A Research Survey of Electronic Commerce Innovation:
Evidence from the Literature

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Abstract

The development of technology has ignited many innovations in business management, especially in the electronic commerce area. The essential example, that is, online stores and online shopping, is a critical evolution and innovation from traditional brick-and-mortar stores to clicks and mortar. Following previous research (Van Oorschot et al.), this present study adopted bibliometric and keyword analysis to review the main characteristics of electronic commerce innovations. Focused on the academic sources, the research data used in this study were searched for and collected from the Web of Science (WoS), a renowned academic database which covers the most influential research journals in electronic commerce. Based on a combination of several keywords related to "innovation" and "electronic commerce," the keyword search in the WoS was conducted in May 2019. As a result, a total of 334 research articles related to electronic commerce innovations were collected. Derived from the bibliometric analysis, some keywords that were seldom used in the earlier decade (2000-2009), but which rapidly grew in use in the recent decade (2010-2018) were found, including m-commerce, platforms, social commerce, online review, and co-creation. In addition, the top 10 influential articles listed in each of the two decades were identified. The results show some of the research trajectories in EC innovations. In the first decade (2000-2009), the top 10 papers focused on traditional IT adoption, such as self-service technology, enterprise resource planning systems, and the adoption of general attitude-intention theories such as the technology acceptance model. In the recent decade (2010-2018), researchers have shown more diverse interest in innovative EC applications, such as RFID applications, cloud computing, crowdsourcing, etc. Accompanying these EC innovation contexts, in addition to general attitude-intention theories, more theories such as signaling theory, have been adopted.

Keywords: electronic commerce innovations, research trajectory, systemic literature survey

1. Introduction

Nowadays, one may see many innovations in the development of Electronic Commerce (EC). For example, Bhattacherjee [1] introduced some e-commerce brokerage services, and Eastin [2] provided some examples of web technologies applied to consumers' purchasing behavior, such as online shopping, online banking, and even online investing. Indeed, these EC innovations have become part of our daily life. In recent studies, researchers have brought more advanced and innovative ideas into EC business research. While Cui et al [3] mentioned some benefits of EC innovations in growing economies in rural China, Escobar-Rodríguez and Bonsón-Fernández [4] pointed out other EC applications in the Spanish fashion industry. More recently, Vakulenko et al. [5] offered the possibility to create an e-customer journey map through innovative management of

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EC services. These original ideas have acted as a lighthouse for EC business, shedding light on the next-generation EC innovations.

However, few studies have focused on the analysis of EC innovations from an academic viewpoint. It is especially necessary because the rigorous nature of academic research has enhanced the reliability of the innovations in real business practices. Moreover, researchers can follow some performance indicators of scientific research, such as times cited per year, to identify and trace the high impact ideas, EC innovative business models or practices. Three purposes of this study were therefore formed as follows. First is ranking the most productive countries and journal publications in the EC innovations literature; Second is identifying the most influential research articles across two decades of observation (the first decade: 2000-2009; the recent decade: 2010-2018); and the last one is highlighting the most critical innovative practices of EC in the two decades of research.

2. Data and Methods

2.1. *The process of data inclusion*

In this paper, a systematic approach for data inclusion was adopted to achieve the above three research questions. The first process of data inclusion was to identify the keywords related to innovation and electronic commerce from the literature. The selection of keywords referred to previous review studies in the fields of innovation management and electronic commerce. In the field of innovation management, Randhawa et al. [6] reviewed "open innovation" in product innovation research. Using bibliometric analysis, van Oorschot et al. [7] analyzed the "innovation adoption" literature with the issue of technology and social change. In electronic commerce literature, Akter and Wamba [8] provided a systematic review of "e-commerce" in electronic markets. Han et al. [9] conducted a literature survey of "social commerce" in e-commerce research. More recently, Gursoy's [10] presented a critical review to highlight the importance of consumers' "online review" in EC platforms. As such, we adopted the most popular terminology used in the above reviews, such as "innovative," "innovation," "electronic commerce," "e-commerce," "e-tailer," "social commerce," and "online review" as the keywords for this search.

The second step was to select the sourcing database. The Web of Science (WoS) was selected as the primary source as it covers the most influential EC journals in the categories of business, management, and information science, including the International Journal of Electronic Commerce, Electronic Commerce Research and Applications, and MIS Quarterly. As such, the above seven terms were used as keywords for searching for high-quality electronic commerce innovation research in terms of citation counts. (Brouthers et al.) Next, two researchers carefully removed those redundant and incomplete items selected during the search. A final total of 334 articles published from 2000 to 2018 were obtained as the literature of research interest. The process of data inclusion was completed on 22 May 2019. More information for the selection of highly cited articles and keywords is provided below.

2.2. *The selection of high impact articles*

In this study, the numbers of articles published and their authorship were counted and are shown in Table 1. Note that only the number of non-repeated authors was reported to show the trend of researchers involved in the field. As shown in Table 1, a total of 118 articles with 256 authors in the first decade were found (2000-2009). Furthermore, Figure 1 shows a highly correlated pattern of publications between the numbers of published papers and involved authors, with a Pearson correlation coefficient of 0.98. The scale of publications increased to 216 articles and 558 authors in the recent decade (2010-2018), which approximately doubled the number of articles and authors in the first decade. The growth of authors involved in the EC innovation research in the last five years (2014-2018, as shown in Fig. 1) is especially noteworthy, indicating the great attraction of EC innovation research to academics. In this study, we adopted a bibliometric analysis to identify the most influential among the 334 articles for each decade. The main idea of bibliometric analysis is to reveal the impact of scientific

publications. The two often-used bibliometric indicators, total times cited (citations) and times cited per year (average citations), were to identify the most influential articles of EC innovation. All 334 articles in this analysis had received a total of 13,858 citations. The citation information was also collected from the WoS document by document, providing evidence of the most critical practices in electronic commerce innovation. The pilot results of the selection of high impact articles are shown in the next section. Furthermore, based on the calculation of total citations received by journal publications and the country in which the researchers are affiliated, the indicator of scientific performance (i.e., h-index) was also provided for the analysis of the most high-impact journals and productive countries in the field.

Table 1 Trend of EC innovation research: articles published and authors involved

Year	Articles published	Authors (Non-repeated)
2000	5	8
2001	13	31
2002	8	13
2003	11	31
2004	12	20
2005	14	33
2006	14	30
2007	11	22
2008	9	19
2009	21	49
Sub-total (2000-2009)	118	256
2010	28	63
2011	15	36
2012	19	55
2013	11	23
2014	13	24
2015	26	71
2016	31	86
2017	38	94
2018	35	96
Sub-total (2010-2018)	216	558
Total (2000-2018)	334	814

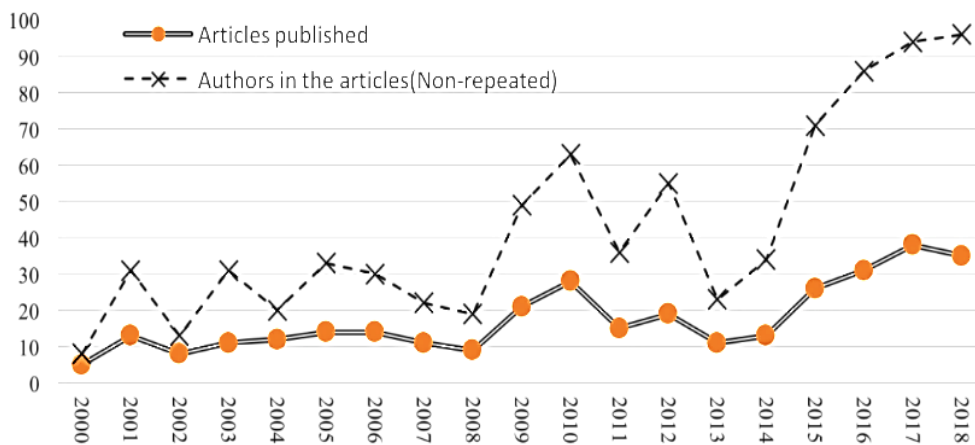Fig. 1 The trend of EC innovation research: articles and authors

2.3. Keyword analysis

Following previous scientometric research [11], we used a keyword analysis to decompose the most valuable content of the corpus from these 334 EC innovation articles. All the wording in the title, keyword, and abstract were gathered. Some insignificant stop words were excluded, such as "and," "at," "in," "above," "under," and so on. Other terms with similar meanings in the context of EC innovation were aligned, for example, "electronic commerce," "e-commerce," "innovation," and "innovations." Next, a process of scraping common terms was conducted to help identify those keywords which are discriminative for representing the main characteristics of EC innovation research.

After the list of keywords was aligned, each keyword was then matched and counted if it appeared in a particular article. Note that each article may have multiple keywords. Only the keywords which appeared in different articles were counted and accumulated; however, those keywords repeatedly used in a single article were counted once. Accordingly, a total of 5,211 keywords were obtained. Based on the frequency count, the most critical keywords with significant growth trends and decline trends were selected. A further comparison of selected keywords for the two periods of research (period I: 2000-2009, and period II: 2010-2018) was conducted to identify the research trends in EC innovation.

3. Results and Discussion

In line with the three purposes of this research, the results of the research survey in EC innovation literature are presented. First is the publication patterns in the EC innovation research, including the most productive countries, influential journals, and representative keywords that are frequently used. Second is the most influential research articles in the first decade: 2000-2009. And the last one is the most influential research articles in the recent decade: 2010-2018. Further discussions of the research changes over the past two decades are also provided.

3.1. The most productive country and journal publications in the EC innovation literature

3.1.1. The most productive countries

To measure each country's productivity, only the first authors' country affiliation was counted because the first author has a major contribution to the research. If the first author has multiple affiliations, the main affiliation was manually checked and coded. As a result, a total of 39 countries were found and listed in EC innovation publications as shown in Table 2. We also found that authors from the first 10 countries contributed over 105 articles and 158 articles, accounting for over 89% and 73% of the total publications in the periods of 2000-2009 and 2010-2018, respectively. Therefore, these countries were labeled as the top 10 productive countries in EC innovation research, namely the USA, Taiwan, China, the UK, Canada, Australia, South Korea, Portugal, Germany, and Spain. To highlight the impact of the top 10 countries, the total citations received are included in parentheses. For example, USA (7309) means that all of the articles published by the authors affiliated with the USA received 7,309 citations in total. Fig. 2 visualizes the distribution of EC innovation research with the number of publications, showing the publication trends of the most productive countries in EC innovation across the two phases (2000-2009 and 2010-2018).

Table 2 The most influential countries in the field of EC innovation

#	Country (citations)	Number of articles published			H-index	Active years
		2000-2009	2010-2018	Total trends		
1	USA (7903)	59	52	111 (↓)	45	2000-2018
2	Taiwan (1032)	15	18	33 (↑)	14	2004-2018
3	China (971)	3	34	37 (↑)	13	2003-2018
4	UK (773)	15	10	25 (↓)	11	2001-2018
5	Canada (706)	4	5	9 (↑)	15	2001-2018
6	Australia (392)	6	6	12 (-)	10	2000-2016
7	South Korea (278)	2	6	8 (↑)	5	2004-2016
8	Portugal (277)	0	5	5 (↑)	4	2014-2018
9	Germany (212)	0	8	8 (↑)	5	2011-2018
10	Spain (198)	1	14	15 (↑)	7	2008-2018

More specifically, the result indicates that over one-third of the publications were from the USA in terms of the total number of articles from 2000 to 2018, (n = 111, 33%); the USA also ranked as the most productive country in period I (n = 59, 50%), but not in period II (n = 52, 24%). It shows a decreasing trend of EC innovation research in USA publications. However, the overall 7,903 citations of the USA were ranked as the first place, revealing that US researchers have a significant impact both in the quantity and quality of EC innovation research. We also found that the UK ranked second in the period I (n = 15, 13%) in terms of publications, but dropped rapidly in period II (n = 10, 5%). This trend indicates that the researchers affiliated

with the USA and the UK have dominated the EC innovation research, but an increasing number of researchers from other countries have since joined the field. Note that Australia's researchers showed a balanced performance in EC innovation across the two decades.
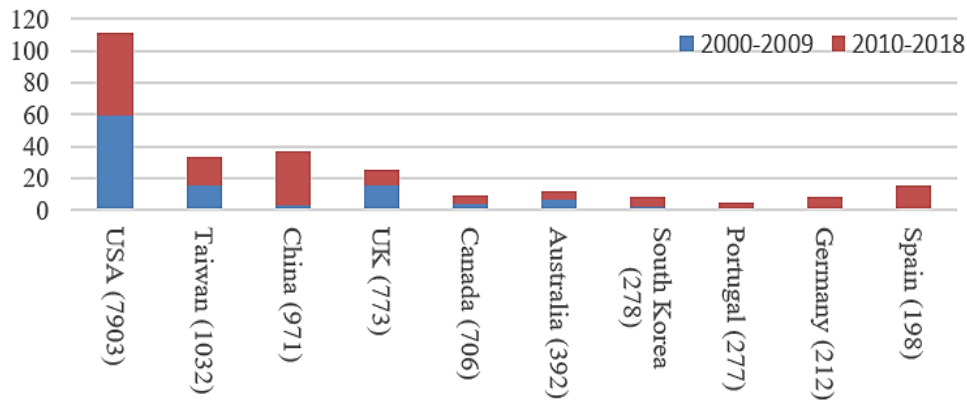

Fig. 2 The most productive country in the EC innovation research

On the other hand, a growth pattern of EC innovation publications appeared in the remaining countries, led by Taiwan. Researchers from Taiwan have been ranked as the second most productive academics in terms of overall citations received (1,032 times). A total of 15 articles published in period I (2000-2009) and 18 articles in period II (2010-2018), demonstrating a growth trend of Taiwan's EC innovation research. China ranked third in terms of total citation times. China researchers published three articles in period I, and rapidly developed to the second in period II (n = 34, 16%). The fifth to tenth countries are Canada (#5), South Korea (#7), Portugal (#8), Germany (#9), and Spain (#10), while Australia (#6) showed a balanced performance in EC innovation. All of them have EC innovation articles in both stages. The following countries (i.e., Germany (#9) and Portugal (#8)), however, started to publish EC innovation articles in 2011 and 2014, individually. This reveals that some potential research issues from Europe and Latin America are also worthy of follow-up attention.

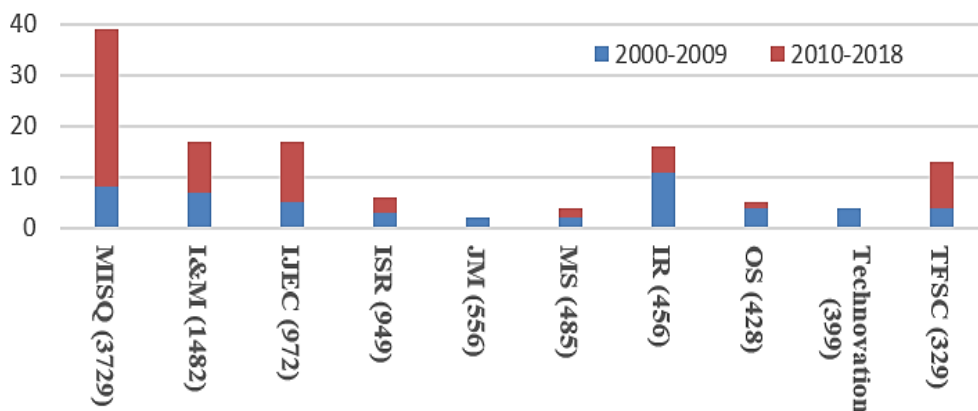### 3.1.2   The most influential journals

Fig. 3 The most influential journals in the EC innovation research

Table 3 shows the most influential journals in the EC innovation research between 2000 and 2018. Based on Brouthers et al.'s suggestion [12], the rankings of the most influential journals are based on the total number of citations, not on journal ranking or the number of journals published. As such, the results showed that the four journals grew in terms of publication trends ranked by citations received, while another four declined. As a leading journal with a growth trend, MIS Quarterly (MISQ) ranked first, with 39 articles receiving 3,729 citation counts, and the h-index was 24. The results suggest the importance of MISQ in EC innovation research. Similarly, the following three journals with growth trends were Information & Management (7→10), the International Journal of Electronic Commerce (5→12), and Technological Forecasting and Social

Change (4→9). The first two journals published at least 17 articles on EC innovation and received about a thousand citations each. Technological Forecasting and Social Change was active between 2004 to 2018 with 13 EC innovation articles published among which, focusing on the new applications of EC, Wang et al.'s research [13] titled "Understanding the determinants of RFID adoption in the manufacturing industry" was the most cited (176 citations).

Table 3 The most cited journals in the field of EC innovation

#	Journal title (Citations)	Number of articles published			H-index	Active years
		2000-2009	2010-2018	Total trends		
1	MIS Quarterly (3729)	8	31	39 (↑)	24	2002~2018
2	Information & Management (1482)	7	10	17 (↑)	12	2002~2016
3	International Journal of Electronic Commerce (972)	5	12	17 (↑)	12	2000~2018
4	Information Systems Research (949)	3	3	6 (-)	5	2001~2018
5	Journal of Marketing (556)	2	-	2 (↓)	2	2005~2009
6	Management Science (485)	2	2	4 (-)	4	2006~2017
7	Internet Research (456)	11	5	16 (↓)	11	2000~2018
8	Organization Science (428)	4	1	5 (↓)	5	2001~2017
9	Technovation (399)	4	-	4 (↓)	4	2006~2009
10	Technological Forecasting and Social Change (329)	4	9	13 (↑)	6	2004~2018

Note that the abbreviations of journal titles. MISQ is MIS Quarterly; I&M is Information and Management; IJEC is International Journal of Electronic Commerce; ISR is Information Systems Research; JM is Journal of Marketing; MS is Management Science; IR is Internet Research; OS is Organization Science; TFSC is Technological Forecasting and Social Change.

The remaining journals have mostly shown a downward trend in terms of the number of publications, including Journal of Marketing, Internet Research, Organization Science, and Technovation. Based on the analysis, only two articles related to EC innovation were published in the Journal of Marketing; however, the influence was considerable. For example, Meuter et al.'s research [14] "Choosing among alternative service delivery modes: an investigation of customer trial of self-service technologies" was cited 2005 times, while Li et al.'s article [15] "Internet auction features as quality signals" was cited 68 times. The two articles pointed out some innovations of alternative service delivery modes and quality signals of the Internet auction. These findings can be considered as the research fronts of the online-to-offline model and online review for online shopping. Internet Research published 16 articles on EC innovation, suggesting that the EC research has become mature and that researchers have turned their interest to new topics in the field. The publication trend of two journals was stagnant, but still active in recent years (Information Systems Research: 2001-2018; Management Science: 2007-2017) and they received a number of citations from follow-up studies (Information Systems Research: 949 times; Management Science: 485 times). The changes in publication patterns for the top 10 journals are also presented in Figure 3.

3.1.3 The most frequently used keywords

Further analysis of publication patterns was conducted by using keyword analysis. In this study, a total of 5,210 keywords were obtained, among which 3,785 were found to show an increasing trend (more frequently used in the recent decade than in the earlier one), and the remaining 1,425 showed a decreasing trend. Twenty keywords that represent some unique attributes and which are frequently used in the EC innovation research are listed in Table 4. The values in each cell are the counts of keywords which appeared in the EC innovation research. The larger the values are, the more frequently the keywords were used in the research articles. In this study, non-repeated counts are presented, showing the mainstreams of EC innovation that most research focused on. Two different research trends of keywords were interpreted as follows.

(a) Keywords with increasing trends

In this study, the counts of most keywords increased. For example, the top two keywords (i.e., innovation and e-commerce) that were used for searching the research data are listed in italics in the parentheses. Overall, these two keywords have been most frequently used by researchers: 233 (67%) and 172 (51%) times, respectively. This result provides evidence of content validity for our research data in the EC innovation area. However, the growth trend of these two keywords is different across two research decades. "Innovation" was the most adopted keyword in the period I (n=85, 2000-2009) and period II (n=148, 2010-2018). This indicates a significant growth of "innovation" in the EC innovation research. On the other hand, "e-commerce" appeared as the second most highly used keyword in the first decade (n=82), but the growth in number (n=90) in the recent decade was not as active as that of "innovation."

The following five keywords (#1-5) show the domain-specific characteristics of EC innovation research, namely "model" (173), "data" (121), "implications" (114), "online" (112), and "technology" (105). The first four keywords almost doubled from the first to the present decade (55->118; 35->86; 29->85; 23->89), while the growth of "technology" (40->65) was relatively stable. This result suggests the need for and importance of scholarly research in EC innovation, such as research models, data-driven evidence, online applications, managerial implications for real business operations, and new technologies.

The next 10 keywords that rarely appeared in the earlier stage (2000-2009) but which were highly researched in the recent decade (2010-2018) are marked in Table 4 (#6-15). They are "m-commerce," "China," "platforms" (0->11); "Amazon," "devices," "image," "shopping experience" (0->10); "social commerce," "online review" (0->8), and "co-creation" (0->6). Most of the above keywords revealed the emerging applications of EC innovations (e.g., m-commerce, platforms, devices, social commerce, online review, co-creation), while others highlighted the great consumption market, China, and the leading EC company, Amazon. It is also interesting to note that "image" and "shopping experience" are specific contexts of consumers' reviews conducted online. Consumers in the digital age are used to shopping online via their smartphones. The images and reviews posted by other consumers have become the first impression of the products they search for. These are popular topics in EC innovation research.

Table 4 A list of keywords used in the EC innovation articles: comparison of two decades

#	Year	Counts (all years)	2000-2009	2010-2018	Δ
-	(innovation)	233	85	148	63
-	(e-commerce)	172	82	90	8
1	model	173	55	118	63
2	data	121	35	86	51
3	implications	114	29	85	56
4	online	112	23	89	66
5	technology	105	40	65	25
6	m-commerce	11	0	11	11
7	china	11	0	11	11
8	platforms	11	0	11	11
9	amazon	10	0	10	10
10	devices	10	0	10	10
11	image	10	0	10	10
12	shopping experience	10	0	10	10
13	social commerce	9	0	9	9
14	online review	8	0	8	8
15	co-creation	6	0	6	6
16	internet	61	34	27	-7
17	b2b	24	13	11	-2
18	b2c	15	9	6	-3
19	travel agency	5	5	0	-5
20	internet banking	2	2	0	-2

(b) Keywords with decreasing trends

Note that two main keywords used for the search are listed in italics in the parentheses. The following are the most often used keywords with increasing trends (#1-5); Ten keywords that seldom appeared in the earlier stage (2000-2009), but were highly researched in the recent decade (2010-2018) were marked (#6-15); The last five keywords, on the other hand, were found to have a decreasing trend of use in recent EC innovation research (#16-20).

Table 4 A list of keywords used in the EC innovation articles: comparison of two decades

#	Details of the earlier decade (2000-2009)									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
-	4	11	7	9	8	9	10	6	7	14
-	5	13	5	7	9	9	10	7	5	12
1	3	3	3	2	5	9	9	6	5	10
2	0	2	3	3	4	4	5	3	3	8
3	0	1	1	3	3	5	4	3	3	6
4	0	1	1	3	2	4	2	2	0	8
5	2	4	5	4	3	2	7	4	3	6
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	3	6	0	6	5	3	3	1	1	6
17	2	1	1	2	2	1	2	1	0	1
18	0	1	1	1	0	1	1	2	0	2
19	0	2	0	0	0	0	0	0	1	2
20	0	0	0	1	1	0	0	0	0	0
#	Details of the recent decade (2010-2018)								
	2010	2011	2012	2013	2014	2015	2016	2017	2018
-	21	8	14	7	10	17	22	25	24
-	18	8	8	4	5	8	13	16	10
1	12	10	7	8	6	15	16	20	24
2	8	7	8	5	6	10	13	13	16
3	14	5	2	2	5	12	11	16	18
4	9	6	4	3	4	12	16	20	15
5	9	7	3	2	4	14	7	9	10
6	0	0	1	0	1	2	2	4	1
7	1	0	1	1	1	1	3	1	2
8	0	1	0	0	0	0	2	5	3
9	1	1	1	0	1	1	0	3	2
10	0	0	1	0	0	2	1	3	3
11	1	0	0	1	0	2	4	2	0
12	1	3	0	0	1	1	0	0	4
13	0	1	0	0	0	1	3	2	2
14	2	0	0	0	1	1	1	2	1
15	1	1	1	0	0	1	1	1	0
16	5	3	4	2	1	3	3	2	4
17	2	0	0	1	1	1	4	1	1
18	1	2	0	1	0	0	2	0	0
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0

Δ: the difference in keyword counts between the earlier decade (2000-2009) and the recent one (2010-2018).

The last five keywords, on the other hand, showed a decreasing trend in recent EC innovation research (#16-20), including "Internet" (34->27), "B2B" (24->13), "B2C" (15->9), "travel agency" (5->0), and "internet banking" (2->0).

Although the keyword "Internet" appeared in 61 articles from 2000 to 2018, it is clear that the figure significantly decreased in recent EC innovation research. We argue that the reason is due to the development of advanced technology. The Internet-based environments for commerce have become more general than in the 1990s (the age of the rise of the Internet). Likewise, EC business models have developed from some essential Business To Business (B2B) and Business To Consumer (B2C) models to an integrated model, such as the Online-To-Offline model (O2O). Many industries were also affected and forced to change by the emerging EC innovations, for example, travel agencies versus online travel platforms, and the applications of Internet banking versus mobile banking apps that are used on smartphones.

3.2. *The most influential research articles in the first decade: 2000-2009*

Table 5 Top 10 research articles of EC innovations in the first decade (2000-2009)

#	Authors	Title	Journal	Main innovations in EC	Category	Cites (avg.)
1	[16]	Understanding and predicting electronic commerce adoption: An extension of the theory of planned behavior	MIS Quarterly (2006)	Theory of planned behavior; perceived behavioral control; self-efficacy; controllability; technology acceptance model; trust; electronic commerce; consumer behavior	Information Science; Management	842 (64.8)
2	[17]	Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry	Information Systems Research (2005)	Technology diffusion; innovation; e-business; IT investment; usage; value; back-end integration; firm performance; resource-based view; international perspective	Information Science	530 (37.9)
3	[14]	Choosing among alternative service delivery modes: An investigation of customer trial of self-service technologies	Journal of Marketing (2005)	Service delivery modes; self-service technologies; customer trial	Business & Economics	488 (34.9)
4	[18]	Enticing online consumers: An extended technology acceptance perspective	Information & Management (2002)	Electronic markets; innovation diffusion; online retailing; technology acceptance model; virtual store	Information Science; Management	503 (29.6)
5	[19]	The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business	Management Science (2006)	Technology diffusion; innovation assimilation; assimilation process; e-business; competition; firm size; technology integration; international perspective	Operations Research & Management Science	371 (28.5)
6	[20]	The effects of personalization and familiarity on trust and adoption of recommendation agents	MIS Quarterly (2006)	Trust; electronic commerce; adoption; personalization; familiarity; cognitive trust; emotional trust; recommendation agent; delegation	Information Science; Management	338 (26)
7	[21]	Shaping up for e-commerce: Institutional enablers of the organizational assimilation of Web technologies	MIS Quarterly (2002)	Web technology; Web implementation; IT management; innovation assimilation; structuring actions	Information Science; Management	359 (21.1)
8	[22]	Shopping motivations on Internet: A study based on utilitarian and hedonic value	Technovation (2007)	Internet shopping; utilitarian motivation; hedonic motivation; shopping motivation; search intention; purchase intention	Engineering & Industrial; Management	188 (15.7)
9	[23]	Informational cascades and software adoption on the internet: An empirical investigation	MIS Quarterly (2009)	E-commerce; herding; informational cascades; decision making; network effects; word-of-mouth; software download; online communities; online user review	Information Science; Management	143 (14.3)
10	[24]	A model of organizational integration, implementation effort, and performance	Organization Science (2005)	Integration; interdependence; performances; ERP implementation; electronic integration	Management	196 (14)

Δ: the difference in keyword counts between the earlier decade (2000-2009) and the recent one (2010-2018).

After counting the total and average citations of influential papers in terms of highly cited papers, we identified the top 10 research articles related to e-commerce applications across the two decades. Table 5 lists the top 10 highly cited articles along with authors, title, the published journal, main keywords, and citations from 2000-2009. In the following, we will summarize research outlines from the top three articles. As seen in Table 5, Pavlou and Fygenson's article emerged as the most influential paper in terms of total citations (842) and average citations per year (64.8) [16]. They proposed an integrated model to predict EC adoption based on renowned theories, such as the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM). In addition, other factors including technological characteristics, consumer skills, time and monetary resources, and product characteristics also contributed to the prediction of EC adoption. Ranked 2nd with total citations of 530 and average citations per year of 37.9, Zhu and Kraemer's research [17] focused on the post-adoption of the e-retailing industry. Based on the Innovation Diffusion Theory (IDT) and the resource-based theory, three perspectives of factors including technological, organizational, and environmental factors were employed to accomplish the research purpose. As Self-Service Technologies (SST) have become increasingly popular, Meuter et al. [14] adopted variables

(e.g., role clarity, motivation, and ability) obtained from the consumer readiness theory to investigate their influences on consumer trials of SST.

As we look inside the articles in the first decade, most of the top 10 highly cited papers are attributed to both the Information Science and Management categories [16-18, 20-21, 23]. In terms of research type, all of them are empirical studies investigating consumers, and only three cover the subject of the organization [15, 19, 24]. In the research contexts, except for the applications of Self-Service Technology (SST) [14] and Recommendation Agents (RAs) [20], most studies applied to EC adoption, including software adoption such as ERP [24]. Note that four of the top 10 articles are published in the prestigious journal, MIS Quarterly [16, 20-21, 23].

Note that a total of 118 research articles published from 2000 to 2009. The most influential articles (top 10) are listed above. The ranking of the top 10 articles was sorted by the times cited per year (average citations), which is presented in parentheses in the citation column.

3.3. *The most influential research articles in the recent decade: 2010-2018.*

Table 6 Top 10 research articles of EC innovations in the recent decade (2010-2018)

#	Authors	Title	Journal	Main innovations in EC	Category	Cites (avg.)
1	[25]	What makes a helpful online review? A study of customer reviews on amazon.com	MIS Quarterly (2010)	Electronic commerce; product reviews; search and experience goods; consumer behavior; information economics; diagnosticity	Information Science; Management	615 (68.3)
2	[26]	Business Models: Origin, Development and Future Research Perspectives	Long Range Planning (2016)	Business models of innovation, change & evolution, performance & controlling and design.	Business; Development Studies; Management	124 (41.3)
3	[27]	Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors	Information & Management (2014)	Cloud computing; IT adoption; Diffusion of innovation (DOI); Technology-organization-environment (TOE)	Information Science; Management	177 (35.4)
4	[28]	Co-Creation: Toward a Taxonomy and an Integrated Research Perspective	International Journal of Electronic Commerce (2010)	Active consumption; co-creation; consumer roles; e-commerce research; taxonomic frameworks	Business & Economics	240 (26.7)
5	[29]	Trust, satisfaction, and online repurchase intention: the moderating role of perceived effectiveness of e-commerce institutional mechanisms	MIS Quarterly (2014)	E-commerce; trust; online repurchase intention; e-commerce; institutional mechanisms; moderation analysis; partial least square modeling	Information Science; Management	109 (21.8)
6	[30]	What signal are you sending? How website quality influences perceptions of product quality and purchase intentions	MIS Quarterly (2011)	Signaling theory; signals; cues; website quality; eCommerce; perceived quality; credibility; information asymmetries	Information Science; Management	162 (20.3)
7	[31]	An integrative model of consumers' intentions to purchase travel online	Tourism Management (2015)	Innovations Diffusion Theory; Intentions to Purchase; Online Travel Shopping; Social Media; Technology Acceptance Model; Theory of Reasoned Action; Theory of Planned Behaviour	Hospitality, Leisure, Sport & Tourism; Management	81 (20.3)
8	[13]	Understanding the determinants of RFID adoption in the manufacturing industry	Technological Forecasting and Social Change (2010)	Radio frequency identification; Technology-organization-environment framework; Technology adoption; Innovation adoption	Business; Regional & Urban Planning	176 (19.6)
9	[32]	Task design, motivation, and participation in crowdsourcing contests	International Journal of Electronic Commerce (2011)	Analyzability; autonomy; co-creation; crowdsourcing; extrinsic motivation; intrinsic motivation; tacitness; task design; variability	Business & Economics	123 (15.4)
10	[33]	Harnessing the influence of social proof in online shopping: The effect of electronic word of mouth on sales of digital microproducts	International Journal of Electronic Commerce (2011)	Digital microproducts; digital products; electronic word of mouth; eWOM; social proofs	Business & Economics	116 (14.5)

Compared with the articles on EC innovation from 2000 to 2009, the top 10 articles of EC innovation in the recent decade seem to have received fewer citations in terms of both total and average per year citations, with the exception of the top one article. As seen in Table 6, Mudambi and Schuff's [25] article, ranked as number one, received a total of 615 citations and 68.3 average citations per year. They worked on the critical issue regarding the success of EC business. Collected from more than

1,500 reviews from Amazon across six products, they found some decisive factors including extremity, review depth, and product type. Amblee and Bui [33] also targeted Amazon's consumers but worked on another important issue of social influence, i.e., electronic word of mouth (eWOM). Wirtz et al. [26] presented a position paper (ranked 2nd) to articulate the development, evolution, and future research of business models. From the organization perspective, Oliveira et al. [27] investigated over 350 firms to assess the determinants of cloud computing adoption based on the theories of Diffusion of Onnovation Theory (DOI) and Technology-Organization-Environment (TOE). The above are the research outlines of the top three articles.

Overall, in the recent decade, fives articles were attributed to the business category [13, 26, 28, 32-33], four to the Information Science Management category [25, 27, 29-30], and one to the hospitality & tourism category [31], showing that the EC innovations have been widely applied to various fields. In terms of research type, eight out of 10 articles are empirical research, and only two are qualitative research. While Wirtz et al. [26] systematically reviewed the research on business models, Zwass [28] conducted a taxonomy of co-creation, another emerging topic. With regard to the research topics, more diverse and innovative themes can be found in the last decade, such as RFID adoption, cloud computing [27], co-creation [28], extrinsic cue signals [30], online travel [31], crowdsourcing contests [32], and recommendation systems [33]. Among the top 10 articles, two well-known journals, MISQ and IJEC, each published three articles.

Note that a total of 216 research articles were published from 2010 to 2018. The most influential articles (top 10) are listed above. The ranking of the top 10 articles was sorted by the times cited per year (average citations), which is presented in parentheses in the citation column.

4. Conclusions

In line with the main research interest, we have concluded some differences in the development of EC innovation (Tables 5 and 6) between the two decades. In summary, the main research streams in the past decade (2010-2018) are more diverse and extensive than the research in the previous decade (2000-2009) in terms of the research categories, research types, and research topics. First, more EC innovation studies were attributed to business and economics fields than to information science and management categories. Next, considering the research type, qualitative studies such as research reviews and position papers have emerged in the past decade, indicating that the EC innovation research has matured in recent years. Finally, in terms of EC innovation topics, the SST and ERP were the foci of research in the early decade, but more innovative applications appeared as hot topics in recent years such as cloud computing, co-creation, and crowdsourcing. We have also identified some theories other than traditional attitude-intention models (e.g., TRA, TPB, TAM, and IDT) that have been used in the contexts of new EC applications over the past decade, including technology-organization-environment (TOE), signaling theory, extrinsic and intrinsic motivations, and theory of job design.

Conflicts of Interest

The authors declare no conflict of interest.

References

[1] A. Bhattacherjee, "Acceptance of e-commerce services: the case of electronic brokerages," IEEE Transactions on Systems, Man, and Cybernetics, vol. 30, no. 4, pp. 411-420, 2000.
[2] M. S. Eastin, "Diffusion of e-commerce: an analysis of the adoption of for e-commerce activities," Telematics and Informatics, vol. 19, no. 3, pp. 251-267, 2002.
[3] M. Cui, S. L. Pan, S. Newell, and L. Cui, "Strategy, resource orchestration and e-commerce enabled social innovation in Rural China," Journal of Strategic Information Systems, vol. 26, no. 1, pp. 3-21, 2017.

[4] T. Escobar-Rodríguez and R. Bonsón-Fernández, "Analysing online purchase intention in Spain: fashion e-commerce," Information Systems and e-Business Management, vol. 15, no. 3, pp. 599-622, 2017.

[5] Y. Vakulenko, P. Shams, D. Hellström, and K. Hjort, "Service innovation in e-commerce last mile delivery: mapping the e-customer journey," Journal of Business Research, vol. 101, pp. 461-468, August 2019.

[6] K. Randhawa, R. Wilden, and J. Hohberger, "A bibliometric review of open innovation: setting a research agenda," Journal of Product Innovation Management, vol. 33, no. 6, pp. 750-772, 2016.

[7] J. A. van Oorschot, E. Hofman, and J. I. Halman, "A bibliometric review of the innovation adoption literature," Technological Forecasting and Social Change, vol. 134, pp. 1-21, 2018.

[8] S. Akter and S. F. Wamba, "Big data analytics in e-commerce: a systematic review and agenda for future research," Electronic Markets, vol. 26, no. 2, pp. 173-194, 2016.

[9] H. Han, H. Xu, and H. Chen, "Social commerce: a systematic review and data synthesis," Electronic Commerce Research and Applications, vol. 30, pp. 38-50, 2018.

[10] D. Gursoy, "A critical review of determinants of information search behavior and utilization of online reviews in decision making process," International Journal of Hospitality Management, vol. 76, pp. 53-60, 2019.

[11] J. S. Liu and L. Y. Lu, "An integrated approach for main path analysis: development of the Hirsch index as an example," Journal of the American Society for Information Science and Technology, vol. 63, no. 3, pp. 528-542, 2012.

[12] K. D. Brouthers, R. Mudambi, and D. M. Reeb, "The blockbuster hypothesis: influencing the boundaries of knowledge," Scientometrics, vol. 90, no. 3, pp. 959-982, 2011.

[13] Y. M. Wang, Y. S. Wang, and Y. F. Yang, "Understanding the determinants of RFID adoption in the manufacturing industry," Technological Forecasting and Social Change, vol. 77, no. 5, pp. 803-815, 2010.

[14] M. L. Meuter, M. J. Bitner, A. L. Ostrom, and S. W. Brown, "Choosing among alternative service delivery modes: an investigation of customer trial of self-service technologies," Journal of Marketing, vol. 69, no. 2, pp. 61-83, 2005.

[15] S. Li, K. Srinivasan, and B. Sun, "Internet auction features as quality signals," Journal of Marketing, vol. 73, no. 1, pp. 75-92, January 2009.

[16] P. A. Pavlou and M. Fygenson, "Understanding and predicting electronic commerce adoption: an extension of the theory of planned behavior," MIS Quarterly, vol. 30, no. 1, pp. 115-143, 2006.

[17] K. Zhu and K. L. Kraemer, "Post-adoption variations in usage and value of e-business by organizations: cross-country evidence from the retail industry," Information Systems Research, vol. 16, no. 1, pp. 61-84, 2005.

[18] L. D. Chen, M. L. Gillenson, and D. L. Sherrell, "Enticing online consumers: an extended technology acceptance perspective," Information & Management, vol. 39, no. 8, pp. 705-719, 2002.

[19] K. Zhu, K. L. Kraemer, and S. Xu, "The process of innovation assimilation by firms in different countries: a technology diffusion perspective on e-business," Management Science, vol. 52, no. 10, pp. 1557-1576, 2006.

[20] S. Y. X. Komiak and I. Benbasat, "The effects of personalization and familiarity on trust and adoption of recommendation agents," MIS Quarterly, vol. 30, no. 4, pp. 941-960, 2006.

[21] D. Chatterjee, R. Grewal, and V. Sambamurthy, "Shaping up for e-commerce: institutional enablers of the organizational assimilation of Web technologies," MIS Quarterly, vol. 26, no. 2, pp. 65-89, 2002.

[22] P. L. To, C. C. Liao, and T. H. Lin, "Shopping motivations on Internet: a study based on utilitarian and hedonic value," Technovation, vol. 27, no. 12, pp. 774-787, 2007.

[23] W. Duan, B. Gu, and A. B. Whinston, "Informational cascades and software adoption on the internet: an empirical investigation," MIS Quarterly, vol. 33, no. 1, pp. 23-48, 2009.

[24] H. Barki and A. Pinsonneault, "A model of organizational integration, implementation effort, and performance," Organization Science, vol. 16, no. 2, pp. 165-179, 2005.

[25] S. M. Mudambi and D. Schuff, "What makes a helpful online review? a study of customer reviews on amazon," MIS Quarterly, vol. 34, no. 1, pp. 185-200, 2010.

[26] B. W. Wirtz, A. Pistoia, S. Ullrich, and V. Gottel, "Business Models: origin, development and future research perspectives," Long Range Planning, vol. 49, no. 1, pp. 36-54, 2016.

[27] T. Oliveira, M. Thomas, and M. Espadanal, "Assessing the determinants of cloud computing adoption: an analysis of the manufacturing and services sectors," Information & Management, vol. 51, no. 5, pp. 497-510, 2014.

[28] V. Zwass, "Co-Creation: toward a taxonomy and an integrated research perspective," International Journal of Electronic Commerce, vol. 15, no. 1, pp. 11-48, 2010.

[29] Y. L. Fang, I. Qureshi, H. S. Sun, P. McCole, E. Ramsey, and K. H. Lim, "Trust, satisfaction, and online repurchase intention: the moderating role of perceived effectiveness of e-commerce institutional mechanisms," MIS Quarterly, vol. 38, no. 2, pp. 407-428, 2014.

[30] J. D. Wells, J. S. Valacich, and T. J. Hess, "What signal are you sending? how website quality influences perceptions of product quality and purchase intentions," MIS Quarterly, vol. 35, no. 2, pp. 373-396, 2011.

[31] S. Amaro and P. Duarte, "An integrative model of consumers' intentions to purchase travel online," Tourism Management, vol. 46, pp. 64-79, 2015.

[32] H. C. Zheng, D. H. Li, and W. H. Hou, "Task design, motivation, and participation in crowdsourcing contests," International Journal of Electronic Commerce, vol. 15, no. 4, pp. 57-88, 2011.

[33] N. Amblee and T. Bui, "Harnessing the influence of social proof in online shopping: the effect of electronic word of mouth on sales of digital microproducts," International Journal of Electronic Commerce, vol. 16, no. 2, pp. 91-113, 2011.