BIBLIOMETRIC AND VISUALIZED ANALYSIS OF RESEARCH ON MAJOR E-COMMERCE JOURNALS USING CITESPACE

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ABSTRACT

The recent boom of Information Technology development has introduced a rising trend in numerous theories and practices with it. E-commerce is one of the many hot topics for both research and non-academic practice in recent years. However, e-commerce is still in the development stage; studies linking previous understanding and future research trends is needed. This study applies a bibliometric approach using CiteSpace to analyze papers across six e-commerce-focused journals from 1999 to 2016, both quantitatively and visually. Assessments on authorship, countries, institutions, keywords, reference articles, and reference journals were conducted in this study. By examining the papers after 2016 (i.e. 2017 to 2019), we have confirmed that social commerce, social media, online reviews, and word of mouth have been most frequently studied in the e-commerce field, and most research themes include current hotspots belonging to products and structures dimension defined by Zwass. Further, we have found that the mainstream research method is currently shifting from structural equation modeling to data analytics (e.g. sentiment, big data, and semantic analysis). All in all, this study not only provides a framework in the e-commerce field for new researchers but directs the center focus of research for scholars in future studies as well. Contributions and limitations are discussed at the end of this study.

Keywords: Electronic commerce; Research trends; Bibliometric; CiteSpace

1. Introduction

During the last decade, globalization and information technologies have progressed and they continue to progress rapidly. Electronic commerce (e-commerce) becomes a novel means in improving organizational performance [Shiau & Dwivedi 2013]. Even though there is not one universal definition of e-commerce, according to its property of online and exchange of value, we can generally refer to the concept of e-commerce as follows: the usage of networks to conduct business activity which consists of the selling and buying of goods and services electronically among both suppliers and customers [Urbaczewski et al. 2002]. With the internet deeply involved in our daily lives, e-commerce is no longer a pathway from a seller to a buyer, but a lifestyle in this current era. Indeed, e-commerce is widely applied in practice. Furthermore, this commercial model raises great interest by scholars in the academic world. Still, issues such as poor navigability, slow download times, and confusing content are too common in website design and technical support. Naturally, consumer behavior is closely linked to trust, security, word of mouth and so forth. These form a

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large research framework on e-commerce, while current reviews are mainly focused on the research themes and future research trends through traditional citation counts and the personal, judgmental, qualitative, narrative-based methods.

Meanwhile, there is little existing research in this field performed using visualized bibliometrics to analyze both papers and corresponding references instead of just original papers. Previous bibliometric analyses of research in e-commerce have mostly used non-visualized approaches, which have limited their potential for illustrating the progression of a specific area as a whole. For example, Adam et al. [2017] conducted a structured literature review of experimental studies and discovered the current state of research on bidding behavior in single-unit and multi-unit Dutch auctions. Akter and Wamba [2016] applied a systematic review approach to present an interpretive framework which explored the definitional aspects, distinctive characteristics, business value and challenges of big data analytics in the context of e-commerce. These reviews focus on one specific aspect of the e-commerce field, rather than a collective review on major e-commerce journals. There are several advantages associated with the method which we apply in this study. First, it shows the network map of authors, articles, and countries, which makes it easy to trace to the original theoretical roots and history. Second, the keyword analysis we conduct is a time-segmented evolution. We used a cluster map with different colors to show the relationship among different topics evolving through time. This can help scholars to trace the shift in research and identify opportunities to extend research. Finally, the map of cluster view facilitates the identification of pivotal points and turning points by generating separated co-citations, forming whole co-citations network, and seeking key nodes with their prominent features. This paper, therefore, aims to fill the gap and provides a clear view based on the bibliometric and visualized analysis. The main focuses in this field typically consist of e-commerce adoption and consumer behavior, whereas the internal relationship, time span, and the future topic of these focuses have not been investigated well. The internal relationship are the links between authors, countries, and key words which shows the cooperative relationships and knowledge connections. The time span refers to the focus periods of different research themes in the e-commerce field. Taken together, internal relationships and research themes can change over different time spans, and these changes can demonstrate how the knowledge in this field evolves and suggests which topics will be more important in the future. Since e-commerce turns into a driving force to push economic development and towards the knowledge economy, research about the implication, hot topics and research directions of this field are necessary. In addition, the knowledge structure and the internal relationship of e-commerce are also needed for both new researchers and scholars in this field to extend their research. Therefore, we apply CiteSpace as a visualized bibliometric tool to provide an overview of previous e-commerce studies, highlight the core authors, important papers, top journals, and distribution of countries of research. This paper aims to answer the below two questions:

RQ1: What insights can we obtain through citing paper analysis?

RQ2: What knowledge can we learn through cited paper analysis?

This paper applies the quantitative visualized technique to review all papers in six influential journals. By using a novel method to discover the quantitative analysis, we avoid bias from subjective assessment by replacing manual work with software. Moreover, the tables and figures generated by software provide denser and richer information than words and thus this more comprehensive content better explains the knowledge structure. Through the network map of authors, countries, and keywords, researchers can easily find the pivotal points, turning points, direct links, and indirect links to understand the internal relationship among different research themes.

This paper begins with a brief review of bibliometric study on e-commerce research. Then we introduce the CiteSpace software, associated configuration, and all details of data sources. Then, results and discussions of citing papers (i.e., papers searched in this study) and cited papers (i.e., references of searched papers in this study) are displayed and analyzed. Last, we conclude the main findings and contributions in this paper and discuss potential limitations.

2. Literature review - bibliometric studies on e-commerce research

E-commerce has many advantages over purchases from physical stores for companies. Corporate benefits could be captured by effective e-commerce adoption through substantial cost savings, revenue maximization, and improvement in product delivery and customer service [Paris et al. 2016].

Zwass [1996] defined e-commerce as sharing business information, maintaining business relationships, and conducting business transactions by means of telecommunications networks. It conveys information more effectively, improves organizational efficiency and indirect activities of an organization's routine. The framework of e-commerce can be described as infrastructure, services, and products & structure.

Considering existing e-commerce research, some influential review articles provide a general framework for the understanding of this field. As early as 2002 and based on the e-commerce research from 1993 to 1999, Ngai and Wat [2002] classified the following four broad categories in e-commerce research: application areas, technological issues, support and implementation, and others. Each of these categories was sub-grouped to provide the detail of each

category. Three years later, Wareham et al. [2005] applied meta-analysis approach to review 582 articles to generate a map for e-commerce research which clearly portrayed the four domains of e-commerce research as applications and industries specific themes, information technology and infrastructure, business issues, and other social issues. In this review, they used methods including conceptual, review, data analysis, survey, experiment, developmental, and case study. Later, Shiau and Dwivedi [2013] applied a co-citation method to review e-commerce research on six core journals from 2006 to 2010. This study identified five research areas which were trust, technology acceptance and technology application, e-commerce task-related application, e-markets, and identity and evaluation. Moreover, 48 high-value research articles were identified to help centralize core knowledge understandings of the field for researchers. Further, Vaithianathan [2010], solely focused on the research of e-commerce for India, provided a study which served as a starting point for further research in e-commerce in India by giving an agenda for the future. The predictions from this agenda contained theoretical model related research, organizational type and size related research, government-related research, acceptance of rural sector research, and so forth.

The research focused on e-commerce also includes articles from different perspectives. For example, Akter and Wamba [2016] conducted a systematic review of big data analytics in e-commerce. This paper provided an interpretive framework that explored the definitional aspects, distinctive characteristics, types, business value and challenges of big data analytics in the e-commerce landscape. Moreover, Purcell and Toland [2004] answered the questions regarding how the countries of the South Pacific can best exploit these opportunities from an e-readiness perspective in their review. Moreover, Grieger [2003] reviewed the supply chain dimension of e-commerce and highlighted that future research should focus on empirically testing the choice of e-marketplaces based on the different e-marketplace categories, as well as the relationship between the type of e-marketplace and the successful use of e-marketplace within a supply chain agreement.

In recent years, e-commerce has successfully evolved into more advanced forms such as mobile commerce [Khansa et al. 2012], [Sun & Chi 2018], [Shiau et al. 2019], social commerce [Schaupp & Bélanger 2016; Cheng et al. 2019], cross-border e-commerce [Cui et al. 2019; Mou et al. 2019; Zhu et al. 2019] and B2B e-commerce [Ghobakhloo et al. 2015]. As an extension of e-commerce, m-commerce refers to any transactions with monetary value through a telecommunication network. This includes not only shopping online but also banking, investing and other mobile phone services [Kleijnen et al. 2007]. Generally, m-commerce is considered as a separate channel with unique advantages over e-commerce by offering conveniences, such as instantaneity, ubiquity, localization, personalization, and identification [Zhang et al. 2012]. Meanwhile, social commerce is defined as a form of commerce mediated by social media engaging transactional activities between online and offline [Zhou et al. 2013]. Social commerce can provide e-commerce companies with more opportunities to improve customer communication, form customer relationships and build trust [Curty & Zhang 2011]. Given the potential advantages, firms such as Facebook, LinkedIn, Twitter, and other numerous start-ups are trying to promote the adoption of social commerce business models for improving their financial growth [Liang & Turban 2011]. Moreover, Cui et al. [2018] have used the CiteSpace technique to conduct a bibliometric analysis of social commerce. Since the dynamic evolution of research themes and the development of various forms of e-commerce, a summary of current knowledge about e-commerce has been synthesized.

3. Methodology and data

Bibliometrics was first introduced in the early 1900s. It formed an independent discipline in 1969 [Pritchard 1969] and became widely applied in literature analysis [Diem & Wolter 2013]. The bibliometric analysis provides a quantitative method for reviewing and investigating extant literature in a given field [Mayr & Scharnhorst 2014]. Details such as authors, keywords, journals, countries, institutions, references can be captured in the analyzing process. Thus, the development of a field can be obtained through bibliometric analysis [Abramo et al. 2011]. With the help of modern computer technology, graphical and visual results can supplement literature analysis. Co-citation is also frequently used in the bibliometric analysis. It is defined as the relationship if two articles are cited by one or more other articles at the same time. It has been emphasized by Ma and Xi [1992] that visualized co-citation analysis in bibliometrics could facilitate data interpretation; it can make results more comprehensive. Moreover, most items in a paper can be applied through this method—including authors, keywords, institutions, countries, in addition to the paper itself. The visualization helps excavate the internal relationship of this information, such as having the same research topic from different authors, the research focus of different institutions, new theories coming from an existing one and so on.

The importance of Bibliometrics has skyrocketed in both the management field and academic research. As a result, a lot of software for bibliometric and co-citation analysis has recently developed and been applied to various fields. CiteSpace, developed by Chaomei Chen in Drexel University [Chen 2004], is a Java-based analytic software which produces tabular data and visual maps. Because of its talent in combining co-citation and visual maps, CiteSpace

is favorable for finding pivotal points and turning points by generating separated co-citations, forming whole co-citations network and seeking key nodes with their respective prominent features [Chen 2013]. In addition, CiteSpace can find fast-growing topics by identifying burst words, cluster different analytic nodes by type, and automatically label clusters with keywords, identifying the collaborating authors and institutions [Chen 2006]. Another remarkable feature of this software is the three kinds of map views it produces – cluster, time-line, and time-zone. These maps can provide information about knowledge structure, a time span of a certain topic, and trends of evolution, respectively.

According to the instruction of CiteSpace from Chen [2013] and studies using CiteSpace, such as studies from Diem and Wolter [2013], Feng et al. [2015], and Ma and Xi [1992], we provided a general framework for conducting a visualized bibliometric review using CiteSpace. Authorship analysis, journal analysis, country analysis, and institution analysis are needed to describe general information about selected papers. These analytic elements can be deeply analyzed to identify core research themes. The reference journal analysis would help researchers to find suitable theories and methods when they construct their research, and also help them with understanding different scopes of each journal when they submit their work. The reference article analysis provides information more specifically on the theories, methods, and findings. All ten most cited articles are worth reading if researchers want to construct rigorous research. Finally, the most important analysis is that of the keywords. By comparing the co-citation network of keywords in different years, researchers can easily find the knowledge structure and potential future research trends in e-commerce. To display these meaningful results, we used descriptive tables and visualized figures. For tables, we used use frequency or publications to show the weight of each node (i.e. author, institution, country, journal, and paper), whereas we use centrality to show the ability of connection of each node. For example, a node with a high centrality illustrates that the node acts as a key point linking two or more groups showing a transition pattern. For figures, the nodes show the analytic items (i.e. author, journal, reference, etc.), and the size of the node demonstrates the aggregate co-occurrence frequency of an item. The thickness and the color of the ring of nodes show the co-occurrence time slices of an item. The lines between nodes show the connection relationships, and the thickness of the line denotes the frequency of co-citation, whereas the color represents the first year of co-citation relationship occurring among these nodes. There are two types of network analysis in this paper: cluster view and time zone view. We applied a cluster view to show the knowledge evolution over time and the collaborations between nodes. Time zone view was used to show the specific focus of e-commerce in a specific time period.

Since the advancements in different technology sectors, including, but not limited to computer science, database management, and statistics, bibliometrics has emerged a powerful discipline to analyze literature [Portner 2008]. This paper uses CiteSpace version V as both the visual and bibliometric analysis software. To identify the development and structure of knowledge in the e-commerce field, we select six leading journals in e-commerce (see Table 1). These journals have recently been ranked as the most popular electronic commerce journals [e.g., Hsu & Chiang 2017; Ku et al. 2018]. Traditionally, bibliometric research by CiteSpace used a keyword search mechanism to study a particular field and its knowledge structure [Diem & Wolter 2013; Feng et al. 2015; Ma & Xi 1992]. However, we extend the scope of this method by applying journal searching in this study rather than keyword searching. Each of the six journals is related to various topics of e-commerce, such as IT in business, data structure, computer communication networks, and e-business and e-management. As recommended by CiteSpace, Web of Science is used as a database source website for searching papers for the structure of knowledge in a particular field. All papers and associated references from these journals are extracted from the Web of Science for analysis. We select all years for data downloading and analyzing in our research, totaling 1799 papers all together. This maintains the integrity of the knowledge structure in a date range of 1999 to 2016. Cumulatively the papers' references cover almost all fundamental and important studies in this area. For more clarity, details are listed in Table 1. We downloaded all papers' records including authors, institutions, countries, journals, keywords, abstracts, and references. After extraction, all downloaded information was fed into the software to analyze each element individually over different periods of time.

Table 1. Summary of Journals Details

Journals	**Periods of time***	**Sample size**
International Journal of Electronic Commerce	2003-2016	348
Electronic Commerce Research	2008-2016	196
Electronic Commerce Research and Applications	2005-2016	538
Journal of Electronic Commerce Research	2008-2016	192
Electronic Markets	2009-2016	223
Journal of Organizational Computing and Electronic Commerce	1999-2016	302

Note. *: the time frame is different due to the various established time of these journals in Web of Science

4. Results of Citing Papers Analysis

4.1. Authorship

Based on the database from 1999 to 2016, 3233 authors contribute to the 1799 articles among the six journals. The top ten most active authors whose number of articles is more than 10 are listed in Table 2, and their cooperative pattern is shown in Figure 1. Each node stands for an individual author, and the more papers published, the larger the node size will be. The size of these links and the links themselves between different nodes represent their cooperative pattern and the degree to their cooperative relationship. In addition, nodes with a purple ring indicate the node has a high centrality. In other words, it plays a key role in combining other papers together or acting as a theoretical basis in this field. By analyzing authorship, we can highlight not only the most influential authors in e-commerce, but also find their valuable works to reflect important research themes of previous research. Articles from the most insightful authors can represent a valuable research theme to some degree. Moreover, articles from the most cited authors are the most important foundation from whatever theoretical based or methodological based for research in this area. For these reasons, authorship analysis is worthwhile.

As shown in Table 2, Kauffman is the most productive author and most of his works are published in "Electronic Commerce Research and Applications". Kauffman is also the author with the highest centrality, meaning his works are highly collaborative with other authors and topically diverse. By analyzing his relative paper importance with high citations, we found that most of his papers were about online auctions and involved many aspects. For example, one topic included how sellers could set the auction price more compatible to potential bidders and thus improve auction performance to obtain better cooperation from bidders [Chen et al. 2009]. Another discussed how demand matters in decision making of group-buying auctions among low-valuation and high-valuation goods [Chen et al. 2010], Kauffman also elaborated on how incentive mechanisms, fairness and participation work in online group-buying auctions [Kauffman et al. 2010], the effects of shilling on final bid prices [Kauffman & Wood 2005] and so on. Zwass [2003] highlighted the importance of e-commerce in organizational innovation. The five fundamental functions of e-commerce include commerce, collaboration, communication, connection, and computation conducted under specific innovational opportunities. For instance, innovative products, cooperating with business partners, transforming business processes, managing marketplaces, and organizing the delivery of information-system services. Other research from Zwass focuses on the significance of the co-creation of value by consumers as a major force in the marketplace. Zwass [2010] also suggested that in order to maintain e-commerce associated with organizational innovation's entirety and to be fully exploited, the taxonomic framework was needed for the basis of future development in this area. Chau's research was mainly focused on two aspects: online shopping and the adoption of e-commerce by different industries. Chau [2000] demonstrated the impact of information presentation modes, or the user interface, of online shopping. He found that pictures were better than text for goods with which the user was familiar, but for unfamiliar goods, these advantages diminished. Besides the interface of an online vendor, customers' trust also played a key role in decision making around different stages of the purchase process [Chau et al. 2007]. In other ways, Chau investigated the determinants of e-commerce's acceptance in various industries, including internet banking [Chau & Lai 2003], electronic data interchange for small businesses [Chau & Hui 2001], and telemedicine technology for healthcare organizations [Hu et al. 2002].

Table 2. Top 10 Most Productive Authors

Author	Publications	Author	Publications
Kauffman R J	59	Osterle H	22
Zwass V	37	Zimmermann H D	16
Chau P Y K	30	Payne T R	16
Westland J C	29	Lee J K	15
Alt R	29	Heyden K	13

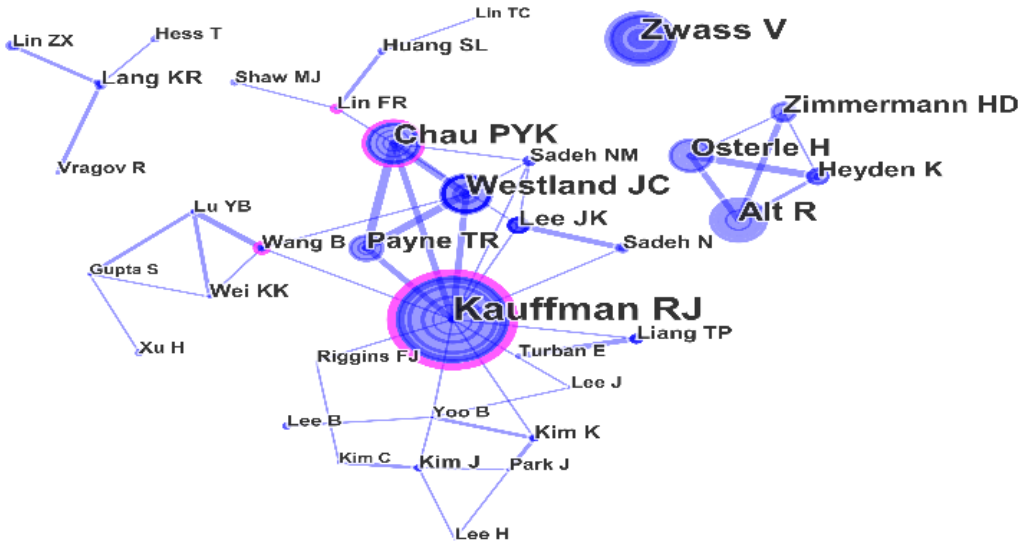

Figure 1. Map of the Most Productive Authors with Collaborative Links
(note: to clearly differentiate authorship, we also included the initials of the given name)

4.2. Countries and Institutions

The top ten most productive countries or territories with the number of publications are listed in Table 3. The USA ranks the first with 685 publications, exceeding one-third of all papers due to its high developmental level of electronic information technology. It should be noticed that most of these top 10 countries or territories are developed, while China, ranking second, is still a developing country. The collaborative relationship of these countries has been analyzed by CiteSpace, using the Pathfinder network scaling method to make the map clear and comprehensive. At this stage, cluster analysis was applied to discover the special research focus of these countries, labeled by keywords and shown in Figure 2. Each node stands for a country or territory, and those which share the same color represent a single cluster – a group with similar research foci. Countries linked with another cluster denote further partial attention toward another focus. Under the Pathfinder network scaling method, the network figure is simplified by ignoring weak links, and highlighting links which are more frequent. This method is used for detecting if there are similar research patterns across different countries. The cluster information is listed in Table 4. We traced the citation history of each node from CiteSpace to account for each and every country of origin in all the chosen publications. Numerically and visually, it is clear the USA and China are the most connected throughout the network; these two countries have already paid more attention to e-commerce, and in diverse research aspects. As the founding country of e-commerce, the USA pays more attention to the relationship quality between buyers and sellers. In addition, one of the most popular e-business models—online auction or online group buying—also attract scholars from the USA. China, which shows a lag-progressive development on e-commerce, closely follows the USA, making more and more endeavors on the adoption of e-commerce. Figure 2 shows the knowledge flow and research focus pattern; no weights on the links are added.

Table 3. Top 10 Countries/Territories for E-Commerce Publications

Country or Territory	**Total publications**
USA	685
China	264
Taiwan	206
Germany	169
South Korea	130
Australia	86
England	82
Canada	72
Switzerland	66
Spain	60
Others	476

Table 4. Cluster Information of Country Analysis

Cluster	Keyword
USA	Relationship quality, Online auction
China	E-shopping, Adoption
Germany	Trust, Preface
Australia	Mobile access, Store atmosphere
England	Buyer profiling
Canada	Auction listing location, Project performance
Netherlands	Knowledge-creation net

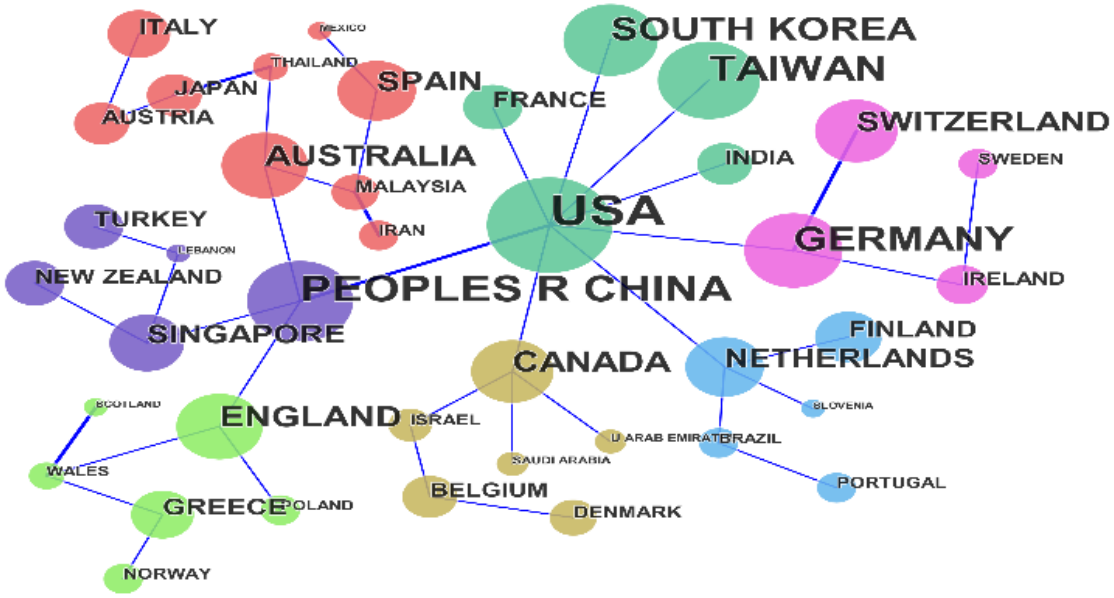

Figure 2. Map of Clustering of Productive Countries/Territories

The top-level research institutions in the e-commerce field are analyzed by CiteSpace, and the result is in accordance with analysis by country. The top ten most productive institutions are listed in Table 5 with associated centrality. Among these institutions, University of Illinois, City University of Hong Kong, and Arizona State University are the three universities with centrality around 0.1. The higher the centrality of a node, the more dispersed of a range it reaches, and consequently, the more links it has. Naturally, these three universities have widespread cooperation with other institutions. Even though the University of Illinois has the most publications, the City University of Hong Kong has the highest value of centrality. Because of its high centrality, we believe the City University of Hong Kong will harvest more publications on e-commerce in the future.

Table 5. Top 10 Institutions for E-Commerce Publications

Institutions	Publications	Centrality*
University of Illinois	48	0.09
City University of Hong Kong	46	0.17
Arizona State University	43	0.14
University of Hong Kong	38	0.01
University of Leipzig	37	0.00
University of St. Gallen	32	0.00
National Sun Yat-sen University	31	0.08
University of Minnesota	28	0.07
Korea Advanced Institute of Science and Technology	27	0.00
Seoul National University	25	0.04

Note. *: Centrality shows the degree of one node linking with other nodes

Taking this information together with Table 4 of Chinese focus, we think e-shopping and adoption are the current foci of e-commerce research. Institutions from other countries are also found to be catching up with the developmental pace of the USA and China. For example, University of Leipzig from Germany, Korea Advanced Institute of Science and Technology and Seoul National University from South Korea do not trail far behind in terms of centrality. In general, the USA, China, Germany, and South Korea are the leading countries in e-commerce research.

4.3. Keywords

A keyword analysis is a primary method to identify current research topics and future orientation. With the help of Citespace, the top 20 keywords with their coordinating frequencies are listed in Table 6. Shown in Figure 3 is the co-occurrence relationship. Two modifications have been applied for brevity. First, keywords with the same meaning, such as website and web, were combined into a single frequency. Second, e-business, e-commerce, and e-commerce are excluded for analysis to eliminate bias. Apart from e-commerce, the most frequently emerged word is "model," followed by "internet," and then "trust." These three aspects of e-commerce are considered the most important and fundamental research in the field. It makes sense that e-commerce is developing due to the development of the Internet and Internet technology. In addition, the uncertainty and opportunism inherent in e-commerce results in increased perceptions of risk in an online environment, elevating the need for trust [Mou et al. 2017]. "Model" is likely the most frequently appeared keyword because the papers are employed with theoretical models as a lens to approach a study, such as to build a research model and empirically test it. The co-occurrence map has been depicted in Figure 3; however, there is not any clear pattern to show the knowledge evolution correlates with time. Despite this, nodes with same color links were pulled to the edge of the network manually and laid counter-clockwise from the earliest to the latest. From this map, 5 key nodes form the main framework throughout the network: model, internet, trust, information technology, and impact. With the color going from cold to warm (dark blue, light blue, green, orange, red), time is various from 1999 to 2016 with 4-year intervals for each time period. The research focused on information technology and impact are proceeding all years, whereas studies associated with the model are mainly conducted from 2003 to 2010. From this perspective, we can infer that most e-commerce research before 2003 was fundamental theoretical models in e-commerce. Research about the Internet and trust in the e-commerce field is mainly carried out after 2003. In fact, after 2003, most e-commerce research and theories applied trust as their core constructs. Currently, trust is still a hot topic. From the internal relationship point of view, most links of trust are red, indicating they are all newly developed. These include the topics of community, intention, and word of mouth, which are currently popular and may become new branches for future studies. On the other hand, some indirect red links with trust also exist, for example, social media via community, and satisfaction via antecedent. The relationship between trust and these indirectly linked topics are needed to be investigated in the future. From the time-span perspective (i.e. warm color of nodes), the red-color words shown in Figure 3, as the most frequently emerged topics in recent years. These include customer satisfaction, intention, word of mouth, service quality, social media and so on. These words are highly related to trust. Therefore, we suggest that the trust in e-commerce will still be pertinent, even in the future. Because of its high importance now and in the future, the quality of service and system should be consistent in businesses within e-commerce to maintain trust. More and more studies also pay attention to customer satisfaction. This is because satisfaction is not only affected by the trust but also influences consumer e-loyalty. In practice, satisfaction is the main driving force for consumers' repurchase behavior.

Table 6. Top 20 Keywords of Publications

Keywords	**Frequency**	**Keywords**	**Frequency**
Model	267	Perspective	96
Internet	239	Online	96
Trust	177	Adoption	93
Information technology	169	Performance	90
Information	155	Management	90
Behavior	145	Satisfaction	86
Web	143	Word of mouth	83
System	140	Market	80
Impact	118	Service	80
Technology	114	User acceptance	69

Thus, how to satisfy consumers and what elements can increase consumer's satisfaction may attract e-commerce practitioners in recent years. A favorable word of mouth response comes from an excellent purchase experience. A satisfied consumer will spread his or her praise and recommend friends, family members, and even strangers online through customer review systems. Service quality is one of the key factors which affect the consumer experience.

Together with information quality and system quality, service quality constitutes the information system success (ISS) model which is a comprehensive research model in e-commerce. All three qualities have a positive relationship with satisfaction and intention to use. E-commerce, combined with social media, generates social commerce. It brings together social media, community interaction, and online commercial activity, in other words, e-commerce is promoted by word of mouth through social media. As discussed above, all five keywords which appeared in recent years may still be focused on in future research. In addition, combining these words, we boldly predict for the practical world that the developmental trend of e-commerce will center on improving the service quality and exploiting more social commerce.

In order to gain more knowledge from our data, we have separated the time period to 1999-2007 and 2008-2016 and compared the ranks of top 20 keywords in two periods as recommended by Feng et al. [2015]. The only keywords or phrases that emerged in 2008 – 2016, "word of mouth" and "satisfaction," demonstrate the importance of these topics in recent years. Since web 2.0 developments, consumers can express their feelings and complaints via customer review systems. As a result, word of mouth is easily an important aspect of e-commerce, and could still be growing in importance today. Secondly, the ranks of "trust", "behavior", "impact", and "adoption" have moved up significantly, which may imply that customer behavior has a great influence on the success of e-commerce in practice [Pavlou 2003]. If this is true, observers will notice that industries will increasingly implement the transition to e-commerce. Meanwhile, e-commerce research will shift focus from the technology itself to behavior; the keywords, "system", "technology", "management", " performance", "market", and "user acceptance" have dropped distinctively, meaning these topics are decreasingly relevant to e-commerce. This may be a result of the Information Technology boom and consequent economic globalization, inducing the maturity of e-commerce in numerous companies among various industries. With this, more attention moves from the basic attributions of e-commerce such as system, technology, or user acceptance onto the internal mechanism of e-commerce, such as customer behavior. To sum it all up, we have identified internet, trust, information technology, and impact as major topics in the field of e-commerce based on our data.

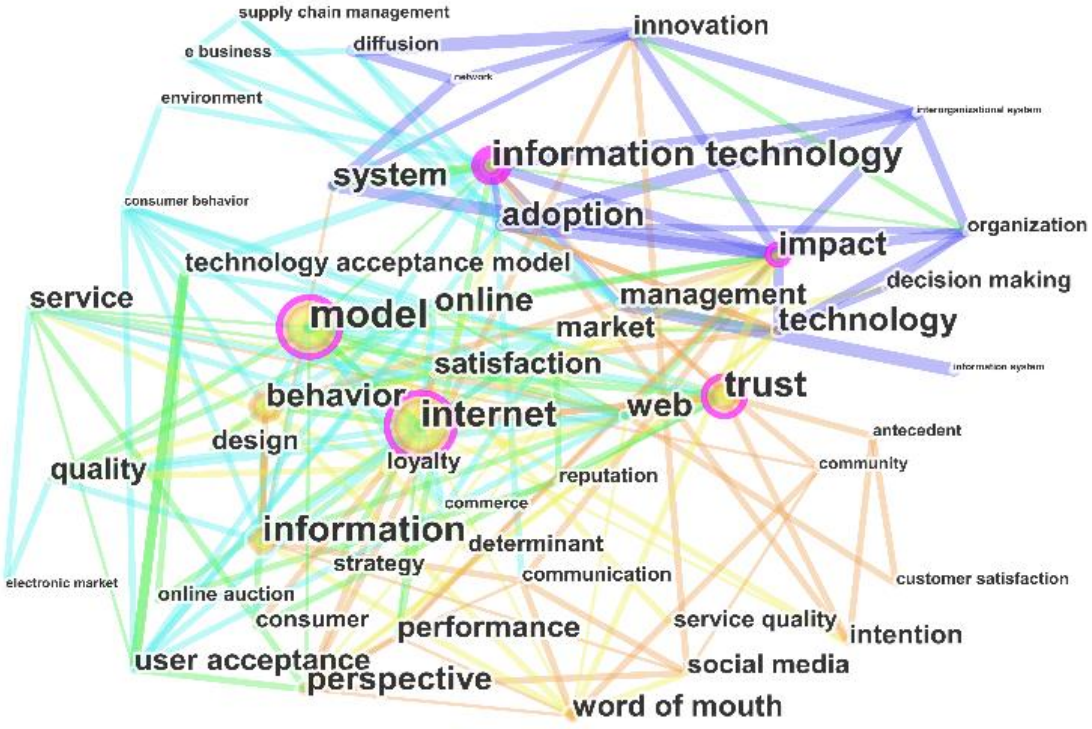

Figure 3. Map of keywords co-occurrence relationship

Next, we analyze the difference and preference of each journal involved in this study. In general, all important keywords such as "model", "internet", "trust", "technology", "behavior" are included across the six journals. To identify the discrepancy among these journals, we have ranked the keywords' frequencies for each journal and seek the compared ordinal position. From this, we observe that "Electronic Commerce Research" pays more attention to purchase intention; "Electronic Commerce Research and Applications" contains a large number of studies associated

with online auctions; "Journal of Electronic Commerce Research" has a particular emphasis on customer attitude; "Electronic Markets" regards user acceptance and user privacy as its focus; research in "Journal of Organizational Computing and Electronic Commerce" is largely related to knowledge management, innovation, and social media. "International Journal of Electronic Commerce" embraces all special foci of other journals, as well as a partial focus on virtual community. In general, this information provides recommendations for scholars to conduct literature reviews of contributions in their respective fields, and also help them with paper submissions.

4.4. Post-hoc analyses of e-commerce research

To make a precise judgment about recent e-commerce research, we have recollected samples from six journals between 2017 and 2019. As a result, 482 papers were extracted for keyword analysis. The top 20 keywords with their coordinating frequencies are listed in Table 7. It is obvious that social commerce with its particular attributes such as social media, e-WOM, and social network have emerged in recent years. Social commerce is an expansion of social media based on the logic of social network. These three keywords are highly correlated and may explain the rise of social commerce in recent years. The social network allows people in a society to interact and to form relational ties. In a social network, people can instantaneously share their videos, images, and text files and establish voice communications irrespective of their locations [Shiau et al. 2017]. Social media platforms such as Facebook which is the most popular website worldwide enables users to share their information and opinions, to show their connections to other users, and to know others through the connections. Through these connections and by sharing information, social network facilitates the investigation of employees' backgrounds, advertising and marketing, tourism development, and also the progression of social commerce [Shiau et al. 2018]. In addition, online reviews, sentiment analysis, big data, and data analytics are also popular recently. These keywords also show cross-linkage. For example, Zhang et al. [2018] analyzed the online reviews using sentiment analysis from a Chinese professional mobile device, Huawei Mate phones. This paper discussed the correlations between online reviews and phone improvement and proposed some suggestions for future product improvement. Another study from Yagci and Das [2018] investigated the volume and quality of product design information available in online reviews and introduced the design-level information quality measure which is indicative of the design contextual information stored in the online reviews for a given product. This study also integrated data mining techniques, big data, and online reviews.

Table 7. Top 20 Keywords of Publications between 2017 and 2019

Keywords	**Frequency**	**Keywords**	**Frequency**
Social media	28	Business model	9
Social commerce	13	Machine learning	9
E-WOM	13	Online reviews	8
Trust	12	Fintech	8
Collaborative filtering	11	Reputation	8
Recommender system	11	Data analytics	8
Sentiment analysis	11	Purchase intention	7
Crowdfunding	10	Online shopping	7
Social network	9	Empirical research	7
Big data	9	Cloud computing	6

Further, we synthesize all data from 1999 to 2019, and extract 2281 samples to detect any burst keywords. A burst keyword shows the phenomenon that any keyword emerges frequently in a particular time of period. This information can not only show the evolution of research hotspots with time but also indicate the research trends in recent years and may suggest that of the future. The eleven discovered burst keywords are shown in Figure 4. There is no doubt that social commerce and its associated attributes begin to largely arouse scholars' interests since 2013 and will continually be focused in the future. This result is consistent with the social commerce study by Cui et al. [2018]. Another potential future research trend is about online reviews, especially using big data and sentiment analysis. For example, Meng et al. [2016], using the sentiment analysis technique, studied how different government strategies are applied to different phases of the incident and why the responses of the public vary during different periods. Chen & Xu [2017] applied text mining to study the determinants of online customer ratings. It is necessary to clarify that other burst keywords could emerge or even fade at any time for any reason in the near future. Take m-commerce for example—apart from social commerce, m-commerce as an extension of e-commerce has dramatically increased over e-commerce in recent years. However, Figure 4 shows that the burst period for m-commerce is from 2003 to 2007. This is not to necessarily say that research on m-commerce will continue to fade in future. Although it is evidence of themes' preference of these six journals over time. For current research on e-commerce, many influential papers on m-commerce are published, such as investigating antecedents of m-commerce acceptance [Liébana-Cabanillas et al.

2017], understanding the role of mobile technology advancement and system barrier on m-commerce channel preference behavior [Shin et al. 2018], determining m-commerce purchase intentions [Blaise et al. 2018], and so forth. Thus, research on m-commerce may be continually progressing but not in these six journals.

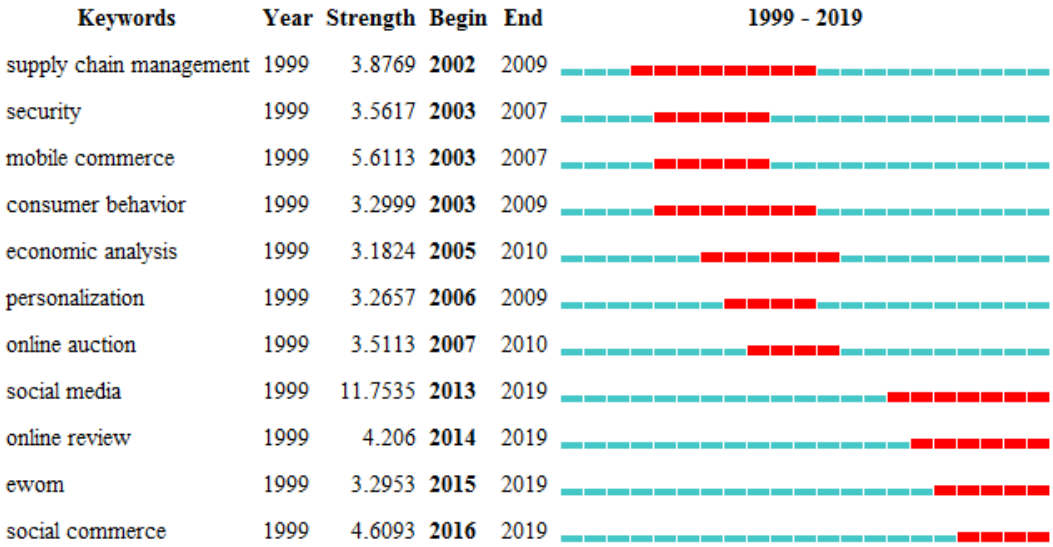

Figure 4. Top 11 Keywords with the Strongest Citation Bursts

To both identify the most popular category of e-commerce discover more potential research themes, we have matched the top 20 keywords of our full samples from 1999 to 2019 with three different dimensions according to Zwass' e-commerce framework [1996] as the conceptual framework. Table 8 shows that most popular research themes are associated with products and structures. This role of this dimension is directing the provision of commercial services to consumers and business partners, intra-organizational information sharing and collaboration, and organization of electronic markets and supply chains [Zwass 1996]. There are two functions of this dimension, one being electronic market places and electronic hierarchies, and another, products and systems. Among these key words and phrases, there are three important e-marketplaces forms which include an online auction, social commerce, and m-commerce.

Table 8. Top 20 keywords with Dimension

Keywords	Frequency	Level and Function	Keywords	Frequency	Level and Function
Trust	83	Level 7: Electronic market places and electronic hierarchies	E-WOM	21	Level 7: Electronic market places and electronic hierarchies
Online auction	62	Level 7: Electronic market places and electronic hierarchies	Recommender system	30	Level 6: Products and Systems
Mobile commerce	44	Level 7: Electronic market places and electronic hierarchies	Online reviews	25	Level 6: Products and Systems
Satisfaction	41	Level 7: Electronic market places and electronic hierarchies	Collaborative filtering	24	Level 6: Products and Systems
Perceived risk	31	Level 7: Electronic market places and electronic hierarchies	Personalization	26	Level 5: Enabling services
Social commerce	31	Level 7: Electronic market places and electronic hierarchies	Privacy	27	Level 4: Secure messaging
Consumer behavior	28	Level 7: Electronic market places and electronic hierarchies	Security	23	Level 4: Secure messaging
Business model	27	Level 7: Electronic market places and electronic hierarchies	Technology adoption	53	Level 3: Hypermedia/multimedia object management
Electronic market	23	Level 7: Electronic market places and electronic hierarchies	Social network	46	Level 1: Wide-area telecommunications infrastructure
Reputation	21	Level 7: Electronic market places and electronic hierarchies	Social media	71	Level 1: Wide-area telecommunications infrastructure

5. Results of Cited Papers Analysis

5.1. Reference Articles

Based on the analysis of reference articles along with corresponding authors, 55,943 references with corresponding authors are extracted in this study. The most influential authors and articles are displayed in Table 9. Among these ten articles, some belong to the methodological category, while some are quantitative studies which employ structural equation modeling (SEM). We can conclude that the major method in this field is SEM. This also makes sense that the paper of Podsakoff et al. [2003] has been cited frequently due to the consideration of common method variance by using survey data. Apart from methodological articles, the most popular paper in e-commerce is from Davis, published on "MIS Quarterly" in 1989. In this study, Davis [1989] developed the scales for measuring perceived usefulness and perceived ease of use, which were thought to be the basic factors of user acceptance. This study also showed both usefulness and ease of use had a significant impact on usage behavior of the future, as well as the current time.

Table 9. Top 10 References of Citing Paper

Reference article	Frequency	Type of source
Fornell, C., and Larcker, D. F. 1981. "Evaluating structural equation models with unobservable variables and measurement error," Journal of Marketing Research	216	Journal
Davis, F. D. 1989. "Perceived usefulness, perceived ease of use, and user acceptance of information technology," MIS Quarterly	134	Journal
Podsakoff, P. M., Mackenzie, S. B., Lee, J. Y., and Podsakoff, N. P. 2003. "Common method biases in behavioral research: a critical review of the literature and recommended remedies," Journal of Applied Psychology	96	Journal
Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. 1989. "User acceptance of computer technology: a comparison of two theoretical models," Management Science	91	Journal
Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C. 1998. Multivariate data analysis, 5th ed, All Publications	90	Book
Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. 2003. "User acceptance of information technology: toward a unified view," MIS Quarterly	89	Journal
Ba, S., and Pavlou, P. A. 2002. "Evidence of the effect of trust building technology in electronic markets: Price premiums and buyer behavior," MIS Quarterly	85	Journal
Gefen, D., Karahanna, E., and Straub, D. W. 2003. "Trust and TAM in online shopping: an integrated model," MIS Quarterly	84	Journal
Nunally, J. C. 1978. Psychometric theory (2nd ed.), New York: Mcgraw-Hill	83	Book
Anderson, J. C., and Gerbing, D. W. 1988. "Structural equation modeling in practice: a review and recommended two-step approach," Psychological Bulletin	83	Journal

Moreover, usefulness is more influential to user behavior. Last, Davis considers that perceived ease of use might be a causal antecedent to perceived usefulness rather than a paratactic direct determinant of system usage. This paper laid a foundation for e-commerce research. On one hand, it provided the scales for measuring two fundamental variables of user acceptance, usefulness, and ease of use in the practice of e-commerce. On the other hand, the high correlation between user acceptance and usage behavior implied that both perceived usefulness and perceived ease of use is important in the information technology field. Another study from Davis et al. [1989] also supported the impact of user acceptance on e-commerce, especially organizational performance. Further, the willing of acceptance attitudes also partially mediated the effect of these variables on intentions. Later, Unified Theory of Acceptance and Use of Technology (UTAUT) [Venkatesh et al. 2003] was developed based on eight extant models, and this model included four core determinants of intention and usage: performance expectancy, effort expectancy, social influence, and facilitating conditions. Besides the user acceptance, trust is also a fundamental topic in the e-commerce field as shown by this research. Ba and Pavlou [2002] also demonstrated that the feedback mechanism could help trust building without repeated interactions between vendor and buyer, hence generating price premiums for creditworthy vendors. Trust also plays an important role in mitigating the risks inherent in transactions [Mou et al. 2017]. Altogether, trust and user acceptance have become the most common research issues in e-commerce.

From the cluster view of reference analysis in Figure 5, it is easily found that the study from Ba and Pavlou [2002] is not only a key node, central to the entire map but also a turning point that brings the significance of trust in the e-commerce fields. Most of the papers associated with trust were published just after Ba and Pavlou's paper, such as "The Effect of Word of Mouth on Sales: Online Book Reviews" from Chevalier and Mayzlin [2006]. This paper has examined the effect of customer reviews on book sales and found that the word of mouth was far more important than

summary statistics of a product, a useful finding to increase sales. The evolution of knowledge structure is displayed by the time-zone map in Figure 6.

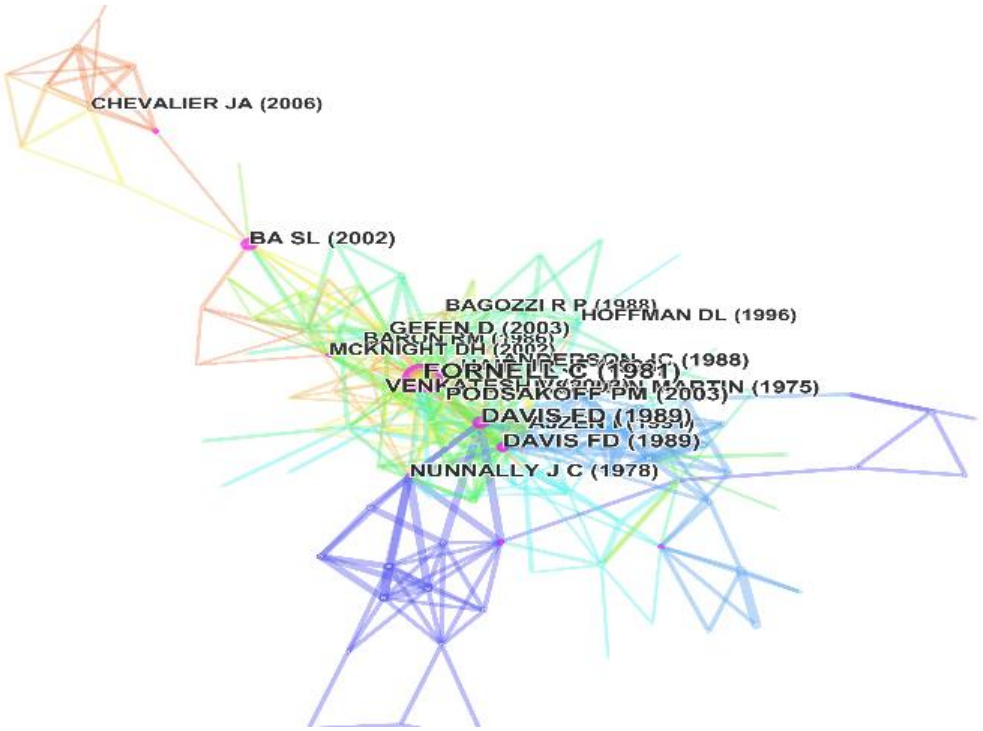

Figure 5. Map of Reference Cluster View

In accord with Ba and Pavlou's paper, Mcknight et al. [2002] emphasized two key points. First, trust is critical to both researchers and practitioners. Second, trust can be measured as a multidimensional concept. The two latest important papers, shown on the right in Figure 6, may hold the potential to form a new branch of e-commerce in the future. A paper from Gefen et al. [2003] has both investigated this statement empirically and highlighted the importance of conducting intentional behavior. Mudambi and Schuff [2010] first investigated the influence of online reviews on making purchase decisions for both search goods and experience goods and then examined the different moderate effects of these two product types. Apart from general attributes such as trust, review, and user acceptance, Kaplan and Haenlein [2010] have demonstrated the importance of social media in e-commerce. They have classified social media by intrinsic characteristics and established ten key pieces of advice for companies which decide to utilize social media as a method for profitable use. Therefore, this paper made a great contribution to practitioners and formed a new branch of e-commerce with respect to social media.

We have also checked the references of all articles published across all six journals in recent years (2017-2019). This makes the results slightly different from above. Compared to Table 9, three articles are missed from the top ten most cited papers, including Davis et al. [1989], Ba and Pavlou [2002], and Gefen et al. [2003]. From this information, we can conclude that TAM is less important in recent years, and the trust from Ba and Pavlou [2002] has been successfully transmitted to new research areas and this research is losing its domination. Instead, three articles emerge at the same time which are Chevalier and Mayzlin [2006], Mudambi and Schuff [2010], and Kaplan and Haenlein [2010]. This also supports the conclusion from above that word of mouth [Chevalier & Mayzlin [2006], online reviews [Mudambi & Schuff 2010], and social media [Kaplan & Haenlein 2010] in e-commerce have become increasingly discussed, and articles associated with these three aspects will harvest the most relevance in the near future.

5.2. Reference Journals

Journal analysis is used in this study to discover the journals contributing most to the intellectual foundation and macrostructure of e-commerce. Although reference journal analysis can neither help with summarizing the current understanding nor predict future research trends, these journals are the highest qualitative journals within the scope of e-commerce research. Thus, these journals are suitable for building a theoretical foundation and to submit for high qualitative papers. Looking at the top ten reference journals listed in Table 10, it is obvious that most of these journals are also in Management Information Systems (MIS) and general Management fields rather than solely the e-commerce

field. Meanwhile, it illustrates that most theories and methodologies in the e-commerce field are based on Management Information Systems and Management subjects. Indeed, it implies that e-commerce is one of the subjects that utilize MIS to generate profit through marketing, consumer, communication, and decision sciences. The single top journal is *MIS Quarterly* with 745 reference articles. This journal is the enhancement and communication of knowledge concerning the development of IT-based services, the management of IT resources, and the use, impact, and economics of IT with managerial, organizational, and societal implications. *Management Science* is a close second with 692 reference articles. This journal includes articles related to all aspects of Management related to strategy, entrepreneurship, innovation, information technology, and organizations as well as all functional areas of business, such as accounting, finance, marketing, and operations. The third journal is *Information System Research* with 653 reference articles. This journal covers a wide variety of phenomena and topics related to the design, management, use, valuation, and impact of information technologies at different levels of analysis. The topics are from a wide range of research traditions, including cognitive psychology, economics, computer science, operations research, design science, organization theory, organization behavior, sociology, and strategic management.

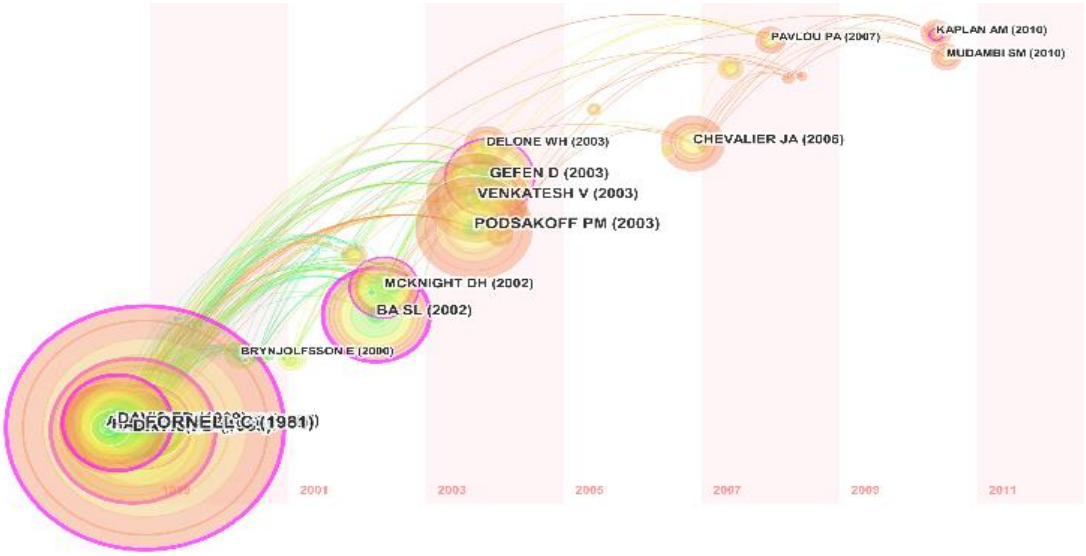

Figure 6. Map of Reference Timezone View

Table 10. Top 10 Journals of References

Journal	Frequency
MIS Quarterly	745
Management Science	692
Information Systems Research	653
Communications of the ACM	649
Journal of Marketing Research	605
International Journal of Electronics and Communications	590
Journal of Marketing	588
Decision Support Systems	548
Journal of Management Information Systems	485
Journal of Consumer Research	427

6. Conclusions

A grand total of 1799 papers with a corresponding 55,943 reference papers are analyzed in this study and the main findings are displayed as follows. First, research on e-commerce emerged around the 21st century. Nevertheless, theories and methodologies this field applied are from psychology as well as the MIS areas as early as the 1980s, approximately speaking (Table 9). Second, the USA and China composed the majority of contributions in this field, and institutions in these two countries provide the same information. These two countries are recognized as the most developed (the USA) and the fastest developing countries (China) in the world. Meanwhile, the e-commerce industry is progressing rapidly in the 21st century, which largely contributes to the country GDP growth comparing to previous years. Third, several important references are extracted. Most of the top 10 references are about research methodology

of e-commerce which can be concluded as structural equation models with its proper procedures. Other than the methodology articles, these core papers in e-commerce are concerned with user acceptance and trust which, in addition to providing the general framework in this field, offer some recommendations for literature reviews. Finally, the hot topics are identified as information technology, user acceptance, adoption, customer behavior, trust, performance, service quality, customer satisfaction, word of mouth and social media along with the development of e-commerce. In addition, future research trends are forecasted to be social commerce, social media, word of mouth, and online reviews. As discussed in section 3.3 and 4.4, social commerce and social media will continue to become increasingly important in the strategic development of e-commerce companies, especially in the age of web 2.0. Word of mouth as an important part of customer post purchase behavior is popular in recent years. Comparing to satisfaction, trust, and sense of belonging, research about word of mouth are not mature but more pivotal in influencing peers' decision making. The last future research branch is the topic of online reviews. In the context of big data, online reviews are a hot topic for researchers. The common research method for this theme is data mining, sentiment analysis, and semantic analysis, rather than structural equation models. What is more, online reviews as a kind of word of mouth can be disseminated through social commerce, demonstrating the internal relationship among these three directions. This suggests potential future research trends. For example, Hsu et al. [2019] adopted a sentiment word database to extract sentiment-related data from an online reviews of a microblog which is a typical social commerce website, and investigated the effect of different types of sentiment-related words on product recommendations. This study incorporates social commerce, online reviews, and word of mouth, and demonstrates a new branch of the future e-commerce researches using a different technique (sentiment analysis) rather than structural equation models. Thus far, three important studies worth reading for the basis of future research include word of mouth [Chevalier & Mayzlin [2006], online reviews [Mudambi & Schuff 2010], and social media [Kaplan & Haenlein 2010]. We also find that the products and structures dimension is the main research area in e-commerce research niche according to Zwass's research framework [1996].

Academically, this paper has both implications for e-commerce scholars and journal editors. First, all results described above provide general knowledge about the current understanding of e-commerce for scholars who are interested in e-commerce or would like to conduct research in this field. Second, future research directions are inferred as social commerce, social media, word of mouth, and online reviews. These topics have been researched for about five years, therefore, these topics are easier for researchers to contribute their work than mature topics such as trust and acceptance, and more knowledge needs to be added to e-commerce journals. From this point of view, journal editors can obtain information about future research foci and restrict the scopes of journals' focus to drive a bright development of the journal. Further, it can help the editors build their editorial board members through authorship analysis. Interestingly, m-commerce research has shown a dramatic increase in current years, but not the same pattern for these six journals. Hence, journal editors may pay attention to this special area. Third, research methods may shift from an empirical survey towards objective data analysis such as data mining and deep learning. Despite the fact that empirical studies by the survey method are classic and effective in human behavior research, and it has been suggested and improved over time. For example, studies from Fornell and Larcker [1981], Podsakoff et al. [2003], and Anderson and Gerbing [1988] are all associated with this method. Objective data analysis such as data mining and regression analysis of panel data, especially big data analysis, sentiment analysis, and semantic analysis become popular with its advantages of objectivity, facticity, and accessibility in the past three years. Therefore, objective data analysis method will be a major research method on e-commerce in the future.

Practically, this paper has contributed three implications for the e-commerce industry. First, the attractions of e-commerce users are moving from system quality, website design, and user acceptance to the communicative experience and trust. This information will help e-commerce companies to make future developmental strategies towards satisfying their users according to customer needs. Second, research about online reviews and social commerce emerging in recent years can reflect that the next developmental opportunities for e-commerce companies may come from these two areas to some degree. Finally, word of mouth is no longer a research point, it has been generally recognized as a powerful driving forth for customer's decision making. Therefore, e-WOM management may also become a spotlight topic in practice.

Apart from these findings, this paper has a methodological contribution on deeply investigating an interesting topic supported by CiteSpace. Compared to merely reviewing extant literature, this method can show visually the development of a subject, important authors, and critical papers on this subject. In addition, reference analysis by Citespace can overcome the lack of literature reading. This is because, although the reviewed papers are limited, their references contain enough information about the key papers in a field, directing toward further suitable papers to review. Instead of keyword searching, we searched all papers within certain journals. We provide an appropriate method to investigate the main topics on which a journal focuses. Even though the research themes that journals cover are available through their official homepage, there are still preferences among different journals. Thus, this method

helps researchers to find a suitable journal for submitting their research papers. It also helps academic institutions select appropriate journals for their various needs.

Despite these advantages, there are still three limitations associated with this study. First, the samples are from six e-commerce concerning journals, and these papers are only a small fraction of the e-commerce field. Nonetheless, they represent the major research focus to some degree. Moreover, some other outstanding papers from management information system journals such as *MIS Quarterly* are still not included in this study. We are also planning to use "e-commerce" as keywords for searching papers from other journals to enlarge our sample size in future studies. Secondly, CiteSpace cannot process the information of both citing papers and cited papers directly, therefore the detail of some important articles are analyzed and interpreted manually which is a time-consuming and relatively fallible procedure. Further, CiteSpace is limited to predict future research trends. Future research may consider big data analytics to predict research trends in the e-commerce field. Third, the information provided by both Web of Science and CiteSpace is just the abstract rather than the entire article, so this may result in loss of critical detail. Finally, this current research is still in its initial stage. The relationships among nodes need to be uncovered, and deeper analyses need to be conducted using a systematic review analysis in the future. These limitations are the problems that can be solved in further studies.

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