ICIC Express Letters
Volume **13**, Number **10**, October **2019**

 ISSN 1881-803X
pp. **913–920**

THE LATEST ADOPTION BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT: A SYSTEMATIC LITERATURE REVIEW

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Received March 2019; accepted June 2019

Abstract. *Supply Chain Management (SCM) has been an invigorating research topic because the industry requires it to improve service, revenues and cost reduction. In this context, Technology Industry 4.0 is used in SCM as a driver of the IoT, robots, sensors that benefit for the acceleration process. In this frame, Technology Industry 4.0 is incorporated with Blockchain in SCM to obtain innovation solutions. Therefore, the aim and novelty of this study become a preliminary point for future research of adoption Blockchain technology in SCM. At a closer look, the research tries to elaborate on essential factors of Blockchain adoption in SCM. The research methodology used a Systematic Literature Review (SLR). The preceding research papers are retrieved from seven reputable publishers and 40 research-related journals that are related to the contemporary situation of Blockchain technology adoption in SCM. Ultimately, 48 critical factors are obtained for the adoption of Blockchain in SCM.*

Keywords: SCM Blockchain, SCM systematic literature review, Adoption Blockchain in SCM, Blockchain systematic literature review

1. **Introduction.** The Blockchain is renowned for cryptocurrency Bitcoin. Bearing in mind, the development of Blockchain with smart contract feature makes Blockchain may be adopted for enterprise systems such as SCM [1,2]. Several research reported such as in automotive industry for tracking genuine part [3,4], monitoring shipping container [5], performance and food traceability [6]. However, the report does not reflect the latest global picture adoption of Blockchain in SCM, where it required to start for future research which uses Design Science Research (DSR) methodology [7]. Therefore, this research tries to elaborate the latest adoption of Blockchain technology in SCM by using Systematic Literature Review (SLR) methodology. The SLR is divided based on three key success factors/framework of SCM which are People, Process and Technology Framework (PPTF) [8]. Per this viewpoint, the PPTF is used to map the crucial factors adoption of Blockchain in SCM. In consonance of the study, the SLR method [9] is used to collect data, find the contemporary research status of Blockchain adoption, and elaborate the factors. The literature delved in seven publishers and result of a total of 441 sorts of literature. Based on the literature studies, it matches with 40 literature and 48 important factors. Figure 1 exhibits the research design. It confirmed that the research plots are arranged with

DOI: 10.24507/icicel.13.10.913

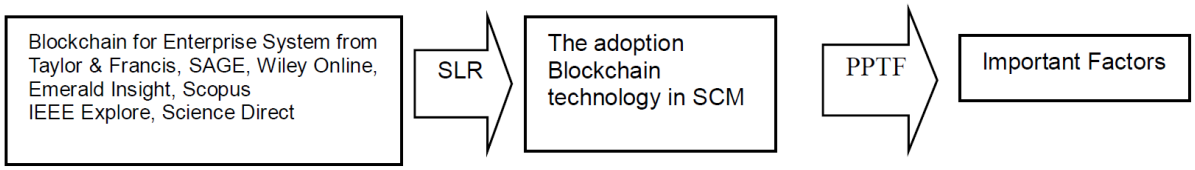

FIGURE 1. Research design

an introduction, literature review, research methodology, result & discussion, research implication, conclusion and future research eventually.

2. Literature Review.

Definition 2.1. Supply Chain Management

The supply chain is an integrated management process among several business entities such as suppliers, retailers, manufacturers and distributors who work together to process raw materials processed into a product and then distributed to retailers [10].

Definition 2.2. Blockchain

The Blockchain is a novel technology. The first published paper was initiated by a person or a group named Nakamoto in 2008 [11]. In its inception, Blockchain was used only for financial transaction applications titled Bitcoin in 2008 [12]. It is famed for Blockchain version 1.0 [1]. In its development with the feature of Smart Contract, it enables Blockchain not only can be used for financial transactions but also enterprise systems such as supply chain management [1].

Definition 2.3. The Process, People, and Technology Framework (PPTF)

The essential aspects of the implementation of an information system in the industry are people, process, and technology [8]. People are the actors in the business and the organization; the process is a business activity that should be done by the worker (people), and technology is a facility that uses within the organization.

Definition 2.4. The Systematic Literature Review (SLR) Method

The use of SLR will facilitate the search for important factors in the discussion for the adoption of Blockchain in SCM. In this point, it will become the basis for further development of research. Therefore, this method served as a reference to any discussion of factors, as well as characteristics such as the year of publication, institutional background, and country [9].

Definition 2.5. Design Science Research (DSR)

DSR is a method for information system research consisting of three principles, i.e., the research should be consistent with early reported research, using nominal process model, and a mental model for present and evaluation of the research [7].

3. Research Methodology.

In the searching process, it includes two keywords, i.e., "Supply Chain" and "Blockchain". The papers select within the past five years. The purpose is to look for related those topics to previous research publications. In this respect, the search is conducted at reputable journal such as Taylor and Francis, Emerald, Wiley Online, IEEE Explore, Sage, Science Direct (Elsevier), Scopus. In the process, four hundred and fourty-one documents are found, and 285 and 116 documents are eliminated for duplication, irrelevant, and unmatched topic respectively. In the topic selection process, the study acquired 156 candidate documents. In this scope, this research solely dissects on 40 selected documents for further discussion. Figure 2 describes the step of the sequential processes.

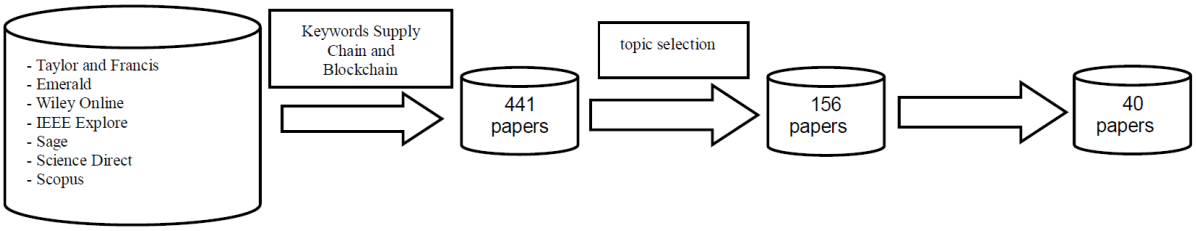

FIGURE 2. Systematic literature review sequential processes

4. **Result and Discussion.** This session will discuss the ultimate status of adoption Blockchain technology in SCM & important factors found with a characteristic or background such as the year of publication, the discussion factor, and types of publication (journal, conference, or symposium).

4.1. **Year period of data characteristic.** As stated in various studies, Industry 4.0 is formally announced in 2014 [13]. In this corridor, relaunching of Ethereum smart contracts was available in the third quarter of 2015 [1]. In this sense, the time had recorded no publication of the Blockchain research in 2013-2015. In interesting research during 2016-2018, the study revealed one publication (2%), 27 publications (68%), and 12 publications (30%) consecutively. For this data, the study collected 40 papers.

4.2. **Type of documents characteristic.** The types of publications are collected from 20 journals, 11 conferences, and two symposiums. Table 1 described the detail of paper publication types.

4.3. **The impact of Blockchain technology in SCM.** Table 2 recapitulated the Blockchain adoption in the SCM area.

Provenance and tracking in logistics and distribution are the most popular topics discussed. Following that, Blockchain of IoT to support the operation, systems/apps, and knowledge sharing and integrations in operation contributed significantly. The last, Blockchain used for supporting the operation.

4.4. **The important factors.** The research obtained 48 important factors in 40 documents. The dominant factors found are traceability and immutable history (26 document (65%)) (e.g., food logistic monitoring [6]). At the second place, the topic of authenticity, provenance, validity (e.g., product authentic, validity and provenance [26]) and decentralization factors (e.g., food supply logistic [17]) comprised 24 papers (60%). Security, tamper-proof, transparent, and visibility factors (e.g., food supply information [17]) are in the third order with 23 papers (57.5%). Subsequently, information sharing and communication contributed 20 papers (50%) (e.g., for food tracing [18]). At last, trust and collaborate consisted of 18 documents (45%). Table 3 exhibited the important factors.

4.5. **Process, People, and Technology Framework (PPTF).** PPTF is a prominent factor in SCM [8]. Figure 3 delineated the conclusion as referred to Table 3 which summarized the linkage of each factor to PPTF.

4.6. **Data characteristic author per country and institution.** The author profiles involved 116 authors from 20 countries, i.e., 27 from USA (23.28%), 23 from China (19.83%), 10 from Taiwan (8.62%), 7 from Germany and UK (6%), 6 from Hong Kong & Switzerland (5.17%), 5 from Austria (4.31%), 4 from Japan and South Korea (3.45%), 3 from Belgium (2.58%), 2 authors respectively from Australia, Canada, Denmark, Russia and Spain (1.72%) and 1 author consecutively from Greece, Hungarian, Turkey and UAE (0.8%).

Table 1. Types of paper publication

Types	Journal/Conference/Symposium Description	Papers	Papers %
Journal	Industrial Management and Data Systems	3	7.5%
Journal	Strategic Change Briefings in Entrepreneurial Finance, Special Issue: The Future of Money and Future Application on the Blockchain	3	7.5%
Journal	Future Generation Computer Systems	2	5%
Journal	IEEE Access	2	5%
Journal	Intelligent Systems in Accounting, Finance, and Management	2	5%
Conference	2016 13th International Conference on Service Systems and Service Management (ICSSSM)	1	2.5%
Conference	2017 IEEE 19th Conference on Business Informatics	1	2.5%
Symposium	2017 IFIP/IEEE International Symposium on Integrated Network Management (IM2017)	1	2.5%
Conference	2017 International Conference on Service Systems and Service Management	1	2.5%
Symposium	The 28th DAAAM International Symposium on Intelligent Manufacturing and Automation	1	2.5%
Conference	The 37th International Conference on Distributed Computing Systems Workshops	1	2.5%
Conference	The 3rd International Conference on Big Data Computing and Communications	1	2.5%
Journal	Asia Pacific Journal of Innovation and Entrepreneurship	1	2.5%
Journal	Business & Information Systems Engineering	1	2.5%
Journal	Expert Opinion on Drug Safety	1	2.5%
Journal	IMP Journal	1	2.5%
Journal	Information	1	2.5%
Conference	International Conference on Electrical Engineering and Computer Science (ICEECS) 2017	1	2.5%
Conference	International Conference on Security with Intelligent Computing and Big-data Services	1	2.5%
Journal	International Journal of Crowd Science	1	2.5%
Journal	International Journal of Environmental Research and Public Health	1	2.5%
Journal	International Journal of Information Management	1	2.5%
Journal	International Journal of Operations and Production Management	1	2.5%
Journal	International Journal of Physical Distribution & Logistics Management	1	2.5%
Journal	Journal of Business Logistics	1	2.5%
Journal	Journal of Computer Science and Technology	1	2.5%
Journal	Journal of Purchasing and Supply Management	1	2.5%
Conference	OZCHI'17 Proceedings of the 29th Australian Conference on Computer-Human Interaction	1	2.5%
Conference	Proceedings of the 2017 IEEE IEEM	1	2.5%
Journal	Review of International Business and Strategy	1	2.5%
Conference	The 15th Global Conference on Sustainable Manufacturing	1	2.5%
Conference	The 14th IEEE International Conference on e-Business Engineering	1	2.5%
Journal	The International Journal of Logistics Management	1	2.5%
	Total	40	100%

TABLE 2. Blockchain adoption in SCM

SCM	Blockchain for	References	Papers	Papers %
Logistic & Distribution	Tracking provenance,	[14], [15], [16], [17], [18], [6], [3], [19] [20], [21], [5], [22], [23], [24], [25], [26]	16	40%
	Purchasing	[27]	1	2.5%
	Visibility Distribution	[28]	1	2.5%
Operation	IoT Enable	[29], [30], [31], [32], [33], [34]	6	15%
	Decision Making	[35]	1	2.5%
	Knowledge Sharing	[36], [37], [38]	3	7.5%
	Security	[39]	1	2.5%
	Integration	[40], [41], [42]	3	7.5%
	Quality/Performance	[43], [44]	2	5%
Other	System/Apps	[45], [46], [47], [48], [49], [50]	6	15%
		Total	40	100%

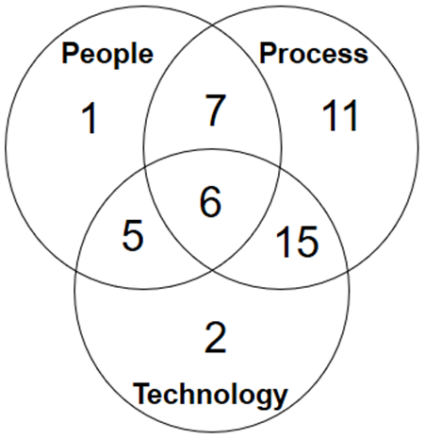

FIGURE 3. Linkage of factor into people, process, and technology framework

The author's institutional background and the major institutions that focused on research adoption of the Blockchain in SCM encompassed 54 authors (90%) from University and six authors (10%) from the non-university institution.

5. **Research Implication and Limitation.** The research implication limitation is associated with a limited number of six publishers and one Scopus-indexed source in English. Similarly, the literature access to several international journal providers is restricted. Based on the research report, the new technology can be implemented to trace logistic, improve the performance, reduce cost, increase safety & healthy, share information, and increase the quality of the product. All important factors found in this research could use for the development of SCM with the adoption of Blockchain technology.

6. **Conclusion and Future Research.** Blockchain's main capabilities listed in the most research topics along with 48 important factors found in SCM. PPTF plays a vital role in the implementation phase. This research supports the academics for future research and future validation research that allows a quantitative approach based on important factors found.

TABLE 3. The important factors

No	Factors	People	Process	Technology	References	Papers	Papers %
1	a. Traceability b. Immutable history		X X	X X	[5], [6], [26], [17], [18], [14], [45], [37], [40], [43], [16], [33], [44], [41], [46], [34], [19], [20], [47], [21], [28], [22], [23], [48], [49], [42]	26	65%
2	a. Authenticity b. Provenance c. Validity		X X X		[3], [5], [26], [17], [45], [37], [40], [43], [16], [33], [34], [20], [47], [21], [28], [22], [23], [48], [49], [42], [35], [30], [39], [31], [25]	25	62.5%
3	Decentralization	X	X	X	[5], [6], [17], [14], [45], [37], [40], [43], [44], [46], [34], [19], [20], [47], [23], [49], [39], [25], [29], [36], [27], [32], [38], [24]	24	60%
4	a. Security b. Tamper proof			X X	[6], [17], [18], [14], [45], [37], [43], [16], [33], [44], [46], [34], [20], [47], [21], [22], [23], [48], [49], [42], [39], [25], [29]	23	57.5%
5	a. Transparent b. Visibility	X X	X X	X X	[3], [5], [6], [17], [45], [37], [40], [16], [33], [44], [41], [20], [21], [28], [22], [23], [49], [42], [35], [39], [29], [32], [24]	23	57.5%
6	a. Information sharing b. Communication	X X	X	 X	[6], [3], [14], [45], [37], [40], [16], [44], [46], [19], [47], [21], [22], [39], [31], [29], [36], [27], [38], [24]	20	50%
7	a. Trust b. Collaborate	X X	 X	X X	[6], [43], [16], [33], [44], [17], [21], [28], [23], [48], [49], [42], [39], [25], [29], [27], [32], [24]	18	45%
8	Cost		X		[3], [5], [44], [41], [34], [19], [47], [28], [22], [48], [39], [25], [36], [27], [32], [24]	16	40%
9	a. Identity b. Privacy	X X		X X	[3], [5], [40], [44], [34], [20], [21], [28] [23], [49], [42], [25], [39], [32]	14	35%
10	a. Efficiency b. Effective		X X	X X	[5], [18], [37], [40], [16], [41], [19], [47], [21], [48], [25], [36], [32], [15]	14	35%
11	Risk	X	X	X	[3], [5], [6], [37], [34], [20], [47], [22], [23], [35], [30], [29], [32], [38]	14	35%
12	Integration		X	X	[14], [45], [37], [40], [47], [22], [21], [35], [30], [39], [32], [50]	12	30%
13	Consensus	X	X		[5], [18], [37], [40], [43], [33], [20], [21], [28], [23], [48], [29]	12	30%
14	Safety	X			[6], [17], [18], [43], [16], [46], [20], [21], [22], [29], [32]	11	27.5%
15	a. Delivery b. Distribution	X X	X X		[3], [5], [19], [21], [28], [22], [42], [25], [32], [50]	10	25%
16	Reliability			X	[37], [40], [16], [41], [46], [47], [23], [30], [32], [15]	10	25%
17	Quality		X	X	[3], [6], [5], [17], [16], [44], [21], [22], [35], [32]	10	25%
18	Time/Speed of process		X	X	[5], [16], [41], [28], [22], [30], [39], [27], [32], [38]	10	25%
19	External factor	X		X	[17], [16], [20], [22], [48], [49], [42], [35], [30], [24]	10	25%
20	Relationship with supplier & customer	X	X		[5], [40], [47], [28], [22], [30], [39], [27], [32], [15]	10	25%
21	a. Product variety b. Availability		X X		[3], [5], [16], [46], [19], [28], [42], [35], [32]	9	22.5%
22	Service		X		[16], [33], [42], [30], [39], [31], [36], [27], [15]	9	22.5%
23	Accurately		X	X	[5], [17], [16], [23], [49], [42], [27], [32]	8	20%
24	Scalability		X	X	[6], [14], [43], [20], [23], [30], [29], [36]	8	20%
25	Flexibility			X	[5], [46], [30], [36], [32], [15]	6	15%
26	Innovation			X	[5], [6], [20], [22], [23], [48]	6	15%
27	Automation		X	X	[33], [34], [49], [30], [24]	5	12.5%
28	Accessibility	X	X	X	[34], [20], [47], [22], [24]	5	12.5%
29	Asset		X		[5], [23], [30], [15], [31]	5	12.5%
30	Intelligence		X	X	[14], [37], [44], [32]	4	10%
31	Complexity		X		[3], [22], [30], [31]	4	10%
32	Price	X	X		[40], [35], [38]	3	7.5%
33	Value Add		X	X	[45], [21], [15]	3	7.5%
34	Accountability		X	X	[40], [27]	2	5%
35	3rd party	X			[5], [23]	2	5%
36	a. Stability b. Sustainability		X X	X X	[5], [30]	2	5%

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