A Global Trend of the Electronic Supply Chain Management (e-SCM) Research: A Bibliometric Analysis

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***Abstract*— Research about electronic supply chain management (e-SCM) has been initiated on 2000, during the advancement of the internet and the information and communication technology (ICT). Since then, e-SCM attracted the attention of many researchers and various studies were conducted. This study aims at drawing the trends of the e-SCM research using bibliometric analysis of all the up to date e-SCM publications that has been indexed in Google Scholar and offer some research ideas in e-SCM. E-SCM related keywords have been used to search in the Google Scholar database. Analysed parameters include year of publication, publication type, language of publication, citation analysis, title analysis, and authorship patterns. The findings show that the first publication on e-SCM was in 2000 and the e-SCM publications reached its peak during 2009. Journal articles type is the most common type that has been published compared to conference paper and other publication types. English language is the dominant publication language. Three publications on e-SCM have been cited more than 100 times. This study also found that the word "analysis" and "study" are the common words used in the title of the publications and most of the publications in e-SCM have been written by a single author.**

***Keywords*—** *Electronic Supply Chain Management, e-SCM, Bibliometric Analysis*

1. Introduction

The term Supply Chain Management (SCM) is believed to be first introduced by Keith Oliver [1]. According to Peter J. Metz [2], "SCM is a process oriented, integrated approach to procuring, producing and delivering products and services to customers which includes sub-suppliers, suppliers, internal operations, trade customers, and end-users." With the advancement of the internet and the information and communication technologies (ICT), and currently the fourth industrial revolution (IR 4.0), the perception of SCM is always deal with the integration with these technologies. According to Arthi Ramesh [3], "Technologies such as the Internet, electronic, data interchange, transportation and warehouse management software, including software that manages plant scheduling, demand forecasting, procurement, makes SCM a resourceful strategy to adopt." Internet as well as IR 4.0 has changed the SCM to an e-enabled or electronic SCM (e-SCM) where it has transformed all the traditional methods and processes in SCM into automated or electronic technologies. The integration in the context of e-enabled activities and SCM in this paper is referred to as e-SCM.

Given the development of e-SCM and its impact on research and business, our inspiration of this study is to provide the trend of the e-SCM research globally. The aim of this paper is to analysis the statistical trends on the e-SCM research to identify areas and directions for future work. In this paper, we explored the trends and patterns of e-SCM research by means of bibliometric and historical reviews since 2000, when the first document on e-SCM was published, until May 2018.

This paper is organized as follows. Section 2 covers the background of the nature of e-SCM and the related studies on SCM that have been conducted using bibliometric analysis. Section 3 presents a descriptive analysis of the research methodology used in this study, while Section 4 provides the detailed findings from analysing the data obtained. Section 5 outlines the concluding

remarks, sets out the research limitations and provides suggestions for future research.

2. Literature Review

Over the last decade, internet and ICT became the must have tools to be implemented in various sectors and industries especially in supply chain management in manufacturing businesses. The e-SCM growing field has been investigated, discussed and presented in various publications including journal articles. According to Pulevska-Ivanovska and Kaleshovska [4], "e-SCM is a new dimension derived from the former SCM concept and developed as a result of the evolution of the information technologies as well as reengineering of the organizations' business processes towards partners cooperation enabled by the Internet." Additionally, Giménez and Lourenço [5], defined e-SCM "as the impact that the internet has on the integration of key business processes from end-user through original suppliers that provides products, services and information that add value for customers and other stakeholders."

With the force of the IR4.0 the focus turned to be not just on Internet and ICT but more on the advanced technology such as big data, artificial intelligence, robotics, internet of things and quantum computing. The implementation of those technologies in SCM will become more challenging. Within the academic and research community, one particular challenge is to predict and guide the direction of the e-SCM research in the near future. Prior to that, it is important to understand the global development of e-SCM for better vision and understanding of its nature, growth and trend that is the specific aim of this paper.

This study investigates the trend of e-SCM research using bibliometric analysis. Bibliometric analysis is the quantitative study of bibliographic materials that provides a general picture of a specific research field that can be classified by papers, authors and journals [6]. There are a few studies that have been conducted on the area of general SCM such as Kumar and Kushwaha [7], Kumar [8], Arantesa, Leiteb and Bornia [9], Santos, Benito and Lannelongue [10], Charvet, Cooper, and Gardner [11]; supply chain integration by Asgari, Abdul Hamid, and Aleebrahim [12]; green SCM by Fahimnia, Sarkis and Davarzani [13] and Maditati, Munim and Schramm [14]; SCM in innovative industry by González-Benito, Lannelongue and Alfaro-Tanco [15], optimization in SCM by Movahedipour, Yang, Zeng, Wu and Salam, [16] and big data and SCM by Mishra, Gunasekaran, Papadopoulos, and Childe [17]. There is also a thesis that has been conducted by West [18] that review the articles on e-SCM from 1998 to 2009. There are however, no recent study that explores the area of e-SCM. Thus, this study provides the current global research trend of e-SCM.

3. Research Methodology

The list of publications has been obtained through Google Scholar search engine as at 31st May 2018 using Google Chrome browser. This study focuses only on the publications that clearly state the word "e Supply Chain Management" or "e SCM" or "Electronic Supply Chain Management" in its title. Thus, the keywords: "e Supply Chain Management" OR "e SCM" OR "Electronic Supply Chain Management" were used to search the title of the publication from the Google Scholar database with the option to exclude the patents and citations. Based on the search, 344 results were obtained in 0.22 seconds. All the publications were imported into Mendeley using Mendeley Importer, an extension that has been embedded into Google Chrome. Then, the publications have been thoroughly reviewed and cleaned-up using Mendeley Desktop software. After removing all the duplicates and the irrelevant publications, 238 publications were available for further analysis.

Journal articles, conference papers, theses, books, book chapters, general manuscripts and reports were obtained from the results of the search for publication type. The lecture and power point notes were excluded from this study. The number of citations also was obtained from the Google Scholar and ranked accordingly.

4. Results and Discussion

The publications obtained were analysed according to their year of publication, type of publication, most frequently cited publications, text analysis of publications' titles and number of authors.

4.1 Year of Publication

The initial frequency analysis provides an overview of the research on e-SCM published according to the year of publication. It was found that the e-SCM research started in the year 2000, when the use of internet and ICT have been increased. Four articles were published on that year. All four articles are from Korea and published in Korean language [19], [20], [21], [22]. Most of the papers published on e-SCM were in 2009 with a total of 23 publications representing 9.7% of the total publications. The summary of the finding can be seen on Table 1.

Table 1. Year of Publication

Year	Frequency	Percent	Cumulative Percent
2000	4	1.7	1.7
2001	4	1.7	3.4
2002	6	2.5	5.9
2003	6	2.5	8.4
2004	13	5.5	13.9
2005	12	5.0	18.9
2006	13	5.5	24.4
2007	16	6.7	31.1
2008	22	9.2	40.3
2009	23	9.7	50.0
2010	9	3.8	53.8
2011	12	5.0	58.8
2012	19	8.0	66.8
2013	22	9.2	76.1
2014	16	6.7	82.8
2015	9	3.8	86.6
2016	21	8.8	95.4
2017	9	3.8	99.2
2018	2	0.8	100.0
Total	**238**	**100**	

4.2 Type of publications

The distribution of publication type identified by Google Scholar was analysed. From this analysis, 7 publication types were found. The journal article was the most-frequently used type comprising 48.7% (116) of the total publications, followed distantly by conference paper (47; 19.7%) and thesis (44; 18.5%). Book chapter (15; 6.3%), book (7; 2.9%), general manuscript (7; 2.9%), and report (2; 0.8%) showed much-lesser significance than journal articles, conference paper and thesis (see Table 2).

Table 2. Type of Document

Type of Publication	Frequency	Percent
Journal Article	116	48.7
Conference Paper	47	19.7
Thesis	44	18.5
Book Chapter	15	6.3
Book	7	2.9
General Manuscript	7	2.9
Report	2	0.8
Total	**238**	100.00

Crosstabulation was also conducted based on the year of publication and publication type of e-SCM research. Table 3 shows the results of the distributions. While the journal article is the most common publication type, it can be seen from the table that most of the journal articles were in 2012 representing 13 of the total publication on e-SCM.

Table 3. Year and Type of Document of e-SCM

Year	Book	Book Chapter	Conference Paper	Journal Article	General Manuscript	Report	Thesis	Total
2000	0	0	2	1	0	1	0	4
2001	1	1	1	1	0	0	0	4
2002	0	0	2	3	0	0	1	6
2003	0	0	3	3	0	0	0	6
2004	1	1	4	4	3	0	0	13
2005	0	1	5	4	0	0	2	12
2006	0	1	5	4	0	0	3	13
2007	1	0	5	8	0	0	2	16
2008	1	2	3	9	0	0	7	22
2009	0	2	5	10	3	0	3	23
2010	0	0	1	6	0	0	2	9
2011	0	2	2	6	1	0	1	12
2012	0	0	1	**13**	0	0	5	19
2013	2	2	1	9	0	1	7	22
2014	0	1	2	9	0	0	4	16

2015	0	1	1	7	0	0	0	9
2016	1	1	4	11	0	0	4	21
2017	0	0	0	6	0	0	3	9
2018	0	0	0	2	0	0	0	2
Total	**7**	**15**	**47**	**116**	**7**	**2**	**44**	**238**

4.3 Language of Publication

Eleven languages were identified from the e-SCM research that has been published since the year 2000. The languages in which the publications were presented were dominated by English (133; 55.9%) followed distantly by Indonesian (47; 19.7%), Korean (29; 12.2%), and Chinese (10; 4.2%). The rest of the languages have less than 10 publications as summarised in Table 4.

Table 4. Language of Publication

Language	Frequency	Percent
English	133	55.9
Indonesian	47	19.7
Korean	29	12.2
Chinese	10	4.2
German	5	2.1
Japanese	5	2.1
Spanish	3	1.3
Arabic	2	0.8
Greek	2	0.8
Croatian	1	0.4
Portuguese	1	0.4
Total	**238**	100.00

4.4 Citation Analysis

We also analysed the publications based on the number of citations that have been identified by Google Scholar. According to Zhao and Strotmann [23], "citation represents the citing author's use of the cited work and indicates an influence of the cited work on the author's new work, and as such a flow of knowledge from the cited to the citing works' authors". Citation analysis is frequently used to evaluate or compare articles or journals [11]. Table 5 shows the top 20 cited publications in e-SCM. As evidenced in the tables, paper by Ross [29], Ke et al. [25], Bayraktar et al. [26], Wu and Chuang [27] and Wu and Chang [28] are the top five articles cited based on the total citation. Based on the citation per year, paper by Ross [24] still become the top cited paper, while paper by Lin [29] and Wu and Chang [27] become second and third top cited paper respectively.

Table 5. Top 20 Cited Documents in e-SCM

Title	Year	Author(s)	Publication	Total Citation	Citation per Year
Introduction to e-supply chain management: engaging technology to build market-winning business partnerships	2016	DF Ross [24]	CRC Press	157	80.5
How do mediated and non-mediated power affect electronic supply chain management system adoption? The mediating effects of trust and institutional pressures	2009	W Ke, H Liu, KK Wei, J Gu, H Chen [25]	Decision Support Systems 46 (4), 839-851	155	17
The role of forecasting on bullwhip effect for E-SCM applications	2008	E Bayraktar, SCL Koh, A Gunasekaran, K Sari, E Tatoglu [26]	International Journal of Production Economics 113 (1), 193-204	124	12.5
Examining the diffusion of electronic supply chain management with external antecedents and firm performance: A multi-stage analysis	2010	L Wu, CH Chuang [27]	Decision support systems 50 (1), 103-115	81	10.25
Using the balanced scorecard in assessing the performance of e-SCM diffusion: A multi-stage perspective	2012	L Wu, CH Chang [28]	Decision Support Systems 52 (2), 474-485	80	13.33
Understanding the determinants of	2014	HF Lin [29]	Technological	77	20

Title	Year	Author(s)	Publication	Total Citation	Citation per Year
electronic supply chain management system adoption: Using the technology–organization–environment framework			Forecasting and Social Change 86, 80-92		
A framework of E-SCM multi-agent systems in the fashion industry	2008	WS Lo, TP Hong, R Jeng [30]	International Journal of Production Economics 114 (2), 594-614	72	7.2
e-SCM: internet's impact on supply chain processes	2008	C Giménez, HR Lourenço [31]	The International Journal of Logistics Management 19 (3), 309-343	63	6.3
Analyzing contextual antecedents for the stage-based diffusion of electronic supply chain management	2009	L Wu, CH Chuang [32]	Electronic Commerce Research and Applications 8 (6), 302-314	41	4.67
E-supply chain management: Review, implications and directions for future research	2004	C Giménez, H Ramalhinho-Lourenço [33]	UPF Economics and Business Working Paper 769	39	2.86
E-supply-chain-management	2004	HH Wannenwetsch, S Nicolai [34]	Gabler, Wiesbaden	39	2.71
E-supply chain management: an evaluation of current web initiatives	2006	S Lancaster, DC Yen, CY Ku [35]	Information Management & Computer Security 14 (2), 167-184	36	3
E-Supply-Chain-Management: Grundlagen—Strategien—Praxisanwendungen	2013	HH Wannenwetsch, S Nicolai [36]	Springer-Verlag	34	7
Electronic supply chain management applications by Swedish SMEs	2007	HM Beheshti, M Hultman, ML Jung, RA Opoku, E Salehi-Sangari [37]	Enterprise Information Systems 1 (2), 255-268	32	3
Integrating EDI with an E-SCM system using EAI technology	2005	M Wang, S Zhang [38]	Information Systems Management 22(3), 31-36	28	2.15
Information technology and collaboration tools within the e-supply chain management of the aviation industry	2008	A Nucciarelli, M Gastaldi [39]	Technology Analysis and Strategic Management 20 (2), 169-184	26	2.6
A hybrid approach using AHP-TOPSIS for analyzing e-SCM performance	2014	M Tyagi, P Kumar, D Kumar [40]	Procedia Engineering 97, 2195-2203	19	4.75
Developing an enterprise simulator to support electronic supply-chain management for B2B electronic business	2004	NKH Tang, H Benton, D Love, P Albores, P Ball, J MacBryde, N Boughton, P Drake [41]	Production Planning & Control 15 (6), 572-583	19	1.36
Key success factor analysis for e-SCM project implementation and a case study in semiconductor manufacturers	2013	BN Hwang, T Lu [42]	International Journal of Physical Distribution & Logistics Management 43 (8), 657-683	17	3.4
E-logistics and e-supply chain management: Applications for evolving business	2013	D Graham, I Manikas, D Folinas [43]	IGI Global	17	3.6

4.5 Word Cloud and Text Analysis of the Document Titles

We also have generated the word cloud analysis for the title of the article using WordSift (wordsift.org), an online application that helps to quickly identify important words that appear in the text. With 200 maximum number of words and n scale setting, the result of word cloud can be seen as per Figure 1. Apart from the keywords that we used in the search engine to find the articles about

e-SCM, there were other words that have been used within the title of the document. It can be seen from the word cloud the stand out words include analysis, study, design, case, system, industry and performance. Table 6 also summarized the frequency of top 20 words based on the title of the papers sorted according to rank.

Figure 1. Word Cloud Analysis

Table 6. Frequency and Top Words

Word	Frequency	Percent (%)
analysis	49	2.41
study	48	2.36
design	39	1.92
case	27	1.33
system	26	1.28
industry	23	1.13
performance	20	0.99
factors	18	0.89
business	17	0.84
implementation	15	0.74
based	13	0.64
strategy	13	0.64
adoption	12	0.59
development	12	0.59
using	12	0.59
success	12	0.59
model	12	0.59
framework	11	0.54
chain	11	0.54
enterprises	10	0.49

4.6 Number of Author

This paper also analyses the total number of authors for each e-SCM publication. Table 7 summaries the results. It is found that most of the publications (96; 40.3%) have been written by a single author. The total highest number of authors is eight.

Table 7. Number of Author(s)

Number of Author(s)	Frequency	Percent	Cumulative Percent
1	96	40.3	40.3
2	63	26.5	66.8
3	48	20.2	87
4	15	6.3	93.3
5	12	5	98.3
6	2	0.8	99.2
7	1	0.4	99.6
8	1	0.4	100
Total	**238**	**100**	

5. Conclusions

This study presented the global trend of e-SCM research since 2000. A bibliometric analysis has been conducted on all the e-SCM publications such as journal articles, conference papers, theses, books, book chapters, general manuscripts and reports that have been indexed in Google Scholar.

The findings show that the e-SCM publications were most published in 2009. Journal articles was the most publication type that has been published representing almost 50% of the total of the e-SCM publications. English was the dominant language. Papers by Ross [24] is the most cited articles in term of both number of citations and average per year.

There are a few limitations of this study. Firstly, this study only used Google Scholar as source of the publications that have been indexed in the database. Some of the publications which are not indexed in the Google Scholar database were not considered for the analysis although they were possibly can be obtained from the normal google search engine. It is recommended that the other database such as Scopus and Web of Science to be used for future research. Secondly, this study only presented the bibliometric analysis of the publications that have been obtained. Further studies may include other types of relevant analysis such as literature review, historical analysis, meta-analysis and structured analysis.

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