

INDUSTRIES PIONEERING BLOCKCHAIN TECHNOLOGY FOR ELECTRONIC DATA INTERCHANGE

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Abstract: Rapid development of blockchain technologies promote involvement of methods using categorize research topics, identify the most topical trends, and ascertain the main publishing sources related to electronic data interchange. The study is based on an analysis of scientific publications (2015-2019 years) and investigation on the theory of supply chain and logistic the research is based on the theoretical research methods that include a literature review and content analysis. The authors have reviewed 9,780 primary papers published between the years 2015-2019 from major academic databases (EBSCO, Elsevier ScienceDirect, Emerald Insight, Scopus, SSRN; Springer SpringerLink, Web of Science). The results of the research are presented, which at the logistics position describing the usage of blockchain technology for electronic data interchange in multiple industries. In concluding the research, the authors present the research gaps discovered, major trends, most discussed industries and suggestions for future research.

1 Introduction

Blockchain technology is quite new; however, its potential for transforming multiple industries is already being noticed. According to Bernard Marr [1], you no longer need a company or central authority to facilitate a transaction of any kind. Blockchain has already found applications across multiple fields, such as healthcare, real estate, the legal industry, security, government, and the banking sector.

Gartner now forecasts that blockchain will generate an annual business value of over \$175 billion by 2025 and rise to over \$3 trillion by 2030. With this potential, business interest in blockchain has increased tremendously in the last two years [2].

As per PWC's latest survey [3], it's possible to imagine that 10-20% of global economic infrastructure will be running on blockchain-based systems by the year 2030.

The growing number of blockchain projects active in industries ranging from education to insurance services to telecom and the supply chain shows the quick adoption of this technology across a number of major domains of our everyday life [4-6].

Design/methodology/approach: the research is based on theoretical research methods, which include a literature review and content analysis.

The authors have reviewed 9,780 primary papers published between the years 2015-2019 from 7 major academic databases (Web of Science (WoS), EBSCO, Springer SpringerLink, Elsevier ScienceDirect, SSRN, Emerald Insight, Scopus).

2 What is Blockchain

Blockchain, in essence, is a distributed database [7]. Essentially this technology is a decentralized ledger that records every transaction made in the network, known as a 'block', the body of which comprises encrypted data of the entire transaction history [8]. The term 'blockchain' is closely associated with the term 'bitcoin'. But in fact, blockchain is a decentralized technology allowing one to store data securely. Bitcoin is just the first use case of blockchain technology implementation.

Blockchain simply combines cryptography, distributed system technology, peer-to-peer networking technology and other well-known technologies. Blockchain as well provides a secure framework for cryptocurrencies in which no one can tamper with the content of transactions and all the nodes participate in transactions anonymously. For this reason, blockchain technology can be widely used in various fields, e.g., finance, medical systems, the supply chain, and the Internet of Things (IoT) [9-11].

Blockchain is a decentralized system, without a single "command centre" which a hacker could attack and thus receive an opportunity to delete all data about transactions and their participants or replace them. All data about any transactions is stored and checked by participants of the blockchain network. To hack blockchain, it is necessary to control the majority of nodes involved in a particular blockchain network.

Authors think that blockchain has a great potential to revolutionise the process of Electronic data interchange due to the functionality of Smart Contracts.

Electronic data interchange (EDI) is a term that describes the means by which automatic, interorganizational computer-to-computer communication is facilitated [12]. Smart contracts, cryptographic "boxes" that contain value and only unlock it if certain conditions are met [13]. Smart contracts are indeed more technologically sophisticated than EDI. Smart contract scripting languages offer a broad range of operations and greater scalability. Firms' operational and financial infrastructures are digital. Smart contracts can directly interact with these systems, whereas EDI was ultimately reliant on human intermediaries [14].

Blockchain can store data about multiple commercial and non-commercial use cases related to electronic data interchange: financial transactions; commercial contracts; purchases of services and goods; transfer of confidential information; insurance; protection and transfer of property rights; personal data management; archiving of official documents; protection of intellectual property; supply chain and logistics.

3 Research methodology

The research object of the given study is blockchain technology.

Research aim

The objective of this study is to categorize research topics related to blockchain technology, identify the most topical trends, and ascertain the main publishing sources of research papers related to blockchain technology. The study is based on an analysis of scientific publications from 2015 to 2019.

The primary research tasks

The authors outlined the following research tasks:

- determine the main publishing sources of research papers related to blockchain technology
- name the top 25 authors in blockchain-related academic research
- identify current and past trends in blockchain-related academic publications
- establish the main research topics in the papers published between the years 2015-2019 from major academic databases

- indicate industries adopting blockchain technology for Electronic Data Interchange.
- draw conclusions and make recommendations for researchers

Research Questions

- What are the main publishing sources of research papers related to blockchain technology? (RQ 1)
- Who are the top 25 authors in blockchain-related academic research? (RQ 2)
- What are the trends in blockchain-related academic publications? (RQ 3)
- What are the main research topics and research gaps in the papers published between the years 2015-2019 from major academic databases? (RQ 4)
- What are the most discussed industries utilizing blockchain technology for Electronic Data Interchange? (RQ 5)

Research limitations

- The authors outlined the following research limitations:
- This research is based on secondary data.
- The authors aggregate articles from the following academic databases only: Web of Science, EBSCO, Springer SpringerLink, Elsevier ScienceDirect, SSRN, Emerald Insight, SCOPUS.
- All articles analyzed are written in English.
- There are no geographical limitations for the research.
- The authors utilized the methods of content analysis and machine learning to identify the main trends and topics.

This research is a systematic stand-alone literature review on the topic of blockchain technology applying grounded theory.

According to Fink, "a rigorous stand-alone literature review must be systematic in following a methodological approach, explicit in explaining the procedures by which it was conducted, comprehensive in its scope of including all relevant material, and hence reproducible by others who would follow the same approach in reviewing the topic" [15].

Following the concept of Fink [15] and grounded theory, the authors focused on utilizing methods that increase the reproducibility of the research: bibliometric analysis, keyword analysis and text mining.

In order to choose publications for this research, the authors carried out a keyword search based on the keyword "blockchain". This method was used in the articles of previous researchers [16-20]. Suitable articles were identified and downloaded by the authors to their database. The authors aggregated all the publications from 2015 to 2019 with the keyword "blockchain" from the major academic databases listed above. The following parameters of the selected articles were manually checked by the

authors in order to confirm that they met the criteria established for this research: title, abstract, keywords.

After the manual validation of the collected publications related to blockchain technology and exclusion of duplicates, the authors obtained a database of 9,780 publications for further analysis.

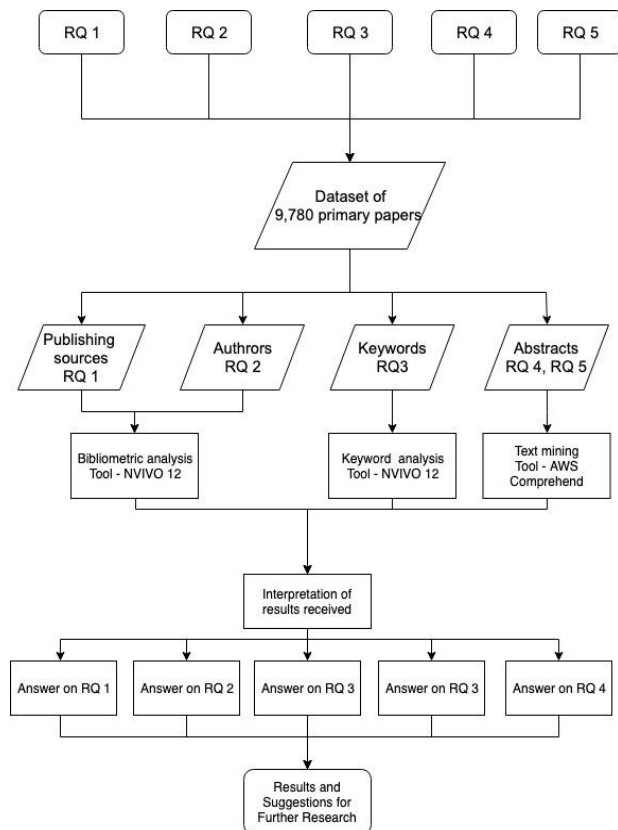


Figure 1 Conceptual model of Research

To answer research questions 1 and 2, the authors used the method of bibliometric analysis. To find the answer for research question 3, the authors used keyword analysis. Bibliometric analysis and keyword analysis were conducted using special software – NVivo 12 by QSR International [21].

NVivo is a qualitative data analysis software package widely used by researchers [22-26] and employs a word count and word cloud metric to find common themes between articles. As a result of the content analyses, a number of common themes were generated by NVivo 12.

To answer research questions 4 and 5, the authors applied the text mining method utilizing the technology of natural language processing powered by Amazon Comprehend. Amazon Comprehend is a natural language processing (NLP) service that uses machine learning to find insights and relationships in texts. Amazon Comprehend can be used to examine the content of a collection of documents to determine common themes. For example, you can provide Amazon Comprehend with a collection of articles on topics such as sports, politics, or

entertainment. Text in documents does not need to be annotated. “Amazon Comprehend uses a Latent Dirichlet Allocation-based learning model to identify topics in a set of documents. It checks each document to determine the context and meaning of the word. A set of words that often belong to the same context in the entire set of documents constitute a topic. A word is associated with a topic in a document based on how often the topic is in the document and how close the topic is to the word. The same word can be associated with different topics in different documents depending on the distribution of topics in a particular document” [27].

To identify major topics and indicate the most discussed industries for blockchain technology adoption, the authors downloaded the abstracts of all the articles from the database to Amazon Comprehend and utilized tool topic modelling [27]. After the data processing, the authors obtained word groups related to 100 topics and a list of articles related to every topic. As a next step, the authors reviewed the abstracts of articles related to every topic to identify similarities, formulate the names of topics and indicate the most discussed industries for blockchain technology adoption.

4 The main findings

Analysis of the database created by the authors based on the search with the keyword “blockchain” resulted in 9,780 publications; a breakdown by years is presented in Figure 1 and a breakdown by databases is presented in Figure 2.

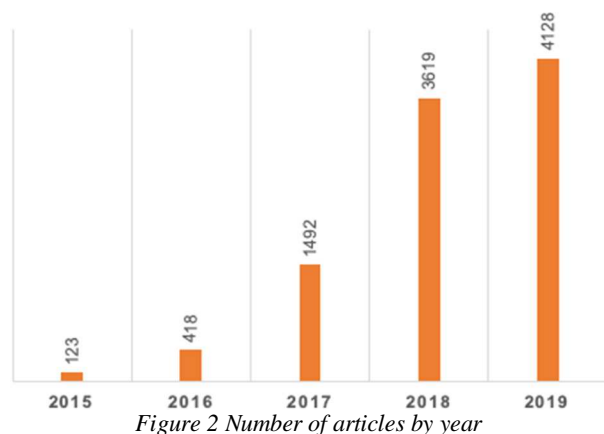


Figure 2 shows that the development of the interest in blockchain has promoted academic research and there is a breakthrough in 2017.

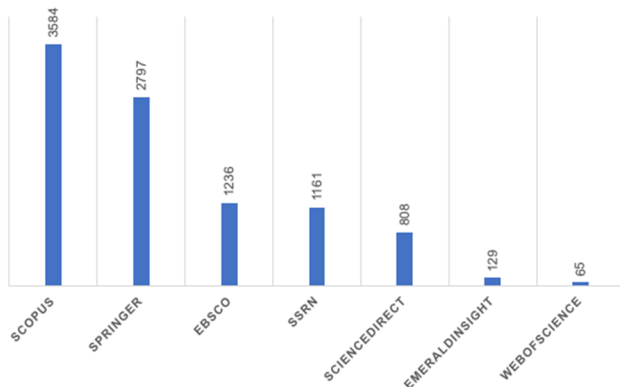


Figure 3 Number of articles by databases

Figure 3 shows that Scopus and Springer are the two main academic databases for articles on blockchain.

Research Question 1. What are the main publishing sources of research papers related to blockchain technology?

Further analysis of the database created by the authors led to the following findings on the main publishing sources for blockchain-related academic research (Table 1) and the top 25 journals publishing on the topic (Table 2).

Table 1 Distribution of sources 2015–2019

Source	Number of sources	Number of articles
Journal	1234	3837
Conference	1025	2693
Books	432	923
Research Paper	68	88
Workshop	102	385
Lecture Notes	9	141
Other	719	1067

Journals and conferences are the main sources of blockchain-related publications from 2015 to 2019.

Table 2 Top 25 journals (2015–2019)

Journals	Number of articles
IEEE Access	138
Future Generation Computer Systems	132
Economist	39
Sensors (Basel, Switzerland)	35
Advances in Intelligent Systems and Computing Journal	31
Journal of Medical Systems	31
Handbook of Blockchain, Digital Finance, and Inclusion	30
Applied Energy	29
Computer Journal	29
Computer Law & Security Review	29
Journal of Network and Computer Applications	29
IEEE Internet of Things Journal	28
Advances in Computers Journal	27
Information Sciences	27
International Journal of Information Management	27
IEEE Communications Magazine	24
Physica A: Statistical Mechanics and its Applications	24
International Journal of Recent Technology and Engineering	23
Security and Communication Networks	21
Computer Networks	20
Energy Procedia	20
IEEE Spectrum	20
New Scientist	20
Business Horizons	19
Communications of the ACM	19

Table 2 shows that IEEE Access and Future Generation Computer Systems are the leading journals for blockchain-related academic publications.

Research Question 2. Who are the top 25 authors in blockchain-related academic research?

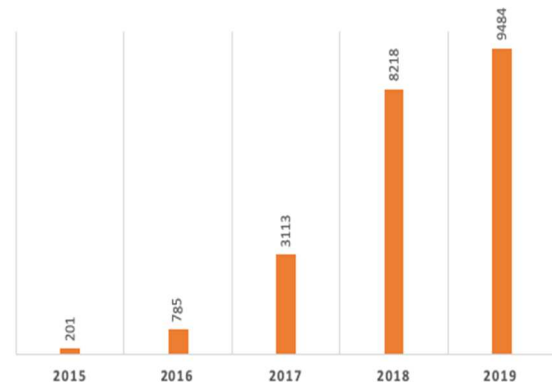


Figure 4 Number of authors by year

Figure 4 shows rapid growth in the number of authors publishing on blockchain-related topics; there is a breakthrough in 2017.

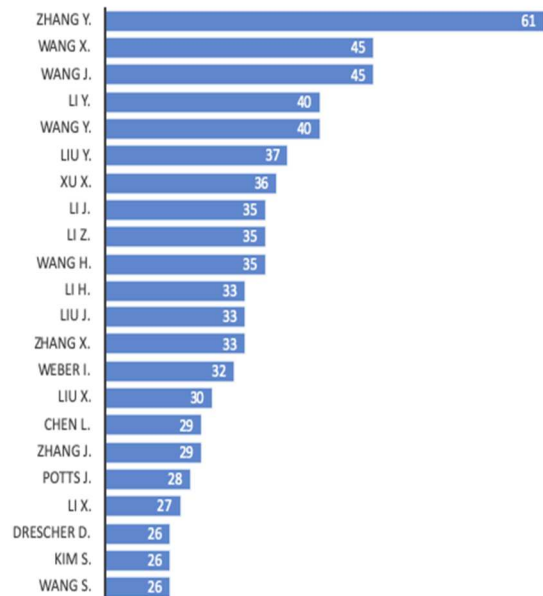


Figure 5 Top 25 authors (2015–2019)

As is evident from Figure 5, authors from Asian countries are the leaders in publishing articles related to blockchain.

Table 3 Top 25 authors from 2015–2019

2015		2016		2017		2018		2019	
Author	Number of Articles	Author	Number of Articles	Author	Number of Articles	Author	Number of Articles	Author	Number of Articles
Chuen D.L.K.	3	Hegadekatti K.	11	Drescher D.	26	Zhang Y.	37	Wang Y.	23
Ali S.T.	3	Hernandez P.	9	Swan M.	17	Wang X.	23	Wang J.	22
Bhaskar N.D.	3	De Filippi P.	6	Dannen C.	13	Li Z.	18	Li J.	20
Aron J.	2	Xu X.	5	Dhillon V.	12	Blakstad S.	17	Li Y.	19
Hanke T.	2	Potts J.	4	Hooper M.	12	Allen R.	17	Zhang Y.	19
Marsden C.	2	Li S.	3	Metcalf D.	12	Chen Y.	17	Weber I.	19
Peters G.W.	2	Holden J.	3	Hegadekatti K.	11	Wang H.	17	Wang X.	18
Decker C.	2	Kiayias A.	3	Chohan U. W.	9	Liu Y.	16	Liu Y.	17
Peters G.W.	2	Baert R.	3	Drucbert A.	8	Chen L.	15	Wang L.	17
Venegas P.	2	Irving G.	3	Abu el Ata N.	8	Berg C.	15	Zhang X.	17
Papadopoulos G.	2	Chapelle A.	3	Kaal W. A.	8	Li H.	15	Liu X.	16
LEE Kuo Chuen D.	2	Huckle S.	3	Li X.	8	Liu J.	15	Zhang J.	16
Norta A.	2	Byrne M.	3	Li Y.	8	Wang J.	15	Liu J.	15
Guadamuz A.	2	S.G.Y.	3	De Filippi P.	7	Liu X.	13	Wang H.	15
Wang Y.	2	Panayi E.	3	Chen S.	7	Dannen C.	12	Xu X.	15
van Lier B.	2	Marchesi M.	3	LEE Kuo Chuen D.	7	Chohan U.W.	12	Li H.	14
Barkatullah J.	2	Taft D.K.	3	Peck M.E.	7	Iyer K.	12	Li Z.	14
Noizat P.	2	Saxena P.	3	Pass R.	7	Li Y.	12	Liu Z.	14
Baert R.	2	Faisca J.G.	2	Wang J.	7	Li J.	12	Li X.	13
Nian L.P.	2	Croman K.	2	Xu X.	7	Poujol P.	11	Wang C.	13
Andrychowicz M.	2	Deichler A.	2	Bartoletti M.	6	Liu Z.	11	Kim S.	12
McCorry P.	2	Juels A.	2	Berg C.	6	Liu H.	11	Mohanty D.	12

Table 3 demonstrates the top 25 authors for each year from 2015 to 2019. This table illustrates how Asian authors became the leaders in publishing articles related to blockchain.

Research Question 3. What are the trends in blockchain-related academic publications?
 To ascertain the current and past trends in blockchain-related academic publications, the authors utilized keyword analysis powered by NVivo 12.

Table 4 Top 25 keywords by trends for the years 2015-2019

Position (2015-2019)	Keyword	Position in 2015	Position in 2016	Position in 2017	Position in 2018	Position in 2019
1	Blockchain	2	1	2	1	1
2	Bitcoin	1	2	1	2	4
3	Cryptocurrency	3	3	3	3	5
4	Smart Contracts	17	5	4	4	3
5	Internet Of Things	6	9	5	5	2
6	Ethereum	56	7	6	7	6
7	Distributed Ledger Technology	51	4	7	6	8
8	Security	331	49	9	8	6
9	Privacy	307	10	8	10	8
10	Blockchain Technology	137	14	10	9	9
11	ICO	n/a	n/a	16	11	22
12	Peer-To-Peer	5	8	24	13	11
13	Artificial Intelligence	29	36	21	12	13
14	Distributed Ledger	50	n/a	17	17	12
15	Fintech	62	16	14	15	20
16	Trust	361	999	15	16	19
17	Cloud Computing	n/a	11	22	19	15
18	Technology	158	50	12	24	17
19	Big Data	119	29	13	32	14
20	Decentralisation	11	45	11	14	18
21	Supply Chain	n/a	167	25	28	24
22	Cryptography	8	18	18	22	27
23	Distributed Computing	201	6	26	18	122
24	Machine Learning	n/a	136	40	26	16
25	Consensus	n/a	58	51	21	21

Table 4 summarizes the changes in the top 25 keywords of academic publications related to blockchain from 2015 to 2019. Due to the large number of publications, articles

published in 2018 and 2019 have the greatest impact on the whole spectrum of studies related to blockchain.

From 2015-2018, the main sustainable trends in publications related to blockchain were: blockchain, bitcoin and cryptocurrency.

This trend is also relevant in 2019, but it is obvious that a general trend for future research may be formulated as follows: the introduction of blockchain technology in various industries.

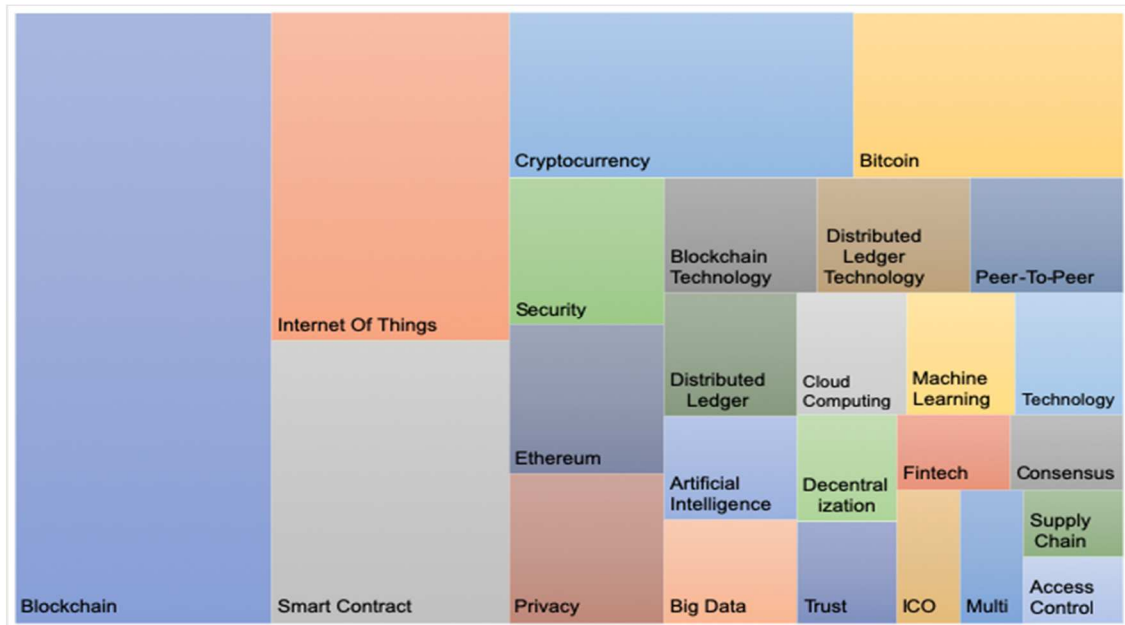


Figure 6 Top 25 keywords in 2019

Figure 6 demonstrates the top 25 keywords of blockchain-related academic publications in 2019. Comparing Table 4 and Figure 6, the trend of implementation of blockchain technology in various industries becomes more evident. Publications about cryptocurrencies are still a hot topic for the scientific community, but the focus of researchers is changing to other industries: the Internet of Things, artificial intelligence, big data, cloud computing, machine learning, the supply chain. From the authors' point of view, the interest of the blockchain-related scientific community for fintech is decreasing due to decreasing attention to the topic of cryptocurrency. But the authors think that this trend will change in a couple of years due to the increasing amount of new non-crypto-related blockchain use cases.

Research Question 4. What are the main research topics and research gaps in the papers published between the years 2015-2019 from major academic databases? Based on the results of utilizing the topic modelling tool powered by Amazon Comprehend, the authors formulated the top 100 research topics in the papers published between the years 2015-2019 from major academic databases.

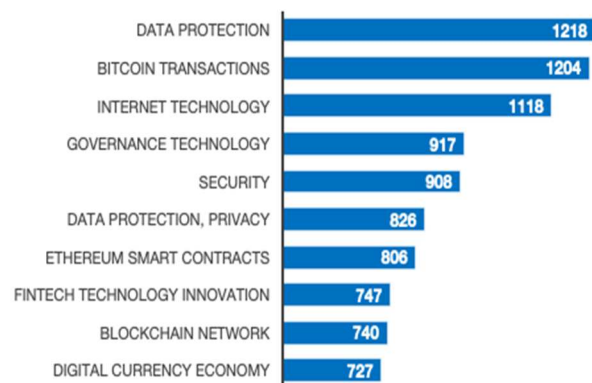


Figure 7 The main research topics

Figure 7 highlights the ten main research topics and research gaps in the papers published between the years 2015-2019 from major academic databases. Despite considerable interest in cryptocurrency and fintech use cases, topics related to other use cases of blockchain technology implementation were not so popular in the scientific community. Based on the data presented in the full list of 100 topics, the following topics are research gaps and potential areas for further research: blockchain potential use cases, blockchain for traditional money, electronic voting, big data in artificial intelligence, blockchain for real estate, blockchain and the education industry, blockchain technology potential in education, and blockchain for crowdfunding; blockchain for supply chain and logistics.

Research Question 5. What are the most discussed industries utilizing blockchain technology for Electronic Data Interchange?

After identifying the main topics, the authors found out the most discussed industries utilizing blockchain technology for Electronic Data Interchange.

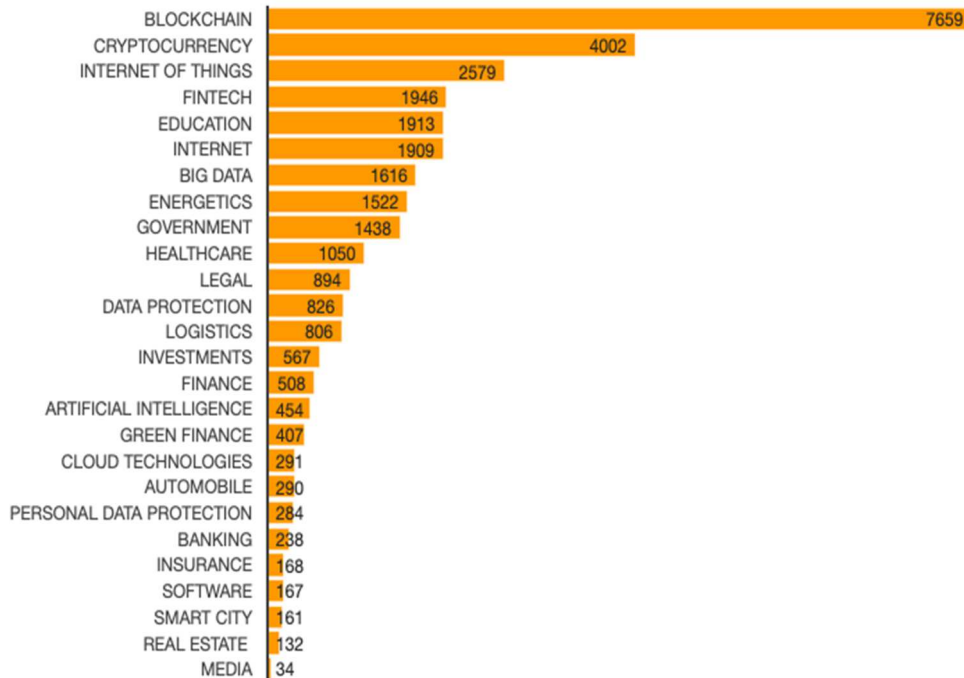


Figure 8 Industries for blockchain technology adoption for EDI

Figure 8 presents the 26 most discussed industries for blockchain technology adoption. The largest proportion of scientific discussions in the papers published between the years 2015-2019 are related to the blockchain industry only and was focused on the technology aspects. The second most discussed industry is cryptocurrency, which is the most well-known use case of blockchain technology implementation.

It is very important to highlight that the results received with the help of Amazon Comprehend show that the blockchain and cryptocurrency industries become separated in scientific discussions. Publications mentioning the Internet of Things industry are the third largest group of interest in academic research on blockchain technology implementation. Other industries like fintech, education, internet, big data, energetics, government, healthcare, legal, data protection, and logistics also receive a reasonable amount of attention in the scientific community.

5 Conclusions

After the analysis of 9,780 primary papers published between the years 2015-2019 from major academic databases, and adhering to research limitations described in chapter 3, the authors made the following conclusions:

Journals and conferences are the main sources for blockchain-related publications from 2015 to 2019.

Asian researchers lead in the publication of blockchain-related articles.

Previous authors focused mostly on understanding the basic principles of blockchain technology implementation and cryptocurrencies. In 2019 a new trend has developed: implementation of blockchain technology in various industries.

Despite considerable interest in cryptocurrency and fintech use cases, topics related to other use cases of blockchain technology implementation for Electronic Data Interchange were not so popular in the scientific community and can be defined as research gaps.

The most discussed industries utilizing blockchain technology for Electronic Data Interchange are the blockchain industry, the cryptocurrency industry, the internet of things industry, fintech industry, education industry, internet industry, big data industry, energetics, government, healthcare industry, legal industry, data protection industry, logistics industry.

6 Further research

According to the analysis of relevant literature on blockchain, future research on blockchain will focus on the following aspects:

Blockchain potential use cases including but not limited to blockchain for traditional money, electronic voting, big data in artificial intelligence, blockchain for real estate, blockchain and the education industry, blockchain

technology potential in education, and blockchain for crowdfunding, blockchain for logistics and supply chain.

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Review process

Single-blind peer review process.