and Web of Science [22]. We begin by conducting a source search for “Electronic Commerce
which resulted in 927 articles, and after filtering out non-ECR articles, we obtain a list of 516 ECR articles (see Fig. 1). However, ECR only gained Scopus indexation in 2005, and thus, only 443 ECR articles (2005–2020) contained full bibliometric data, whereas the remaining 73 ECR articles (2001–2004) contained only partial bibliometric data (e.g., no affiliation, abstract, and keyword entry). All 516 ECR articles were fetched and included in the performance analysis as partial
bibliometric data was sufficient, but only 443 ECR articles were included in science mapping (e.g., co-authorship, bibliographic coupling, and keyword analyses using VOSviewer [23] and Gephi [24]) as full bibliometric data was required. This collection of articles met the minimum sample size of 200 articles for bibliometric analysis recommended by Rogers, Szomszor, and Adams [25].

3 Performance analysis: productivity and impact

3.1 ECR

The publication and citation trends of ECR between 2001 and 2020 are presented in Fig. 2 (RQ1). In terms of publication, the number of articles published in ECR has grown from 20 articles per year in 2001 to 81 articles per year in 2020, with an average annual growth rate of 7.64%. In terms of citations, the number of citations that ECR articles received has grown from three citations in 2001 to 1219 citations in 2020, with an average annual growth rate of 37.19%. These statistics suggest that ECR’s publications and citations have seen exponential growth since its inception, and that the journal’s citations have grown at a much faster rate than its publication, which is very positive.

3.2 Authors

The most prolific authors in ECR between 2001 and 2020 are presented in Table 1 (RQ2). The most prolific author is Jian Mou, who has published six articles in ECR, which have garnered a total of 95 citations. This is followed by Yan-Ping Liu and Liyi Zhang, who have published three articles each in ECR, which have received a total of 46 and 42 citations, respectively. Among the top 20 contributors, the author with the highest citation average per publication is Katina Michael (TC/TP and TC/
TCP = 59 citations), who is followed closely by Yue Guo (TC/TP and TC/TCP = 51 citations); they are the only two authors who have an average citation greater than 50 for their ECR articles.

### 3.3 Institutions

The most prolific institutions for ECR between 2001 and 2020 are presented in Table 2 (RQ2). IBM, with 14 articles and 371 citations, emerges as the highest contributing institution to ECR. It is surprising yet encouraging to see a high number of contributions coming from practice, which reflects the ECR’s receptiveness to publish industry-relevant research. Nonetheless, it is worth mentioning that this contribution is derived from the collective effort of IBM’s research labs around the world (e.g., Delhi, Haifa, and New York)—a unique advantage that most higher education institutions do not enjoy unless they have full-fledged research-active international branch campuses around the world. The second and third most contributing institutions are Nanjing University and Xi’an Jiaotong University, with 11 and 10 articles that have been cited 116 and 29 times, respectively. This is yet another interesting observation, as the contributions by

### Table 1 Most prolific authors for ECR between 2001 and 2020

| Author         | TP | TCP | TC  | TC/TP | TC/TCP | $h$ |
|----------------|----|-----|-----|-------|--------|-----|
| Mou J          | 6  | 5   | 95  | 15.83 | 19.00  | 4   |
| Liu Y.-P       | 3  | 3   | 46  | 15.33 | 15.33  | 3   |
| Zhang L        | 3  | 2   | 42  | 14.00 | 21.00  | 2   |
| Lin Z          | 3  | 3   | 40  | 13.33 | 13.33  | 3   |
| Westland J.C   | 3  | 3   | 21  | 7.00  | 7.00   | 3   |
| Luo X          | 3  | 1   | 19  | 6.33  | 19.00  | 1   |
| Yan B          | 3  | 2   | 6   | 2.00  | 3.00   | 1   |
| Sun J          | 3  | 0   | 0   | 0.00  | 0.00   | 0   |
| Michael K      | 2  | 2   | 118 | 59.00 | 59.00  | 2   |
| Guo Y          | 2  | 2   | 102 | 51.00 | 51.00  | 2   |
| Choo K.-K.R    | 2  | 2   | 78  | 39.00 | 39.00  | 2   |
| Khedmatgozar H.R| 2 | 2   | 74  | 37.00 | 37.00  | 2   |
| Wei J          | 2  | 2   | 73  | 36.50 | 36.50  | 2   |
| Teng C.-I      | 2  | 2   | 71  | 35.50 | 35.50  | 2   |
| Paraschiv C    | 2  | 2   | 67  | 33.50 | 33.50  | 2   |
| Chen M.-Y      | 2  | 2   | 63  | 31.50 | 31.50  | 2   |
| Cohen J        | 2  | 2   | 61  | 30.50 | 30.50  | 2   |
| Maes P         | 2  | 2   | 56  | 28.00 | 28.00  | 2   |
| Tsao W.-C      | 2  | 2   | 55  | 27.50 | 27.50  | 2   |
| Lee H.S        | 2  | 2   | 50  | 25.00 | 25.00  | 2   |

TP = total publication(s). TCP = total cited publication(s). TC = total citation(s). TC/TP = cites per publication. TC/TCP = cites per cited publication. $h = h$-index
Chinese institutions suggest that *ECR* is a truly international journal despite its origins and operations stemming in the United States. Finally, the University of California (TC/TP and TC/TCP = 34.86 citations) emerges as the institution that averages the most citations per publication, followed by IBM (TC/TP and TC/TCP = 26.50 citations) and Texas Tech University (TC/TP and TC/TCP = 26.20 citations).

### 3.4 Countries

The most prolific countries in *ECR* between 2001 and 2020 are presented in Table 3 (RQ2). China emerges as the most prolific contributor, with 152 articles and 1066 citations. This is followed by the United States, which has contributed 143 articles and 2813 citations. No country other than China and the United States has contributed more than 50 articles to *ECR*. Nevertheless, it is important to note that *ECR* also receives contributions from many countries around the world, as the remaining ± 50% of contributions in the top 20 list comes from 18 different countries across Asia, Europe, and Oceania.
Table 3 Most prolific countries for ECR between 2001 and 2020

| Country       | TP  | TCP | TC   | TC/TP | TC/TCP | h   |
|---------------|-----|-----|------|-------|--------|-----|
| China         | 152 | 108 | 1066 | 7.01  | 9.87   | 15  |
| United States | 143 | 133 | 2813 | 19.67 | 21.15  | 23  |
| Taiwan        | 35  | 34  | 535  | 15.29 | 15.74  | 12  |
| South Korea   | 34  | 26  | 451  | 13.26 | 17.35  | 7   |
| Australia     | 30  | 28  | 547  | 18.23 | 19.54  | 13  |
| Germany       | 21  | 20  | 565  | 26.90 | 28.25  | 9   |
| United Kingdom| 21  | 18  | 413  | 19.67 | 22.94  | 11  |
| India         | 21  | 15  | 163  | 7.76  | 10.87  | 6   |
| Spain         | 20  | 18  | 321  | 16.05 | 17.83  | 12  |
| Greece        | 17  | 17  | 512  | 30.12 | 30.12  | 11  |
| Hong Kong     | 16  | 13  | 142  | 8.88  | 10.92  | 8   |
| Canada        | 15  | 12  | 506  | 33.73 | 42.17  | 10  |
| France        | 13  | 11  | 218  | 16.77 | 19.82  | 9   |
| Italy         | 13  | 11  | 186  | 14.31 | 16.91  | 8   |
| Switzerland   | 11  | 11  | 250  | 22.73 | 22.73  | 9   |
| Iran          | 11  | 11  | 222  | 20.18 | 20.18  | 7   |
| New Zealand   | 10  | 10  | 167  | 16.70 | 16.70  | 8   |
| Japan         | 8   | 7   | 87   | 10.88 | 12.43  | 5   |
| Singapore     | 7   | 7   | 215  | 30.71 | 30.71  | 5   |
| Sweden        | 6   | 6   | 79   | 13.17 | 13.17  | 4   |

TP = total publication(s). TCP = total cited publication(s). TC = total citation(s). TC/TP = cites per publication. TC/TCP = cites per cited publication. \( h = h \)-index

3.5 Articles

The most cited articles in ECR between 2001 and 2020 are presented in Table 4 (RQ3). The most cited article published in ECR during this period is Füller et al.’s [26] article on the role of virtual communities in new product development (TC = 270). This is followed by Sotiriadis and van Zyl’s [27] article on electronic word of mouth and its effects on the tourism industry (TC = 188), Nonnecke et al.’s [28] article on the phenomena of ‘lurking’ in online communities (TC = 185), Lehdonvirta’s [29] article on the factors that drive virtual product purchases (TC = 170), and Bae and Lee’s [30] article on the effect of gender on consumer perception of online reviews (TC = 125). The diversity of topics in the most cited articles indicate that electronic commerce is indeed a multi-faceted subject, which we will explore in detail in the later sections.
| Author(s) | Title                                                                 | Year | TC  | C/Y  |
|----------|----------------------------------------------------------------------|------|-----|------|
| Füller J., Bartl M., Ernst H., Mühlbacher H | Community based innovation: how to integrate members of virtual communities into new product development | 2006 | 270 | 18.00 |
| Sotiriadis M.D., van Zyl C | Electronic word-of-mouth and online reviews in tourism services: the use of Twitter by tourists | 2013 | 188 | 23.50 |
| Nonnecke B., Andrews D., Preece J | Non-public and public online community participation: needs, attitudes and behavior | 2006 | 185 | 12.33 |
| Lehdonvirta V | Virtual item sales as a revenue model: identifying attributes that drive purchase decisions | 2009 | 170 | 14.17 |
| Bae S., Lee T | Gender differences in consumers' perception of online consumer reviews | 2011 | 125 | 12.50 |
| Kim J.B | An empirical study on consumer first purchase intention in online shopping: integrating initial trust and TAM | 2012 | 124 | 13.78 |
| Zarpou T., Saprikis V., Markos A., Vlachopoulou M | Modeling users’ acceptance of mobile services | 2012 | 121 | 13.44 |
| Sila I | Factors affecting the adoption of B2B e-commerce technologies | 2013 | 118 | 14.75 |
| Malaga R.A | Web-based reputation management systems: problems and suggested solutions | 2001 | 118 | 5.90 |
| Gregg D.G., Walczak S | The relationship between website quality, trust and price premiums at online auctions | 2010 | 104 | 9.45 |
| Huang T.-L., Liao S | A model of acceptance of augmented-reality interactive technology: the moderating role of cognitive innovativeness | 2015 | 102 | 17.00 |
| Flanagan A.J., Metzger M.J., Pure R., Markov A., Hartsell E | Mitigating risk in ecommerce transactions: perceptions of information credibility and the role of user-generated ratings in product quality and purchase intention | 2014 | 101 | 14.43 |
| Lee P.M | Behavioral model of online purchasers in e-commerce environment | 2002 | 101 | 5.32 |
| Guo Y., Barnes S | Virtual item purchase behavior in virtual worlds: an exploratory investigation | 2009 | 97 | 8.08 |
| Pourshahid A., Amyot D., Peyton L., Ghanavati S., Chen P., Weiss M., Forster A.J | Business process management with the user requirements notation | 2009 | 96 | 8.00 |
| Hsieh J.-K., Hsieh Y.-C., Tang Y.-C | Exploring the disseminating behaviors of eWOM marketing: persuasion in online video | 2012 | 80 | 8.89 |
| Xu F., Michael K., Chen X | Factors affecting privacy disclosure on social network sites: an integrated model | 2013 | 79 | 9.88 |
| Patton M.A., Josang A | Technologies for trust in electronic commerce | 2004 | 79 | 4.65 |
| Taylor D.G., Davis D.F., Jillapalli R | Privacy concern and online personalization: the moderating effects of information control and compensation | 2009 | 76 | 6.33 |
| Author(s)       | Title                                                      | Year | TC  | C/Y |
|-----------------|------------------------------------------------------------|------|-----|-----|
| Jeffrey S.A., Hodge R | Factors influencing impulse buying during an online purchase | 2007 | 74  | 5.29|

TC = total citation(s). C/Y = cites per year
3.6 Publication outlets

The publication outlets that have cited ECR articles the most between 2001 and 2020 are presented in Table 5 (RQ4). The list includes many prestigious journals such as *International Journal of Information Management* (ABDC = A*, IF = 8.210), *Information and Management* (ABDC = A*, IF = 5.155), and *Decision Support Systems* (ABDC = A*, IF = 4.721), among others. The presence of such reputed journals reflects ECR’s own reputation of high standing among its peers. Apart from ECR, the publication outlets that have highly cited ECR include *Lecture Notes in Computer Science* including subseries *Lecture Notes in Artificial Intelligence* and *Lecture Notes in Bioinformatics* (TC = 218), *Computers in Human Behavior* (TC = 95), and *ACM International Conference Proceeding Series* (TC = 88), which reflect the diversity in publication outlets that ECR is making an impact (e.g., book, conference, journal).

### Table 5: Publications citing ECR the most between 2001 and 2020

| Title                                                                 | TC   | ABDC rank | IF   | CiteScore | SNIP |
|----------------------------------------------------------------------|------|-----------|------|-----------|------|
| Electronic Commerce Research                                        | 267  | A         | 2.507| 4.3       | 1.962|
| Lecture Notes in Computer Science including subseries               | 218  | NA        | NA   | NA        | NA   |
| Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics |
| Computers in Human Behavior                                         | 95   | A         | 5.003| 12.1      | 3.079|
| ACM International Conference Proceeding Series                      | 88   | NA        | NA   | 0.8       | 0.333|
| Journal of Retailing and Consumer Services                           | 69   | A         | 4.219| 7.4       | 2.166|
| Sustainability                                                       | 67   | NA        | 2.567| NA        | NA   |
| Electronic Commerce Research and Applications                        | 61   | C         | 3.824| 6.9       | 1.787|
| Advances in Intelligent Systems and Computing                        | 60   | NA        | NA   | 0.9       | 0.429|
| Lecture Notes in Business Information Processing                     | 51   | NA        | NA   | 1.3       | 0.573|
| Internet Research                                                    | 47   | A         | 4.708| 7.9       | 2.213|
| Journal of Business Research                                         | 44   | A         | 4.874| 8.9       | 2.76 |
| International Journal of Information Management                      | 43   | A*        | 8.21 | 14.1      | 3.773|
| Decision Support Systems                                             | 43   | A*        | 4.721| 9.5       | 2.718|
| IEEE Access                                                          | 41   | NA        | 3.745| 3.9       | 1.734|
| Information and Management                                           | 38   | A*        | 5.155| 11        | 3.002|
| Communications in Computer and Information Science                   | 37   | NA        | NA   | 0.7       | 0.403|
| Ceur Workshop Proceedings                                            | 31   | NA        | NA   | 0.6       | 0.293|
| Journal of Electronic Commerce Research                              | 30   | B         | 1.875| 4         | 0.963|
| Industrial Management and Data Systems                               | 30   | A         | 3.329| 7.9       | 2.502|
| Telematics and Informatics                                           | 29   | C         | 4.139| 9.7       | 2.566|
| Journal of Internet Commerce                                         | 29   | B         | NA   | 3.7       | 1.203|
| Expert Systems with Applications                                     | 29   | C         | 5.452| 11        | 3.139|

TC = total citation(s). ABDC rank = Australian Business Deans Council rank. IF = 2019 impact factor by Clarivate Analytics. SNIP = 2019 source normalized impact per paper by Scopus. NA = not available.
4 Co-authorship analysis: scientific network

4.1 Co-authorship

The co-authorships in ECR between 2005 and 2020 are presented in Table 6 (RQ5). On the one hand, the co-authorship analysis shows that the share of articles written by a single author has gone down over the years from 10.94% (2005–2008) to 8.61% (2017–2020). The small and decreasing share of single-authored articles do not come as a surprise given the importance and proliferation of collaboration to address increasing thematic and methodological complexity in research [31]. On the other hand, the co-authorship analysis shows that multi-authored articles have increased their share in ECR, especially articles with three authors or more. In particular, the share of articles with three and five or more authors have increased from 31.25% and 4.69% between 2005 and 2008 to 34.45% and 14.35% between 2017 and 2020, respectively. These statistics suggest that collaboration is growing in prominence, which is consistent with recent observations reported by other premier journals in business [32–34], and that ECR is a good home for collaborative research.

4.2 Network centrality

The most important authors, institutions, and countries across different measures of centrality are presented in Table 7 (RQ6). In this study, we employ four measures of centrality: degree of centrality, betweenness centrality, closeness centrality, and eigen centrality.

In essence, degree of centrality refers to the number of relational ties a node has in a network. In contrast, betweenness centrality refers to a node’s ability to connect otherwise unconnected groups of nodes, wherein nodes act as a gateway for the flow of information. Whereas, closeness centrality refers to a node’s closeness to every other node in the network, whereby nodes that reflect a greater number of shortest paths than others in a network indicates the ability of those nodes to transmit information and knowledge across the network with relative ease. Finally, eigen centrality refers to a node’s relative importance in a network, whereby nodes that are connected to other highly connected nodes are crucial to information transfer.
| Rank | Author | Degree of centrality | Betweenness centrality | Closeness centrality | Eigen centrality |
|------|--------|----------------------|------------------------|---------------------|-----------------|
| 1    | Mou J  | Mou J                | Luo X                  | Wang J.-X           |                 |
| 2    | Sun J  | Sun J                | Zhang L                | Chan F.T.S          |                 |
| 3    | Lin Z  | Ding Z               | Yan B                  | Amyot D             |                 |
| 4    | Ding Z | Luo X                | Wang Q                 | Chen P              |                 |
| 5    | Luo X  | Zhang L              | Chen K                 | Yang L              |                 |
| 6    | Wang Q | Yan B                | Westland J.C           | Wang T              |                 |
| 7    | Zhang L| Wang Q               | Li X                   | Choo K.-K.R         |                 |
| 8    | Yan B  | Chen K               | Zhang N                | Weiss M             |                 |
| 9    | Chen K | Zheng H              | Fan W                  | Chen J.-K           |                 |
| 10   | Zheng H| Westland J.C         | Kim J                  | Shi Y               |                 |

| Rank | Institution | Degree of centrality | Betweenness centrality | Closeness centrality | Eigen centrality |
|------|-------------|----------------------|------------------------|---------------------|-----------------|
| 1    | Renmin University | Renmin University | University of Ottawa | University of Ottawa |                 |
| 2    | University of Ottawa | Xidian University | University of Electronic Science and Technology of China | IBM |                 |
| 3    | Xidian University | City University of Hong Kong | Yonsei University | Renmin University |                 |
| 4    | University of Alabama | Chinese Academy of Sciences | Nanjing University | Zhejiang University |                 |
| 5    | Zhejiang University | University of Ottawa | Beihang University | Hefei University of Technology |                 |
| 6    | Hefei University of Technology | Beijing Institute Of Technology | Seoul National University | City University of Hong Kong |                 |
| 7    | University of Texas | University of Illinois | National Cheng Kung University | University of Electronic Science and Technology of China |                 |
| 8    | Tsinghua University | Wuhan University | National Taichung University | Yonsei University |                 |
| 9    | IBM         | Soochow University | University of the Basque Country | Xi’an Jiaotong University |                 |
| 10   | City University of Hong Kong | Kookmin University | University of Nottingham | Wuhan University |                 |
| Rank | Degree of centrality | Betweenness centrality | Closeness centrality | Eigen centrality |
|------|----------------------|------------------------|---------------------|-----------------|
|      | Country              |                        |                     |                 |
| 1    | United States        | China                  | United States       | United States   |
| 2    | China                | United States          | Spain               | Venezuela       |
| 3    | Spain                | Spain                  | Norway              | United Kingdom  |
| 4    | United Kingdom       | Greece                 | Iran                | Slovenia        |
| 5    | Australia            | Germany                | Belgium             | South Korea     |
| 6    | Greece               | Italy                  | Czech Republic      | Norway          |
| 7    | Germany              | France                 | Netherlands         | Switzerland     |
| 8    | Italy                | United Kingdom         | Singapore           | New Zealand     |
| 9    | South Korea          | Norway                 | India               | Italy           |
| 10   | New Zealand          | South Korea            | Turkey              | Spain           |
In terms of authors, Jian Mou emerged as the most important author for degree of centrality and betweenness centrality, whereas Xin Luo and Jian-xin Wang were flagged as the most important authors for closeness centrality and eigen centrality, respectively. In terms of institutions, Renmin University emerged as the most important institution for degree centrality and betweenness centrality, whereas the University of Ottawa was rated as the most important institution for closeness centrality and eigen centrality. In terms of countries, China emerged as the most important country for betweenness centrality, whereas the United States emerged as the most important country for the other three measures of centrality. Collectively, these findings indicate the most important constituents for degree of centrality, betweenness centrality, closeness centrality, and eigen centrality in terms of authors, institutions, and countries.

### 4.3 Collaboration network

The author collaboration network in Fig. 3 indicates that authors groups in ECR are fairly separated from each other, especially among highly connected authors (more than five links in the network).
five links in the network). This suggests that most authors in ECR chose to work in a single team rather than across multiple teams. The institution collaboration network in Fig. 4 reaffirms our earlier finding that Renmin University is indeed the most important constituent of the network, especially among highly connected institutions (more than five links in the network). The institution collaboration network also appears to be more complex than the author collaboration network, wherein institutions appear to be far more connected to each other, indicating a good degree of collaboration across institutional lines. The country network in Fig. 5 presents a similar network scenario, where countries appear to be fairly well connected, with the United States being at the center of the country-level collaboration network. These findings suggest that ECR authors collaborate more actively across institutions and countries than teams.

5 Bibliographic coupling: thematic clusters

Bibliographic coupling is applied to unpack the major clusters (themes) within the ECR corpus. The method is predicated on the assumption that documents that share the same references are similar in content [18, 35]. The application of bibliographic
coupling on 443 ECR articles resulted in the formation of 30 clusters, wherein 11 major clusters were identified. The 11 major clusters, which contained 401 (or 90.5%) ECR articles, were ordered based on number of publications and average publication years, with more recent clusters ordered before older clusters in the case of clusters sharing the same number of publications. The summary of the 11 major clusters, which take center stage in this study, is presented in Table 8.

5.1 Cluster #1: online privacy and security

Cluster #1 contains 74 articles that have been cited 963 times with an average publication year of 2013.09. The most cited article in this cluster is Zarpou et al.’s [36] article on the adoption of mobile services. This is followed by Chaudhry et al.’s [37] article on user encryption schemes for e-payment systems, and Antoniou and Batten’s [38] article on purchaser’s privacy and trust in online transactions. Other articles in this cluster have considered topics such as e-commerce trust models [39].
| Cluster # | Cluster theme                      | TP | TC  | APY   | Most cited articles                                                                 |
|----------|------------------------------------|----|-----|-------|------------------------------------------------------------------------------------|
| 1        | Online privacy and security        | 74 | 963 | 2013.09 | Zarmou T., Saprikis V., Markos A., Vlachopoulos M                                    |
|          |                                    |    |     |       | Chaudhry S.A., Farash M.S., Naqvi H., Sher M                                         |
|          |                                    |    |     |       | Antoniou G., Batten L                                                               |
|          |                                    |    |     |       | Modeling users' acceptance of mobile services                                      |
|          |                                    |    |     |       | A secure and efficient authenticated encryption for electronic payment systems using elliptic curve cryptography |
|          |                                    |    |     |       | E-commerce: protecting purchaser privacy to enforce trust                           |
| 2        | Online channels and optimization   | 49 | 451 | 2016.67 | Jeffrey S.A., Hodge R                                                              |
|          |                                    |    |     |       | Biller S., Chan L.M.A., Simchi-Levi D., Swann J                                     |
|          |                                    |    |     |       | Yan R                                                                              |
|          |                                    |    |     |       | Factors influencing impulse buying during an online purchase                        |
|          |                                    |    |     |       | Dynamic pricing and the direct-to-customer model in the automotive industry         |
|          |                                    |    |     |       | Profit sharing and firm performance in the manufacturer-retailer dual-channel supply chain |
| 3        | Online engagement and preferences  | 49 | 982 | 2013.98 | Nonnecke B., Andrews D., Preece J                                                  |
|          |                                    |    |     |       | Sila I                                                                             |
|          |                                    |    |     |       | Factors affecting the adoption of B2B e-commerce technologies                      |
|          |                                    |    |     |       | Ozok A.A., Wei J                                                                    |
|          |                                    |    |     |       | An empirical comparison of consumer usability preferences in online shopping using stationary and mobile devices: results from a college student population |
| Cluster # | Cluster theme                                      | TP | TC | APY | Most cited articles                                                                 |
|----------|---------------------------------------------------|----|----|-----|--------------------------------------------------------------------------------------|
|          |                                                   |    |    |     | Author                                                                                             |
|          |                                                   |    |    |     | Title                                                                                             |
|          |                                                   |    |    |     | Year | TC  |
| 4        | Online market sentiments and analyses              | 41 | 198| 2018.56 | Zhou Q                                                                 | Multi-layer affective computing model based on emotional psychology |
|          |                                                   |    |    |     | Suki N.M                                                                 | Consumer shopping behaviour on the Internet: insights from Malaysia |
|          |                                                   |    |    |     | Chen Y., Mullen T., Chu C.-H                                                                 | An in-depth analysis of information markets with aggregate uncertainty |
| 5        | Online reviews and ratings                        | 40 | 611| 2017.28 | Bae S., Lee T                                                                                   | Gender differences in consumers’ perception of online consumer reviews |
|          |                                                   |    |    |     | Flanagin A.J., Metzger M.J., Pure R., Markov A., Hartsell E                                 | Mitigating risk in ecommerce transactions: Perceptions of information credibility and the role of user-generated ratings in product quality and purchase intention |
|          |                                                   |    |    |     | Fairlie R.W                                                                                     | Explaining differences in access to home computers and the Internet: a comparison of Latino groups to other ethnic and racial groups |
| 6        | Online exchanges and transactions                  | 34 | 320| 2011.29 | Narayanasamy K., Rasiah D., Tan T.M                                                             | The adoption and concerns of e-finance in Malaysia |
|          |                                                   |    |    |     | Dumas M., Aldred L., Governatori G., Ter Hofstede A.H.M                                         | Probabilistic automated bidding in multiple auctions |
|          |                                                   |    |    |     | Marinč M                                                                                         | Banks and information technology: Marketability vs. relationships |
| Cluster # | Cluster theme                        | TP | TC  | APY  | Author                          | Title                                                                 | Year | TC  |
|----------|-------------------------------------|----|-----|------|--------------------------------|----------------------------------------------------------------------|------|-----|
| 7        | Online media and platforms          | 30 | 668 | 2016.23 | Sotiriadis M.D., van Zyl C | Electronic word-of-mouth and online reviews in tourism services: the use of Twitter by tourists | 2013 | 188 |
|          |                                     |    |     |       | Huang T.-L., Liao S          | A model of acceptance of augmented-reality interactive technology: the moderating role of cognitive innovativeness | 2015 | 102 |
|          |                                     |    |     |       | Hsieh J.-K., Hsieh Y.-C., Tang Y.-C | Exploring the disseminating behaviors of eWOM marketing: persuasion in online video | 2012 | 80  |
| 8        | Online technology acceptance and continuance | 26 | 249 | 2016.37 | Zhou T                      | An empirical examination of user adoption of location-based services | 2013 | 42  |
|          |                                     |    |     |       | Chen Q., Chen H.-M., Kazman R | Investigating antecedents of technology acceptance of initial ECRM users beyond generation X and the role of self-construal | 2007 | 34  |
|          |                                     |    |     |       | Royo S., Yetano A           | “Crowdsourcing” as a tool for e-participation: two experiences regarding CO2 emissions at municipal level | 2015 | 22  |
| Cluster # | Cluster theme                                      | TP | TC  | APY    | Most cited articles                                                                 |
|----------|---------------------------------------------------|----|-----|--------|------------------------------------------------------------------------------------|
| 9        | Online communities and commercialization in the virtual world | 22 | 771 | 2012.23 | Füller J., Bartl M., Ernst H., Mühlbacher H
Lehdonvirta V
Guo Y., Barnes S
|                      | Most cited articles                                                                 |
| 10       | Online customer expectations, satisfaction, and loyalty | 18 | 291 | 2016.11 | Hanafizadeh P., Khedmatgozar H.R
Valvi A.C., Fragkos K.C
Aloudat A., Michael K
|                      | The mediating role of the dimensions of the perceived risk in the effect of customers’ awareness on the adoption of Internet banking in Iran
Critical review of the e-loyalty literature: a purchase-centred framework
Toward the regulation of ubiquitous mobile government: a case study on location-based emergency services in Australia |

| Author           | Title                                                                                   | Year | TC  |
|------------------|-----------------------------------------------------------------------------------------|------|-----|
| Füller J., Bartl M., Ernst H., Mühlbacher H | Community based innovation: How to integrate members of virtual communities into new product development | 2006 | 270 |
| Lehdonvirta V    | Virtual item sales as a revenue model: Identifying attributes that drive purchase decisions | 2009 | 170 |
| Guo Y., Barnes S | Virtual item purchase behavior in virtual worlds: An exploratory investigation        | 2009 | 97  |
| Hanafizadeh P., Khedmatgozar H.R | The mediating role of the dimensions of the perceived risk in the effect of customers’ awareness on the adoption of Internet banking in Iran | 2012 | 63  |
| Valvi A.C., Fragkos K.C | Critical review of the e-loyalty literature: a purchase-centred framework | 2012 | 60  |
| Aloudat A., Michael K | Toward the regulation of ubiquitous mobile government: a case study on location-based emergency services in Australia | 2011 | 39  |
| Cluster # | Cluster theme                  | TP | TC  | APY | Author                        | Title                                                                 | Year | TC  |
|----------|-------------------------------|----|-----|-----|-------------------------------|-----------------------------------------------------------------------|------|-----|
| 11       | Online purchase intention    | 18 | 671 | 2014.00 | Kim J.B | An empirical study on consumer first purchase intention in online shopping: integrating initial trust and TAM | 2012 | 124 |
|          |                               |    |     |      | Gregg D.G., Walczak S        | The relationship between website quality, trust and price premiums at online auctions | 2010 | 104 |
|          |                               |    |     |      | Taylor D.G., Davis D.F., Jillapalli R | Privacy concern and online personalization: the moderating effects of information control and compensation | 2009 | 76  |
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consumer privacy [40], cybercrime and cybersecurity issues [41], gender differences [42], and the development and implementation of various authentication systems [43, 44]. Thus, ECR articles in this cluster appear to be centered on **online privacy and security issues**, including equivalent solutions for improved authentication and encryption to improve trust in electronic commerce.

### 5.2 Cluster #2: online channels and optimization

Cluster #2 contains 49 articles that have been cited 415 times with an average publication year of 2016.67. The most cited article in this cluster is Jeffrey and Hodge’s [45] article on impulse purchases in online shopping. This is followed by Biller et al.’s [46] article on dynamic pricing for online retailing in the automotive industry, and Yan’s [47] article on profit sharing and firm performance in manufacturer-retailer dual-channel supply chains. Other articles in this cluster have examined online channels such as peer-to-peer networks and social commerce [48, 49] and optimal supply chain configuration [50, 51]. Thus, *ECR* articles in this cluster appear to be concentrated on **online channels and optimization**, particularly in terms of the channel characteristics and price and supply chain optimization in electronic commerce.

### 5.3 Cluster #3: online engagement and preferences

Cluster #3 contains 49 articles that have been cited 982 times with an average publication year of 2013.98. The most cited article in this cluster is Nonnecke et al.’s [28] article on online community participation. This is followed by Sila’s [52] article on business-to-business electronic commerce technologies, and Ozok and Wei’s [53] article on consumer preferences of using mobile and stationary devices. Other articles in this cluster have explored topics such as online community participation and social impact across countries [54], online opinions across regions and its impact on consumer preferences [55, 56], content and context factors [57], data mining techniques [58], and recommender systems and their application in online environments [59, 60]. Thus, *ECR* articles in this cluster appear to be focused on **online engagement and preferences**, including the adoption and usage of technology (e.g., data mining, recommender systems) to curate engagement and shape preferences among target customers in electronic commerce.

### 5.4 Cluster #4: online market sentiments and analyses

Cluster #4 contains 41 articles that have been cited 198 times. This cluster has the highest average publication year among the 11 major clusters (2018.56), which indicates that most articles in this cluster are fairly recent. The most cited article in this cluster is Zhou’s [61] article on multi-layer affective modeling of emotions in the online environment. This is followed by Suki’s [62] article on online consumer shopping insights, and Chen et al.’s [63] article on information markets. Other articles in this cluster have investigated topics such as Internet queries and marketplace sentiments.
prediction [64], cross-border electronic commerce using the information systems success model [65], and electronic [66] and social [67] commerce using big data. Thus, ECR articles in this cluster appear to be centered on online market sentiments and analyses, with the use of advanced modeling techniques to unpack fresh insights on electronic commerce being relatively prominent.

5.5 Cluster #5: online reviews and ratings

Cluster #5 contains 40 articles that have been cited 611 times with an average publication year of 2017.28. The most cited article in this cluster is Bae and Lee’s [30] article on online consumer reviews across gender. This is followed by Flanagin et al.’s [68] article on user-generated online ratings, and Fairlie’s [69] on the digital divide in online access, which speaks to the technological infrastructure required to post and respond to online reviews and ratings. Other articles in this cluster have examined quantitative and qualitative feedback in online environments [70], electronic word of mouth platforms and persuasiveness [71], online reviews and product innovation [72], recommender systems and product ranking [73], and online rating determinants [74]. Thus, ECR articles in this cluster appear to be concentrated on online reviews and ratings, including its potential differences among consumers coming from different demographic backgrounds.

5.6 Cluster #6: online exchanges and transactions

Cluster #6 contains 34 articles that have been cited 320 times with an average publication year of 2011.29. The most cited article in this cluster is Narayanasamy et al.’s [75] article on the adoption and concerns of e-finance. This is followed by Dumas et al.’s [76] article on bidding agents in e-auction, and Marinč’s [77] article on the impact of information technology on the banking industry. Other articles in this cluster have explored topics such as game theoretic aspects of search auctions [78], auction mechanism for ad space among advertisers [79], trust analysis in online procurement [80], efficiency of reverse auctions [81], and effect of hedonic and utilitarian behaviors on the e-auction behavior [82]. Thus, ECR articles in this cluster appear to be focused on online exchanges and transactions, particularly in terms of auction mechanisms and banking-related services.

5.7 Cluster #7: online media and platforms

Cluster #7 contains 30 articles that have been cited 668 times with an average publication year of 2016.23. The most cited article in this cluster is Sotiriadis and van Zyl’s [27] article on social media in the form of Twitter. This is followed by Huang and Liao’s [83] article on augmented reality interactive technology, and Hsieh et al.’s [84] article on online video persuasion in electronic commerce. Other articles in this cluster have investigated topics such as the role of social media in disseminating product information [85], the effect of video formats on person-to-person streaming [86], interpersonal relationship building using social media [87], and microblog
usage [88]. Thus, ECR articles in this cluster appear to be centered on online media and platforms, particularly in terms of its variation, use, and impact in shaping consumer behavior in electronic commerce.

5.8 Cluster #8: online technology acceptance and continuance

Cluster #8 contains 26 articles that have been cited 244 times with an average publication year of 2016.37. The most cited article in this cluster is Zhou’s [89] article on the adoption of location-based services. This is followed by Chen et al.’s [90] article on the adoption of electronic customer relationship management, and Royo and Yetano’s [91] article on crowdsourcing usage in local governments. Other articles in this cluster have examined topics such as gender discrimination in online peer-to-peer lending [92], continued usage of e-auction services [93], and investor trust in peer-to-peer lending platforms [94]. Thus, ECR articles in this cluster appear to be concentrated on online technology acceptance and continuance, including determinants and discriminants that explain online technology-mediated behavior across different forms of electronic commerce such as e-auction, e-lending, e-government, and e-customer relationship management.

5.9 Cluster #9: online communities and commercialization in the virtual world

Cluster #9 contains 22 articles that have been cited 771 times with an average publication year of 2012.23. The most cited article in this cluster is Füller et al.’s [26] article on the role of virtual communities in new product development. This is followed by Lehdonvirta’s [29] article on the revenue model of virtual products, and Guo and Barnes’s [95] article on the purchase behavior of virtual products. Other articles in this cluster have investigated topics such as metaverse retailing [96], issues faced by developers of virtual worlds [97], the impact of virtual world on e-business models [98], e-commerce transactions in virtual environments [99], and customer value co-creation in virtual environments [26]. Thus, ECR articles in this cluster appear to be focused on the online communities and commercialization in the virtual world, particularly in virtual environments such as online gaming.

5.10 Cluster #10: online customer expectations, satisfaction, and loyalty

Cluster #10 contains 18 articles that have been cited 291 times with an average publication year of 2016.11. The most cited article in this cluster is Hanafizadeh and Khedmatgozar’s [100] article on consumer expectations of risk in online banking. This is followed by Valvi and Fragkos’s [101] article on purchase-centered e-loyalty, and Aloudat and Michael’s [102] article on regulatory expectations of ubiquitous mobile government. Other articles in this cluster have examined topics such as continued usage of e-services [103], determinants of e-loyalty [104], risk expectations of e-services [105], and e-service quality implications for customer satisfaction and loyalty [106]. Thus, ECR articles in this cluster appear to be centered on online
customer expectations, satisfaction, and loyalty, particularly in e-service settings such as online banking.

5.11 Cluster #11: online purchase intention

Cluster #11 contains 18 articles that have been cited 671 times with an average publication year of 2014.00. The most cited article in this cluster is Kim’s [107] article on online purchase intention using trust theory and technology acceptance model. This is followed by Gregg and Walczak’s [108] article on the effects of website quality on online purchase intention, and Taylor et al.’s [109] article on the effects of privacy concerns on online purchase intention. Other articles in this cluster have explored topics that either reaffirm the findings of the highly cited articles in this cluster, such as privacy concerns and personalization [109, 110], or that extend the breadth of cluster coverage, such as store image [111], risk, and trust [112] as determinants of online purchase intention. Thus, ECR articles in this cluster appear to be concentrated on online purchase intentions, particularly in terms of its multi-faceted determinants that avail or transpire in electronic commerce.

6 Temporal keyword analysis: thematic evolution

Building on the thematic clusters uncovered using bibliographic coupling (see Fig. 6), this study performs a temporal keyword analysis to unpack the development of themes and its evolutionary trajectory in ECR over time.
6.1 Thematic development from 2005 to 2008

Most ECR articles between 2005 and 2008 appear in Clusters #1, #3, and #6 (see Fig. 6), which indicate research concentration on online privacy and security, online engagement and preferences, and online exchanges and transactions. The keyword network in Fig. 7 confirms this observation. Apart from general keywords such as “e-commerce,” keywords such as “cryptography,” “privacy,” and “security” relate directly to the theme of Cluster #1, which is about online privacy and security. The prominence of the word “cryptography” indicates the popularity and importance of the topic during this period. Other keywords such as “auctions,” “online auctions,” and “bidding strategies” relate to the theme of Cluster #6, which is about online exchanges and transactions, with particular focus on online auction and banking. Other keywords such as “collaborative filtering,” “online communities,” and “mobile commerce” relate to the theme of Cluster #3, which is about online engagement and preferences. The bigger and bolder keywords observed in Clusters #1 and #3 suggest that the direct benefits and costs of electronic commerce were most pertinent in the early stages of ECR, with the augmented aspects of electronic commerce in Cluster #6 emerging closely behind the two leading clusters in this period.
6.2 Thematic development from 2009 to 2012

Most ECR articles between 2009 and 2012 are located in Cluster #1 (see Fig. 6), which reveal the continued pertinence of research concentrating on online privacy and security during this period. Nonetheless, ECR experienced a substantial growth in research focusing on online media and platforms, online communities and commercialization in the virtual world, online customer expectations, satisfaction, and loyalty, and online purchase intention, as seen through ECR articles in Clusters #7, #9, #10, and #11 during this period. The keyword network in Fig. 8 adds to this observation. In particular, keywords such as “security,” “payment protocol,” and “trust management” relate to the theme of Cluster #1 on online privacy and security, whereas keywords such as “metaverses,” “second life,” “virtual reality,” and “virtual world” speak to the emergence of online communities and commercialization in the virtual world characterizing Cluster #9. Similarly, keywords such as “reputation” and “trust” are important to online customer expectations, satisfaction, and loyalty (Cluster #10) and their online purchase intention (Cluster #11). Interestingly, though Cluster #7 emerged during this period, we did not observe any unique or specific keywords relating to this cluster, which may be attributed to online media and platform research early focus on its “adoption,” a keyword that we felt resonates more with Cluster #8.

Fig. 8  Keyword network between 2009 and 2012. Note Threshold for inclusion is a minimum of two occurrences
Most *ECR* articles between 2013 and 2016 continue to be situated in Cluster #1 (see Fig. 6), which suggest the continued pertinence of research concentrating on online privacy and security during this period. Nonetheless, there are a number of clusters that saw noteworthy growth, such as Clusters #2, #5, #7, #8, and #10, which indicate that research attention has also been invested in topics related to online channels and optimization, online reviews and ratings, online media and platforms, online technology acceptance and continuance, and online customer expectations, satisfaction, and loyalty. The keyword network in Fig. 9 supports this observation. More specifically, keywords such as “personal information” and “privacy” indicate continued research in Cluster #1, though it appears that the focus has shifted from authentication and security mechanisms to privacy matters, which may be attributed to the rise of personalized and targeted online marketing activities (e.g., tracking of user activity for personalized advertisements). Whereas, keywords such as “B2C e-commerce” and “e-government” denote emerging interest in online channels and optimization (Cluster #2), “electronic...
word of mouth” indicates growing interest in online reviews and ratings (Cluster #5), “cloud computing,” “IPTV,” and “social media” reveal increasing interest in online media and platforms (Cluster #7), “information technology,” “technology adoption,” and “technology acceptance model” speak to research on online technology acceptance and continuance (Cluster #8), and “product type,” “quality of service,” and “user satisfaction” resonate with research on online customer expectations, satisfaction, and loyalty (Cluster #10).

6.4 Thematic development from 2017 to 2020

Most ECR articles between 2017 and 2020 are located in Cluster #4 (see Fig. 6), which reflect the noteworthy emergence and shift of research concentration from online privacy and security to online market sentiments and analyses. Other thematic clusters such as Clusters #2, #3, and #5 have also witnessed a massive increase in publications during this period. This implies that ECR has become relatively diverse in the research that it publishes, which also explains the rise in the number of papers that the journal publishes during this period. The keyword network in Fig. 10 sheds further light on this observation. In particular, many keywords in the network illustrate a strong research concentration on online market sentiments and analyses, such as “big data,” “data mining,” machine learning,” “sentiment analysis,” and “social network analysis” (Cluster #4). Similarly, keywords such as “dual channel supply chain,” “supply chain coordination,” and “social commerce” indicate the type of research focusing on online channels and optimization (Cluster #2), “social influence,” “social media,” and “social media marketing” reflect research in the area of online engagement and preferences (Cluster #3), and “consumer reviews,” “online reviews,” “reputation,” and “word of mouth” speak to research on online reviews and ratings (Cluster #5).

7 Conclusion

This study presents a 20-year retrospective of ECR since its inception in 2001. Several research questions were proposed and pursued using a bibliometric methodology consisting of performance analysis and science mapping (e.g., co-authorship analysis, bibliographic coupling, and temporal keyword analysis).

Our first four research questions—i.e., research question 1 to research question 4—concentrated on the publication and citation trends of ECR. Through performance analysis, we found that ECR has grown exponentially in terms of its publications and citations. Most contributors of ECR come from China and the United States, which reflect (1) China’s standing as the world’s largest e-commerce market with 50 percent of the world’s online transactions occurring in this country, and (2) the United States’ standing as the world’s pioneer of e-commerce (e.g., Amazon) and her expectation for e-commerce to reach 50% of total retail sales in the country in 10 years [113]. Interestingly, IBM, a non-academic institution, emerged as the highest contributing institution to the journal, which is unsurprising given that
IBM is the largest industrial research organization in the world with 12 research labs across six continents [114]. More importantly, ECR was found to be well received among its peers, with many of its citations coming from prestigious journals in the field of information systems and management. Nevertheless, we observed that ECR receives very little contribution from Africa and several parts of Asia, particularly South Asia and South East Asia. Though electronic commerce may not have been very prominent in these regions in the past, we believe that the coronavirus pandemic that has taken the world by storm in 2020 has accelerated the proliferation and adoption of electronic commerce in these regions, and thus, we would encourage authors from these regions to submit their best papers to ECR in the near future. Thus, we raise two future research questions (FRQs) for exploration:

FRQ1: What are the e-commerce innovations that avail in underexplored regions (e.g., Africa, South Asia, and South East Asia) and how do such innovations fare in terms of similarities and differences in manifestations and impact against their more richly explored counterparts (e.g., China, United States)?
FRQ2: How can global pandemics such as COVID-19 change or impact e-commerce around the world (e.g., can the pandemic accelerate e-commerce adoption across all layers of society; can the pandemic lead to new innovations; can e-commerce contribute to positive and/or negative economic and social impact during the pandemic—and if yes, what and how, and if no, why)?

Our next two research questions—i.e., research question 5 and research question 6—focused on the collaboration trends in and the important constituents of ECR in the co-authorship network. Using co-authorship analysis, we found that the collaboration culture in ECR has grown with the passage of time, as evidenced through the decreasing share of single-authored articles and the increasing share of multi-authored publications, especially in the five or more authors category. We also observed that the share of multi-authored articles has always been dominant in the journal, with such publications forming nearly 90% of the corpus at any given point in time. Indeed, these observations reflect the increasing emphasis that universities place on multi-author and inter-/multi-/trans-disciplinary collaborations in promotion and tenure practices and policies [115]. In terms of important constituents in the co-authorship network, Jian Mou emerged as the most important author across two measures of centrality, whereas Renmin University and University of Ottawa emerged as the most important institutions at the institution level, and the United States emerged as the most important constituent at the country level. Nonetheless, we noted that authors who collaborate in ECR do not work much across diverse teams, but they do, however, work a lot across institutions and countries. Future scholars could rely on the centrality networks that we have curated herein this study for potential collaboration with authors from varying institutions and countries who have a good publication record and a research interest to publish with ECR.

Our final research question—i.e., research question 7—was dedicated to unpacking the major themes in ECR. Through bibliographic coupling, our study found 11 major clusters that reflected the major themes underpinning research published in ECR: (1) online privacy and security, (2) online channels and optimization, (3) online engagement and preferences, (4) online market sentiments and analyses, (5) online reviews and ratings, (6) online exchanges and transactions, (7) online media and platforms, (8) online technology acceptance and continuance, (9) online communities and commercialization in the virtual world, (10) online customer expectations, satisfaction, and loyalty, and (11) online purchase intention. Through temporal keyword analysis, our study observed that the topics published in ECR has become more diverse over time, with a noteworthy shift from an early concentration on online privacy and security to a contemporary focus on newer, industry-informed topics, such as online market sentiments and analyses, which we reckon coincides with the emergence of the unique peculiarities of the fourth industrial revolution (IR 4.0), such as big data and machine learning, in recent years [116, 117]. Thus, to extend the line of research that concentrates on unpacking the contemporary realities of e-commerce, we propose another two future research questions (FRQs) for exploration:

FRQ3: How can emergent technologies (e.g., artificial intelligence, big data analytics, blockchain, machine learning) be applied to improve forecasting (e.g.,
cybercrime, social network), optimize functions (e.g., advertising, sales), and protect stakeholders (e.g., privacy, security) in e-commerce?

FRQ4: How can e-commerce operators leverage on emergent technologies to acquire competitive advantages (e.g., how to build trust and good relationships with customers [e.g., digital natives, digital migrants], and how to respond to changes in customer demands and marketplace trends with agility), and whether these competitive advantages that they acquired are sustainable or transient (and if transient, then what can they do to curate, maintain, or replenish their competitive advantages in the long run)?

Though thorough in its approach, this study does suffer from certain limitations. First, this study relies on the Scopus for bibliometric data. Though the database has its merits, as laid out in the methodology section, the bibliographic data is not created for the purpose of bibliometric analysis. This may lead to errors in the data source. Through data cleaning, we have attempted to minimize errors, but any remaining error in the source data, which we might have missed, could have an impact on the final analysis, though we believe that the margin for such errors would be relatively small, if not, negligible. Second, ECR has been around for 20 years, but the dataset available on Scopus, which we used, is only complete for 16 years (2005–2020). Due to this limitation, the science mapping part of the study—i.e., co-authorship, bibliographic coupling, and temporal keyword analysis—had to be restricted to this period only. We do not discount the possibility that the complete set of earlier data (2001–2004) may become available on Scopus in the future, and thus, we would encourage future research aiming to conduct a bibliometric review for ECR, perhaps in the next milestone (e.g., 30, 40, or 50 years), to check on such data availability, and if available, to take advantage and conduct a full-fledged science mapping for the journal. Finally, the scientific insights that could be uncovered through a bibliometric methodology, though rich, remain limited. In particular, bibliometric reviews such as ours do not delve into expert information, such as the theories, contexts, and methods employed to create new knowledge on electronic commerce in the ECR corpus. This, in turn, makes it difficult for bibliometric reviews to put forth a comprehensive set of data-informed proposals for future research. Nonetheless, we opine that bibliometric reviews do provide a good starting point of data-informed insights that future research can rely on to understand the trajectory of the extant discussion of electronic commerce in the journal. In particular, we believe that such insights would be useful, not only for future empirical research (e.g., potential collaboration networks, research themes of interest), but also for future reviews on thematic domains in ECR (e.g., systematic reviews on online market sentiments), which can be done in a number of ways, such a critical review [118–120], a thematic review [121, 122], a theory-driven review [123], a method-driven review [124, 125], or a framework-based review [126].

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.
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