E u r o E c o n o m i c a

Issue 2(40)/2021 *ISSN: 1582-8859*

EuroEconomica

Block-chain Applications in Business. A Systematic Literature Review

Alisa-Mihaela Ambrozie[1], Sergiu-Lucian Șorcaru[2]

Abstract: Considering the growing interest shown in block-chain and the involvement of public and private systems in the development of this technology, this paper aims at a systematic analysis of the literature to identify areas that use block-chain or intend to use it as soon as possible. The review covers 507 articles from economic, business and management from Springer's electronic database. The results show that the first 5 areas of interest for research are cryptocurrencies, supply chain, energy, banking, healthcare. The added value of this paper is a forecast of key industries that will develop and operate using block-chain technology in the next future.

Keywords: block-chain application; Literature review; Technology usage; Emerging technology

JEL Classification: E32; F44

1. Introduction

Block-chain is based on a distributed ledger technology register, which aims at maintaining and updating the database independently by each participant in a network. The database ensures the complete registration of all entered operations, as well as the integrity and security of information through algorithms. The registration and storage of information is done independently by each customer connected to the network, who receives an updated and validated copy of the data (Boucher, 2020).

The principles underlying the use of block-chain technology are as follows (Ganne, 2018, Belu, 2019):

• decentralized, transparent and reliable feature, resulting from the fact that data and operations are shared and visible to all network participants;

• distributed feature: refers to the fact that each participant in the block-chain network keeps a complete copy of the data, and the updates are shared with the whole network;

• operation without intermediaries and the advantage that no central authority controls the network;

[1] PhD Student, Academia de Studii Economice Bucuresti, Phd School of Economics and International Affairs, Address: 11 Tache Ionescu Street, Bucuresti, Romania, Tel.: +0372713954, Corresponding author: ambrozie.alisa@gmail.com.
[2] Senior Lecturer, PhD, "Danubius" University of Galati, Faculty of Communications and International Relations, Romania, Address: 3 Galati Blvd., Galati, Romania, Tel.: +40372361251, e-mail: sorcarusergiu@univ-danubius.ro.

• trust and transparency: the simultaneous use of different cryptographic techniques and the decentralized and distributed nature of block-chain platforms make them extremely resistant to attacks compared to traditional databases;

• consensus: transactions are accepted and rejected according to the consensus on the block chain platform and not as a result of a decision by central institutions;

• immutable feature resulting from the fact that it is impossible to delete or modify information from the system: when information is added, it is marked by time and it cannot be easily modified. This feature makes it easy to keep track of the changes and makes it easy to authenticate products and documents, helping to prevent data register fraud.

• resistance: once the information is added, it is shared with the entire network and saved on all nodes, being almost impossible to change. If a node is affected by a disaster, the information can be easily retrieved;

• Real-time checking and acceptance of information and transactions,

• automation: the use of "smart contracts", which are self-executing, makes it possible to automate processes, transactions and payments, thus increasing efficiency.

Beyond these features, there are actually many different models of block chain platforms, which vary in terms of decentralization and access, participant identity, consensus mechanism, speed, level of confidentiality, power consumption, fees and scalability. Often, the classification of block chain platforms considers how the platform is managed (Buterin, 2015). In this case, there are three types of public, private and consortium block chain. Anyone can participate in the creation, confirmation and registration of content on the public platform, while for a private platform the permission to enter and validate information is controlled by an entity. A consortium block chain network is a form of private block chain, partially decentralized and managed by a group. Another classification of block chain application concerns the extent to which access to the platform is restricted, where unauthorized platforms and allowed platforms meet (Ganne, 2018).

Block chain technology is used in various fields (Zheng et al., 2018): international trade (for issues related to business transactions, logistics and document management), finance (financial services, risk management, financial markets, etc.), the Internet of Things (e-business, personal data protection, etc.), public services (customs authorities and government institutions).

Due to the rapid development of the block chain as a technological solution in a wide variety of industries, with the potential to radically change existing business models (Probst, Frideres, Cambier, Martinez-Diaz, 2016)

Block chain is a decentralized innovation that can revolutionize organizations and be applied in various industries. The block chain originally appeared in the financial sector, but at the moment researchers, companies, governments and institutions are exploring the block chain for its application in various fields. Bitcoin was the first block chain-based application to facilitate currency transfers without the involvement of third parties. Block chain projects have been initiated in several industries, such as banking, insurance, supply chains, real estate, healthcare, renewable energy, and more.

The high interest of states, companies and researchers in adopting block chain technology due to its potential and its rapid development in various industries motivates this study to identify the areas in

which block chain can be applied. Performing a systematic analysis of the literature we can see which are the business areas in which block chain technology can be applied. This article aims at identifying areas where block chain technology is implemented, areas where this technology can be adopted, the impact of this technology and possible impediments to block chain adoption in different sectors.

2. Methodology

The aim of the research is to highlight the industries in which block-chain technology is implemented. Systematic analysis of the literature helps us to identify past cases in which block-chain technology was used. 14 years after its inception, block-chain has expanded its reach into many other services, not just cryptocurrency trading. The multitude of articles in the literature in the field of economics, business and management provides us a starting point for formulating research question.

2.1. Research Question

Q: What are the business sectors in which block-chain applications are used?

The purpose of this question is to find out in the specialized literature which are the areas in which block-chain technology is currently used.

This article aims at analyzing the literature and identifying in which industry sectors block-chain technology is applied, what are the benefits it brings, but also what are the challenges encountered in implementing block-chain. In this sense, we will perform a textual analysis of the articles in the literature.

2.2. Data Source

The systematic review included the online database of the Springer publication, the articles from the last 5 years were selected, the chosen period being 2016-2021.

According to Liberati et al. (2009) we built a flowchart (Appendix 1) in order to clarify search results and select studies for inclusion in the review.

2.3. Selection of Studies

The selection process was divided into 4 stages:

Step 1

Following the preliminary search, 17,028 results were listed on the block-chain, which include: books, chapters, conference papers, articles, books, video segments, from different fields: computer science, engineering, economics, environment, business and management.

Step 2

After restricting your search, only English-language publications were selected. For the next stage, 14476 publications remained after the exclusion of 2552.

Stage 3

We focused our search only on publications in the fields of economics, business and management, and after the elimination of 11789, we were left with a total of 2687 publications.

Stage 4

As a result of the filtering process, only 507 scientific articles remained that dealt with the subject of block-chain in the title, abstract or keywords.

2.4. Data Gathering

Following the collection of relevant publications according to the criteria in point 2.3, we obtained 507 articles divided as follows: 14 articles about block-chain were published in 2016, 27 articles in 2017, 22 articles in 2018, 56 articles in 2019, 134 articles in 2020 and 254 in 2021. You can see the growing interest of researchers in the subject of block-chain, articles published in 2021 exceeded the total number of articles published in the previous 4 years.

2.5. Qualitative Analysis

To answer Q: What are the business sectors in which block-chain applications are used?, we decided to use Atlas.ti, a quality data analysis and processing software (CAQDAS).

We have established 3 steps for careful filtering and finding areas where block-chain technology is currently used.

Stage 1

By using the Word Cloud function, the Atlas.ti software, we have an overview of the keywords in the 507 articles, according to Appendix 2 the frequency is mainly bitcoin and block-chain, but not very far are keywords such as services, financial, covid, business, market, systems, investors, etc., which gives us confidence that in the second stage the articles will lead us to niche areas of technology, but different at the same time.

Stage 2

We have searched all 507 articles with Atlas.ti's *Search & Code* feature for the following keywords "BLOCK-CHAIN AND APPLICATIONS", "BLOCK-CHAIN AND USE CASES". The first 5 areas at a considerable distance from the others are cryptocurrencies, supply chain, banking, energy, health, according to Appendix 3.

Stage 3

In order to obtain quantitative data that can give us an accuracy in choosing the articles in the fields of cryptocurrencies, fields of supply chains, banking, energy and health domain, we chose to encode the 5 keywords with their synonyms, their partial synonyms or other words used mainly in the basic field.

According to Appendix 4, coding has been developed around the keyword, which also represents their field of activity.

3. Results and Debates

We set out to answer the question: What are the business sectors in which block-chain applications are used?, to find out the different industry sectors in which block-chain technology is used. We chose Springer Journal's online database.

By building the flowchart we managed to reach from 50,028 results listed about the block-chain to 507 articles dealing with the topic of block-chain in the title, abstract or keywords, in the fields of economics, business and management.

To find out the business sectors in which block-chain applications are used, we have developed a qualitative analysis through the Atlas.ti software in 3 stages, these are: cryptocurrencies, supply chain, banking, energy, health.

In order to check and exclude the articles in which the keywords are found but are not relevant, we insisted on the 3rd stage of the qualitative analysis, this stage showed us the frequency of coding according to Appendix 5.

And after this stage the order represented by the number of articles published in the field remains the same for the business sectors in which block-chain applications are used are the field of cryptocurrencies, supply chains, the field of banking, the field of energy and health.

Cryptocurrencies are of great interest to researchers, following the systematic analysis of the literature, the largest number of articles have addressed the subject of cryptocurrencies. Block-chain is the technology that underlies cryptocurrencies, its architecture was created by the holders of the virtual currency Bitcoin, considered the original cryptocurrency. Block-chain has been introduced as a decentralized technology that can help establish uninterrupted peer-to-peer transactions, coordinated in distributed systems without mutual trust, and centralized control between individual nodes, based on techniques such as data encryption, timing, and algorithms of distributed consensus[1]. Block-chain technology was introduced in 2008 as part of a proposal for the Bitcoin virtual currency[2].

Cryptocurrencies are still the main field of application of block-chain technology, as the analysis shows, the authors researched the way in which the most popular virtual currencies work and the application of block-chain technology as a payment solution. Different digital currencies are analyzed and compared in terms of their efficiency and limitations such as high energy consumption or delays in validating transactions. We have also identified a considerable number of articles that analyze how to trade cryptocurrencies, trading platforms and trading strategies. Sarma et al. (2017) studied cryptocurrencies, the advantages of cryptocurrencies compared to fiat currencies and compared different currencies proposed in the literature. Kyriazis (2019) analyzed the efficiency and profitable trading opportunities in the virtual currency market.

[1] Blockchain and Cryptocurrencies: Model, Techniques, and Applications Yong Yuan, Senior Member, IEEE, and Fei-Yue Wang, Fellow, IEEE.
[2] Bitcoin: A Peer-to-Peer Electronic Cash System, Satoshi Nakamoto.

Supply chain and block-chain applications are a research topic that is in the authors' attention. The supply chain is the necessary steps to complete the trading process, which ultimately results in the delivery of the goods to the buyer. The complexity of the supply chain increases significantly in the international trading scenario, where the number of actors involved increases exponentially: importers, exporters, customs agents, transport agents, port operators, shippers and customs brokers. Following the analysis of the articles, we can see that block-chain technology can bring benefits in terms of logistics operations. Both the port authorities and the transport and logistics companies have noticed the potential of using block-chain technology together with the Internet of Things (IoT). The interest in block-chain technology stems in particular from the desire to reduce costs, improve processes and develop business platforms that can connect all actors along the supply chain, from shippers to customs and banks. The development of such platforms would have a significant impact on the transport and logistics sector. In practice, there are several transport and logistics companies, as well as port authorities that have adopted block-chain technology to facilitate import-export operations. The UK-based Marine Transport International (MTI) has designed a public block-chain system through which the logistics industry has improved its connectivity, efficiency and security (Marine Transport International, 2017).

The global trade platform TradeLens, developed by IBM and the logistics company Maersk, aims at connecting the various parties involved in international trade (from freight forwarders to government authorities) to streamline and facilitate business procedures by digitizing the supply chain from one end to the other. The ClearWay module is specialized in commercial documents and allows importers, exporters, customs authorities, government agencies and other trusted third parties to collaborate in business processes. At the same time, through this module, automation of various business processes takes place, such as authorized import and export through smart contracts (Wass, 2018).

The field of energy has been approached by researchers who considered that block-chain applications can be used due to the complex structure of an electricity system. Managing such a complex system is difficult to achieve in a centralized way, as a central authority may be non-existent or may not be trusted by all parties involved. From this point of view, block-chain technology is a promising tool because it offers a solution to this problem. The use of block-chain in the energy sector was initiated in pilot projects, so far, block-chain applications have not been widely implemented. The opinion of the European Energy Exchange must be maintained, it considers that block-chain technology seems to be the answer to the challenges of building an accessible, reliable system that supports sustainable energy (Alt, & Wende, 2020, pp. 325–330). Japan's largest energy provider has set up a unit called Trende, which uses block-chain technology to enable customers with solar power packages to sell peer-to-peer sales (Wörner, et al. 2019).

The banking domain is considered by the authors to be one that can be significantly improved by the implementation of block-chain technology. Following the analyzed articles, we have noticed that the implementation of block-chain in the banking field is seen as a necessity by specialists due to economic transformations, digitalization and financial innovations. This topic is not only addressed by researchers but also by international institutions such as the United Nations and the International Monetary Fund[1]. A large number of financial institutions such as J.P. Morgan and UBS have founded their own block-chain labs, working closely with block-chain application development platforms. The R3 block-chain consortium has brought together over 40 of the world's largest financial institutions, including Bank of

[1] The Rise of Digital Money, Tobias Adrian and Tommaso Mancini-Griffoli July 2019.

America, Citigroup, Morgan Stanley, Deutsche Bank and Barclays Bank. The benefits of adopting block-chain technology in banking include: improved transparency, trust and confidentiality for stakeholders, faster transfers at a lower cost (Peters, & Panayi, 2016, pp. 239-278). Block-chain technology is attractive to commercial banks around the world because it provides them with competitive advantages by reducing the cost of interactions between economic agents and ensuring effective control over operations (van Engelenburg, Janssen, M. & Klievink, 2018, pp. 69-82).

Health is a domain where the block-chain has great potential. The biggest impact that block-chain technology can have on health is in data management, more precisely in electronic health records. Block-chain technology can be used for drug prescriptions, supply chain management, data sharing and auditing of medical activities. Other areas of health in which block-chain applications can be implemented are: provider accreditations, medical bills, contracts, medical record exchanges, clinical trials, and the prevention of counterfeit drugs. Storing patients' medical data is very important in the field of health, these data are sensitive and therefore a target for cyber-attacks. Block-chain technology is known to be resistant to attacks.

In terms of the content of the articles analyzed, most of them suggest a framework, a model for the use of block-chain technology in health, and few articles give examples of block-chain applications currently used in healthcare. There seems to be a lot of interest in this topic, but the use of block-chain technology in the health field is just beginning. Block-chain in health applications is currently used for data transfer and medical records. The applications were developed through Etherium and Hyperledger Fabric (Zhang & Lin, 2018).

4. Conclusions

This study has analyzed the economic sectors in which block-chain applications are implemented.

Nowadays block-chain technology is attractive in many areas due to the ability to transfer value (money, assets, assets, etc.) in a decentralized manner, while block-chain provides security, integrity, confidentiality, efficiency, traceability and transparency.

Block-chain is a fairly new technology and new ways to apply it can still be found and researched. We believe that further research on block-chain limitations is needed when applied on a large scale.

5. References

Alt, R. & Wende, E. (2020). Block-chain technology in energy markets – An interview with the European Energy Exchange. *Electron Markets* 30, 325–330.

Boucher, P. (2020). Block-chain for supply chains and international trade: report on key features, impacts and policy options. *European Parliamentary Research Service*, Mai.

Belu, M. (2019). Application of Block-chain in International Trade: An Overview. The Romanian *Economic Journal*, 71(22), pp. 2-16.

Ganne, E. (2018). Can Block-chain revolutionize international trade?. *World Trade Organization Publications*, Geneva.

Liberati, Alessandro, et al. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Journal of clinical epidemiology*, pp. 1-34.

MacMillan, Katie. (2005). More than just coding? Evaluating CAQDAS in a discourse analysis of news texts. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, Vol. 6, No. 3.

Peters, G.W. & Panayi, E. (2016). Understanding modern banking ledgers through block-chain technologies: future of transaction processing and smart contracts on the internet of money. *Banking beyond Banks and Money*, Springer International Publishing, Cham, Switzerland, pp. 239-278.

Probst, L.; Frideres, L.; Cambier, B. & Martinez-Diaz, C. (2016). PwC Luxemburg: Block-chain Applications and Services, Directorate-General for Internal Market, Industry. *Entrepreneurship and SMEs*, European Union.

Nakamoto, Satoshi; Tobias, Adrian & Mancini-Griffoli, Tommaso (2019). Bitcoin: A Peer-to-Peer Electronic Cash System, *The Rise of Digital*.

van Engelenburg, S.; Janssen, M. & Klievink, B. (2018). A block-chain architecture for reducing the bullwhip effect. *International Symposium on Business Modeling and Software Design*, Springer, Cham, pp. 69-82.

Yuan, Yong Senior Member, IEEE, and Fei-Yue Wang, Fellow, IEEE (2018). Block-chain and Cryptocurrencies: Model, Techniques, and Applications. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, Volume: 48, Issue: 9.

Wörner, A.; Meeuw, A.; Ableitner, L. et al. (2019). Trading solar energy within the neighborhood: field implementation of a block-chain-based electricity market. *Energy Inform* 2, 11.

Zhang, A. & Lin, X. (2018). Towards Secure and Privacy-Preserving Data Sharing in e-Health Systems via Consortium Block-chain. *J Med Syst* 42, 140.

Zheng, Z.; Xie, S.; Dai, H.; Chen, X. & Wang, H. (2018). Block-chain challenges and opportunities: a survey. *International Journal of Web and Grid Services*, 14(4), pp. 352-375.

Appendix 1.

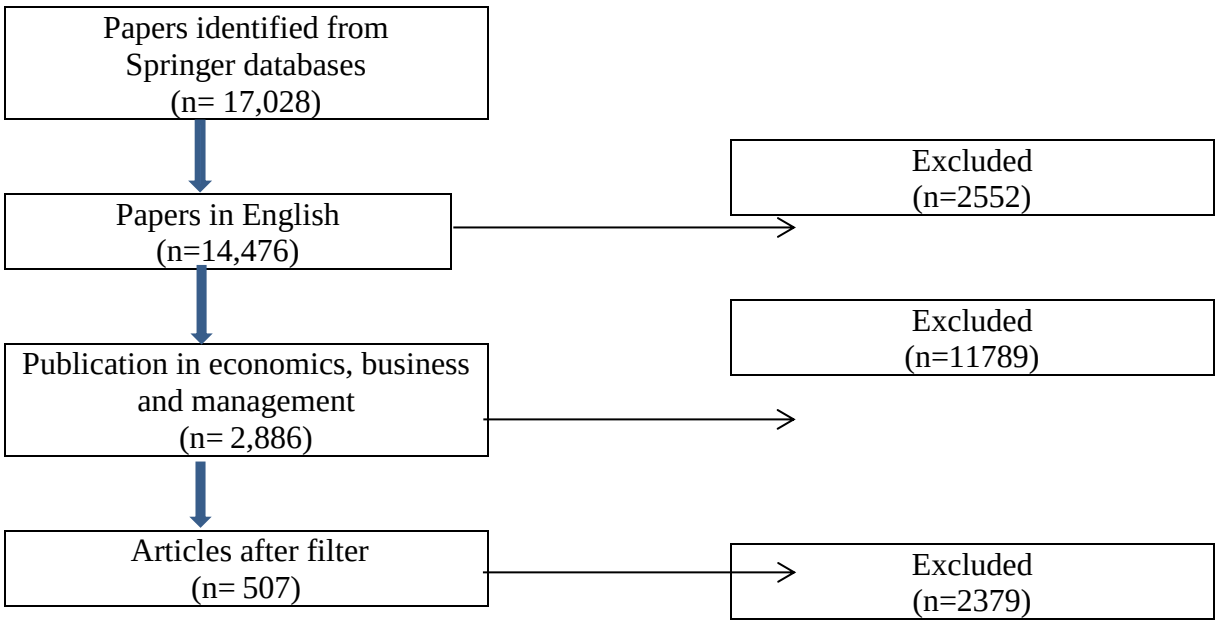

Figure 1. Flow diagram of research

Appendix 2.

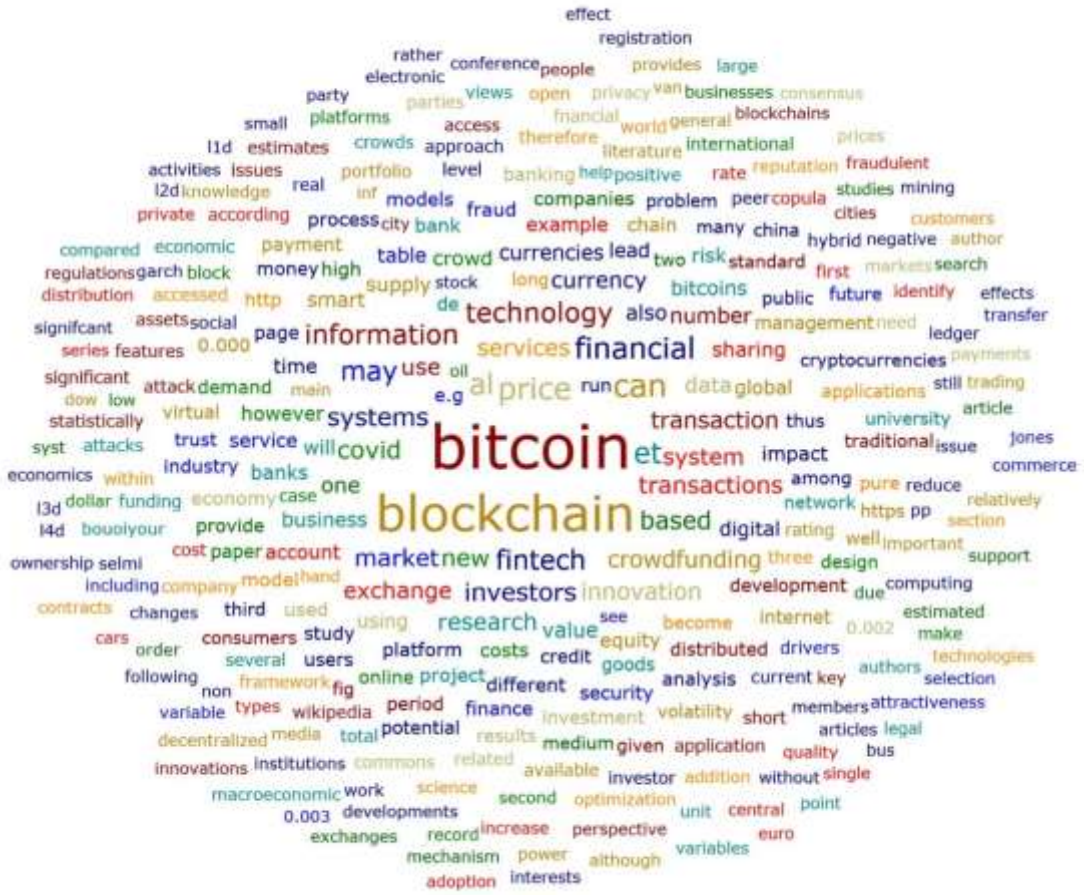

Figure 2. Word cloud on selected studies keywords

Appendix 3.

Table 1. Articles about block-chain from Springer database

	Total Papers in						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Total Papers**
Cryptocurrencies	8/14	14/27	8/22	21/56	52/134	75/254	178/507
Supply chain	6/14	4/27	1/22	6/56	9/134	81/254	107/507
Energy	1/14	7/27	3/22	4/56	18/134	36/254	69/507
Banking	6/14	9/27	3/22	4/56	18/134	29/254	69/507
Healthcare	2/14	3/27	0/22	2/56	9/134	19/254	35/507

Appendix 4.

Table 2. Coding use in Atlas.ti

Cryptocurrencies	Supply chain	Energy	Banking	Healthcare
digital currency	logistics	power	investment	health
crypto	supply network	efficiency	funding	medic
satoshi	logistics network	green energy	moneylending	medicine
coins		solar power	Money dealing	medical
token		sustainable energy	finance	m-health
altcoins			fintech	e-health
bitcoin			financial transaction	telehealth
BTC				m-health
ether				wellness program
ETH				
binance Coin				
BNB				
solana				
SOL				
XRP				
tether				
USDT				
decentralized money				
digital currency				
peer-to-peer money				
digital gold				
Gold 2.0				

Appendix 5.

Table 3. Articles with block-chain application in different business sectors

	Total Papers in						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**Total Papers**
Cryptocurrencies	5	9	6	18	37	41	116
Supply chain	3	4	1	6	9	42	65
Energy	1	5	3	4	7	9	29
Banking	1	3	2	5	8	11	29
Healthcare	2	1	0	3	5	10	21