Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

"We are not fit to lead an army on the march unless we are familiar with the face of the country - its mountains and forests, its pitfalls and precipices, its marshes and swamps."

Sun Tzu
The Art of War

Blockchain technology is widely seen as a promising technology for global supply chains, though early adoption of the technology is both costly and risky. Along with many other discouraging factors, large investments required to enter or develop a blockchain raise barriers to entry. Concerns about potential benefits, on the other hand, have led to companies questioning whether it is worth it. Consequently, many players in the global arena are still preferring to wait by observing current practices before making investments, while trying to figure out what the technology might bring them. Hence, the main purpose of this paper is to research various implementations of blockchain technology in supply chains, in order to learn from its early adopters. For this purpose, we chose case studies as the research method, which we used in a systematic way. We focused on multiple relevant case studies from previous research concerning the use of blockchain technology in supply chain practices. Through a systematic analysis of case studies, the paper aims at bringing forward different views, approaches, and results about blockchain adoption, as a way to show the pros and cons of adopting the technology under certain circumstances. The research was obtained from the Web of Science Core Collection. This paper contributes to the literature by showcasing the use of blockchain in supply chains via multiple cases to learn from early blockchain adopters in supply chain practices.

1. Introduction

Blockchain technology is expected to contribute to the global economy in many ways. A recent study by PwC (2020) estimates that blockchain technology has the potential to boost the global GDP by $1.76 (USD) trillion by 2030 through five main areas. The following table summarizes the report's findings from the report (PwC, 2020), showing the top five uses that are driveing blockchain adoption and their estimated economic contributions to the global GDP by 2030.

As the emphasis on provenance (that is, verifying the sources of goods, tracking their movement, and increasing transparency) demonstrates, a key area of blockchain applications is global supply chains. Some reasons that make supply chains a potentially high-gain area for blockchain implementation include their complex network structure with several stakeholders, need for information sharing between the parties, difficulty and risk in transfer of documents, time-consuming processes, and lack of trust between parties. Research shows that the number of blockchain

Table 1. Top five uses driving blockchain adoption and their estimated economic contribution to GDP

Uses driving blockchain adoption	Potential boost to global GDP by 2030
Provenance	$962 bn
Payments and financial instruments	$433 bn
Identity	$224 bn
Contracts and dispute resolution	$73 bn
Customer engagement	$54 bn

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

engagements per industry is highest in the supply chain industry, constituting 19% of all distributed ledger technology (DLT) implementations worldwide (HFS Research, 2020). Yet, the number and variety of use cases is still limited, while much potential remains to be realized.

1.1 Purpose and structure of the paper

This study aims to research and evaluate various implementations of blockchain and DLT in supply chains in order to provide insights regarding applications currently trending, while also establishing a viable resource to learn from case studies in the related literature. Conforming with this purpose, the study is designed as a systematic literature review of formerly conducted case studies concerning the use of blockchain technology in supply chain practices.

The study has five main sections. The introductory section specifies the scope and structure of the paper, provides a general overview related to the digital economy, and focuses on blockchain implementation in supply chains, setting forth problems in supply chains that the use of blockchain could solve. The second section describes the research methodology, namely research questions addressed in this study, the search process, inclusion and exclusion criteria for the cases, and data collection and analysis procedures. The third section presents the actual case studies used, while the fourth section details the results associated with each research question, along with limitations of the study. Finally, the conclusion draws an application from the search results and findings, while shedding light on future research possibilities.

1.2 Blockchain Implementations in Supply Chains

As challenges and environmental conditions (that is, complexity, intense competition, pressure on lead times, regulations, etc.) push organizations to find novel solutions, many global enterprises are placing emphasis on understanding how blockcain technology can help improve their supply chain operations to reach strategic objectives. Gradually enabled in global supply chains over the years, blockchain technology has a goal of improving efficiency through digitalization. Benefits from blockchain implementation in supply chains include keeping track of cargoes, enchanced visibility, decreased time spent in customs clearance, reduced risk, cost efficiency, and reduction in paperwork (Aich et al., 2019). According to an analysis by the platform Blockdata, six of the companies on Forbes' "Blockchain 50" list (of the largest global brands with an annual revenue of over $1 billion) developed blockchain use cases directly related to supply chain management (Kshetri, 2021). Among these 50, 15 companies, including IBM, Nestlé, Walmart, and Amazon, have used blockchain technology for traceability/provenance purposes, highly related to supply chain management, with one third of these projects in the pilot phase, and the rest already in use.

The beneficial features of distributed ledger technology have opened up many possiblities for improving supply chains. With high trade volumes and a large number of players, the shipping industry is an important component of supply chains worldwide, providing a number of very good examples of blockchain implementation. Maersk and International Business Machines (IBM), for example, have been collaborating for ecosystem-wide blockchain integration in maritime transportation, starting the "TradeLens" project in 2018. The maritime transportation domain constitutes an information structure, when considered as a domain consisting of many actors scattered in a complex supply chain environment, with direct or indirect collaboration (Stopford, 2009). Mike White, Head of TradeLens at Maersk, stated (2019) that in the shipping industry, data gets trapped in organizational silos, operations are complex and costly, processes are time-consuming, clearance can be subject to delays, and collaboration with stakeholders in the industry's external environment is a necessity. Hence, the TradeLens initiative aims to increase transparency and traceability, while eliminating intermediaries and paperwork required for maritime transportation. The platform was designed with accessibility in mind, providing transparency and traceability to shipowners, brokers, customs, port authorities, and insurance companies by tracking cargo for all users in the private blockchain network, from the first port of call to the last.

According to the 2020 Maersk Sustainability Report (2021), TradeLens integration has increased to over 220 organizations, comprising data from more than ten ocean carriers, and 600 ports and terminals, thus covering almost half the world's ocean container cargo. TradeLens will be utilized for developing countries in automation of sea cargo data in a multi-stakeholder project starting from Sri Lanka and Cambodia (Maersk, 2021).

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

2. Research Method

This study was designed as a systematic review of case studies that rigorously reviews several formerly conducted case studies. Through a systematic analysis of these case studies, our study aims at presenting different views, approaches, and results in relation to blockchain implementation in supply chains, thus giving readers a chance to grasp the pros and cons of adopting the technology under certain conditions.

In carrying out the systematic review, this study follows guidelines as proposed by Kitchenham (2004) who described a systematic review as "a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenoenon of interest". Systematic reviews require a well-defined methodology in order to decrease the probability of being biased in examining the related literature. Further, the methodology should be made transparent to readers through detailed explanation and documentation about the search process (Kitchenham, 2004). To this end, the research questions addressed in this study, search process, inclusion and exclusion criteria for the cases, procedures for data collection, and analysis are explained in detail.

2.1 Research Questions

This study aims to answer the following research questions (RQ):

RQ1: *What blockchain features regarding blockchain implementation in supply chains are addressed in case studies?*

RQ2: *Which sectors are leading case study research on blockchain implementation in supply chains?*

RQ3: *What benefits of adopting blockchain technology are improving supply chain operations and helping to achieve supply chain strategies?*

RQ4: *What are the biggest challenges of adopting blockchain technology in supply chains?*

RQ1 intends to analyse blockchain features that are most utilized and, thus, most emphasized, in supply chain case studies. RQ1 provides insight into the needs of supply chains regarding implementation of blockchain technology in currently utilized systems, while emphasizing where most problems in supply chains occur. In RQ2, the analysis of blockchain adoption from a sectoral perspective shows information on sectors that have most utilized blockchain in their supply chains, as well as those needing more research on blockchain adoption. Finally, RQ3 and RQ4 provide analysis regarding advantages and drawbacks, respectively, of blockchain adoption.

2.2 Search Process

The search process of this study was performed electronically using the Web of Science (WoS) database. The cases were obtained from the WoS Core Collection, starting with a broad search with the terms "blockchain" and "distributed ledger" (or DLT) in the title, along with the terms "case study" and "supply chain" in the abstract [TI=(blockchain OR "distributed ledger" OR DLT) and AB=("case study" AND "supply chain")]. Although this paper considers blockchain technology, the researchers consciously did not limit the search terms to "blockchain". On account of the fact that blockchain is a type of distributed ledger technology (DLT), and that both are commonly used interchangeably, the search terms included "distributed ledger" and "DLT", as well. This approach eliminated the risk of missing out on a relevant work simply because it used the term "distributed ledger" instead of "blockchain". Given that not all distrubuted ledgers are blockchains, but that all blockchains are fundamentally distributed ledgers, the main research subject in this study covers a set of case studies on blockchain applications in supply chains.

Because a number of papers phrased the blockchain concept as "block-chain" or "block chain", the initial database search included the terms "block-chain" and "block chain," along with the most commonly used term, "blockchain". Adding them to the database search, however, did not bring up any further relevant results, and thus, the two less common variations of the keyword "blockchain" (that is, "block-chain" and "block chain") were excluded from the search. To direct the search toward a focus on maritime supply chains, the search terms "shipping" and "maritime" were added to the initial search term, "supply chain".

As a default search parameter, we set the timespan for our research from January 1st, 2017 to April 15th, 2021. The initial search with the aforementioned combinations identified 171 results in total, 125 of which were articles published in journals. The remaining 46 search results consisted of 37 conference papers

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

(proceeding books included), and 9 books or chapters in a book. For the second step, any duplicates were identified and removed, after which the abstracts were scanned for relevance, and non-relevant papers were also eliminated. The remaining 63 papers were those included in our systematic analysis of case studies.

2.3 Inclusion and Exclusion Criteria

In order to focus the research on case studies that have dealt with blockchain implementation in supply chains, certain papers were excluded from the initial list of results. The exclusion was carried out according to the following criteria:

- Conjectural case studies (case studies that included hypothetical applications)
- Non-relevant case studies (case studies that did not include a supply chain application)
- Technical case studies (case studies that focused mainly on software, but did not include a supply chain application)

Furthermore, certain inclusion criteria were set as:

- Case studies that included real supply chain systems, but only simulated blockchain implementations
- Mathematical approaches that provided supply chain case studies

3. Results

The following table presents the 63 selected case studies relevant to our systematic literature review, along with a summary of each study.

We assigned each case study an identification number in the table (for example, CS1, CS2). In the year of publication column, "EA" in parentheses denotes the publication as an early access publication. Under the type of publication column, journals are indicated by a "J", books by a "B", and conference papers by a "C".

4. Discussion

This section systematically presents answers to our research questions, discussing what may be learned from the literature on blockchain in supply chains.

4.1 What blockchain features regarding blockchain implementation in supply chains are addressed in case studies?

The systematic review demonstrates that a number of blockchain features are specifically addressed in supply chain case studies. *Traceability* (that is, the ability to track goods), for instance, is addressed in 55 of the 63 case studies reviewed. Traceability, combined with

Table 2. Systematic literature review of case studies

CS ID	Author(s)	Year	Main topic	Type of Publcation	No of Citations
CS1	Alles & Gray	2020	Pharmaceutical	J	7
CS2	Bal & Pawlicka	2021	Retail, Finance	J	-
CS3	Baralla et al.	2021	Food SC	J	6
CS4	Bodkhe et al.	2020 (EA)	Food SC, Cyber security	J	9
CS5	Caldarelli et al.	2020	Food SC	J	9
CS6	Casino et al.	2020 (EA)	Food SC	J	7
CS7	Curbera et al.	2019	Healthcare	J	7
CS8	Danese et al.	2021	Food SC	J	-
CS9	Ethirajan et al.	2020	Manufacturing	J	-
CS10	Fu et al.	2020	Food SC	J	4
CS11	Garrard & Fielke	2020	Food SC	J	7
CS12	Gausdal et al.	2018	Maritime	J	60
CS13	Khatoon et al.	2019	Green operations	J	28
CS14	Kshetri	2018	Shipping, Food SC, Military, Pharmaceutical, Retail, Insurance	J	688

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

Table 2. Systematic literature review of case studies (cont'd)

CS15	Kumar et al.	2020 (EA)	Logistics	J	-
CS16	Kumar et al.	2020 (EA)	Logistics	J	4
CS17	Li & Zhou	2020 (EA)	Maritime, Food SC, Logistics, Green Operations	J	2
CS18	Li et al.	2020	Retail	J	14
CS19	Maity et al.	2021	Food SC	J	1
CS20	Orjuela et al.	2021	Food SC	J	-
CS21	Park & Li	2021	Food SC, Maritime	J	-
CS22	Patelli & Mandrioli	2020	Food SC	J	7
CS23	Perez et al.	2020	Textile	J	7
CS24	Philipp	2020	Maritime, Green Opeartions	J	2
CS25	Philipp et al.	2019	Maritime	J	18
CS26	Prause	2019	Logistics, Autonomous Delivery	J	10
CS27	Prause & Boevsky	2019	Small and medium enterprises (SME), Food SC, Autonomous Delivery	J	8
CS28	Rijanto, Arief	2020 (EA)	Food SC	J	-
CS29	Rodriguez-Espindola et al.	2020	Humanitarian	J	13
CS30	Roeck et al.	2020	Diamond, Food SC, Pharmaceutical	J	31
CS31	Rogerson & Parry	2020	Food SC	J	25
CS32	Shemov et al.	2020	Construction	J	1
CS33	Sivula et al.	2021	Construction, Regional Development	J	-
CS34	Sternberg et al.	2021	Food SC	J	17
CS35	Stranieri et al.	2021	Food SC	J	11
CS36	Sund et al.	2020	Retail	J	8
CS37	Tan & Sundarakani	2021	Logistics	J	2
CS38	Toennissen & Teuteberg	2020	Shipping, Food SC, Retail, Pharmaceutical, Diamond	J	78
CS39	Tseng & Shang	2021	Healthcare, Accounting, Food SC, Logistics	J	-
CS40	van Hoek	2020	Retail, Logistics	J	16
CS41	Vishnubhotla et al.	2020	Oil Trade	J	1
CS42	Vivaldini	2021 (EA)	Food SC	J	-
CS43	Wamba et al.	2020	Food SC, Consumer Engagement	J	58
CS44	Wang	2019	Construction	J	5
CS45	Wang et al.	2020	Construction	J	43
CS46	Zhou et al.	2020	Maritime	J	5
CS47	Calle et al.	2019	SME, Finance, Logistics	B	-
CS48	Di Ciccio et al.	2018	Pharmaceutical	B	35
CS49	Potancok et al.	2020	Pharmaceutical	B	-
CS50	Aich et al.	2019	Automotive, Food SC, Retail, Pharmaceutical	C	32
CS51	Casado-Vara et al.	2018	Food SC	C	222
CS52	Cui et al.	2019	Food SC	C	1
CS53	Grest et al.	2019	Pharmaceutical	C	-
CS54	Hafizon et al.	2019	Maritime	C	4
CS55	Haroon et al.	2019	Food SC	C	6

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

Table 2. Systematic literature review of case studies (cont'd)

CS56	Kanak et al.	2019	Automative, Inner City Transportation, Cyber Security, Green Opeartions	C	2
CS57	Koirala et al.	2019	Reverse Auction Supply Chain	C	2
CS58	Lam & Lei	2019	Textile, Green Opeartions	C	4
CS59	Miehle et al.	2019	Automotive	C	9
CS60	Pundir et al.	2019	Retail	C	19
CS61	Scheid et al.	2019	Cold Chain Supply Chain	C	12
CS62	Wu et al.	2019	Food SC	C	17
CS63	Yusuf et al.	2019	Food SC	C	5

transparency, increases supply chain visibility, while ensuring product quality and safety, thus contributing to profitability. By accessing data records with time stamps, stakeholders can track transactions in an efficient manner. Similarly, transparency provides stakeholders with the ability to monitor and access data on the chain, as addressed in 53 studies. By providing access to the history of activities, transparency also facilitates validating and auditing distributed ledger elements.

Immutability, which involves disabling the ability to make changes to initial or previous data, is another feature commonly addressed in supply chain case studies. This feature is enabled by cryptographic security in distributed ledgers and is considered as the most expensive aspect of blockchains, since it has technological requirements such as databases, distribution, and hashing to ensure the data does not change.

Security, efficiency, and confidentiality are also among the blockchain features addressed in supply chain case studies. *Security* refers to cybersecurity measures that prevent forced or unintentional data access by unwanted parties. The high level of difficulty in changing data on blockchains is essential regarding supply chain processes. *Efficiency* refers to the reduction in cost, paperwork, and unnecessary intermediaries. Faster data handling, easier accessibility, and the elimination of geographical limitations further boosts efficiency in supply chain processes. *Confidentiality*, meanwhile, refers to maintaining the privacy of users and their data, as well as certain aspects of their transactions. This feature is hard to balance with transparency and traceability for supply chain processes, but in blockchains, stakeholders may prefer a private permissioned blockchain option to limit the monitoring and controlling actions in the blockchain.

Finally, the culmination of all the aforementioned features of blockchain use in supply chains is trust. Trust is established by blockchain's ability to remove untrusted parties while providing information sharing, immutability, visibility, and automation. In conventional companies, stakeholder trust develops through transactions themselves, while in blockchain implemented supply chains, trust is established through blockchain distributed ledger accounting. In an environment lacking trust, blockchains carry the potential to fundamentally improve transactions between parties.

4.2 Which sectors are leading case study research on blockchain implementation in supply chains?

Overall, the case studies regarding blockchain implementation in supply chains are dominated by food supply chains. The number of case studies in food supply chains increased substantially in 2020 and 2021, making up 28 of the total case studies examined. Logistics, pharmaceuticals, and retail (for example, Walmart) industries are the next common areas of investigation, but still far behind food supply chains with 10, 8, and 8 cases, respectively. Finally, automotive, maritime, construction, and green operations are found to be the other significant areas for case studies.

4.3 What are the benefits of adopting blockchain technology that are improving supply chain operations and helping to achieve supply chain strategies?

In the case studies reviewed, the benefits of adopting blockchain technology mostly refer to features. One common advantage mentioned in the case studies is the feature of secure, real-time data handling with monitoring and controlling of data in a virtual environment. Reduced (or eliminated) paperwork in supply chain processes increases efficiency through decreased response times. Similarly, traceability

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

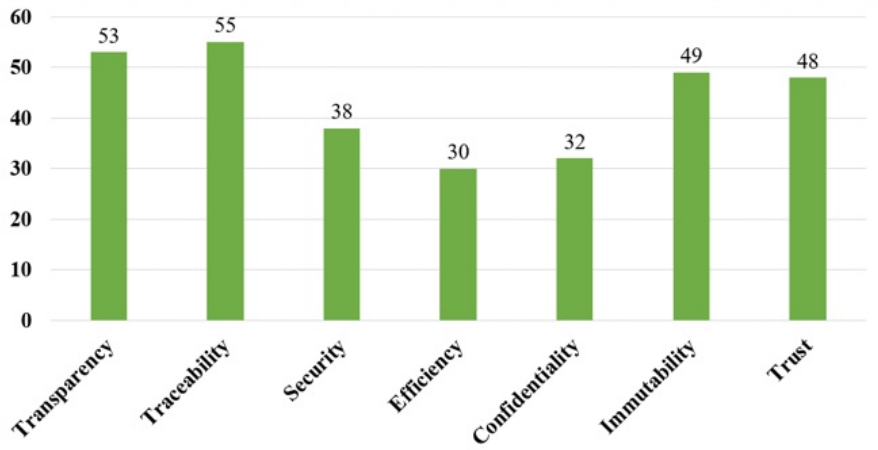

Figure 1. Blockchain features addressed in case studies

increases or goes hand-in-hand with supply chain visibility. Digitalizing the processes also reduces risk of error while removing geographic boundaries and providing easier access from all over the world.

Blockchain technology also enables flexibility in supply chains. Since data is transferred in an automated environment with digital interfaces, instead of through constant physical document exchange with couriers, the data record stored in the blockchain ledger can be available anytime. Data transparency contributes to data accessibility and information sharing among stakeholders, thereby increasing and enabling improved communications. Blockchain systems likewise facilitate interoperability in a way that aims to connect the participants of the ecosystem, while providing secure data exchange and confidentiality through decentralization and data encryption. Since complete transparency may not be desirable for some (or many) transactions in a distributed ledger ecosystem, a private permissioned blockchain option, or cases of semi-transparency for certain parties in a supply chain, may be the appropriate choice.

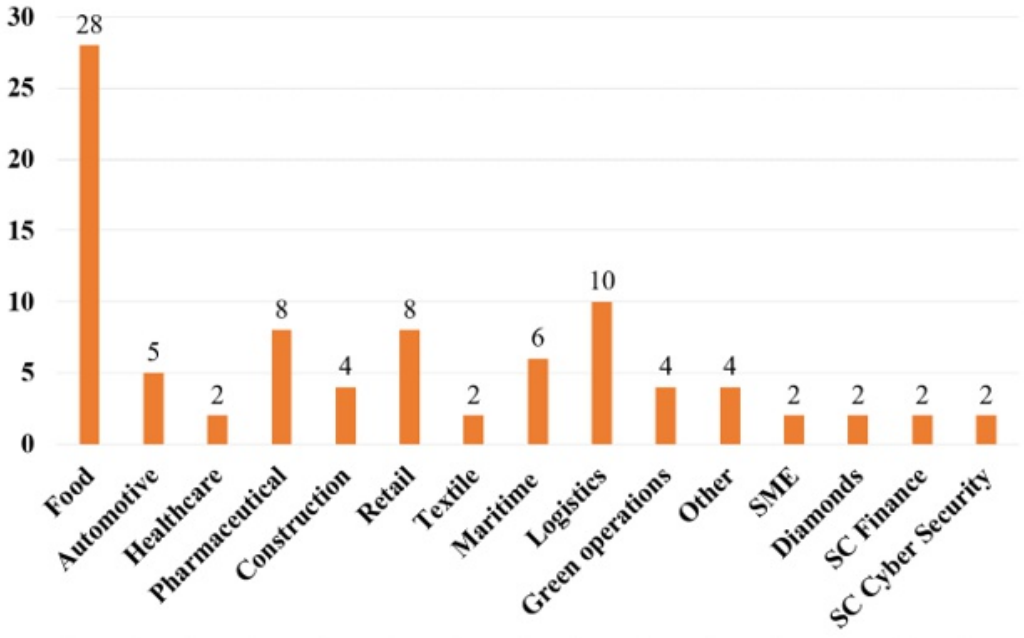

Figure 2. Leading sectors for case studies in the blockchain-supply chain field

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

Finally, blockchain technology provides immutability, which prevents counterfeting of documents, and, thus, increasies trust between parties in the supply chain. "Smart contracts" enable more efficient business arrangements by generating automated documentation for use in a supply chain, which are among the most commonly mentioned advantages of blockchain implementation. If records in a supply chain could be immutable and eliminate counterfeting, this would ensure a high level of trust. With need for intermediaries removed, no single company then has control over the entire business process in an ecosystem, thus eliminating issues like disclosure and accountability, while being cost effective.

4.4 What are the biggest challenges to adopting blockchain technology in supply chains?

The most common challenge emphasized in the case studies is the uncertain regulatory environment. Uncertain and divergent laws and regulations negatively impact the efficiency and effectiveness of international trade applications, as organizations have the tendency of being reluctant to adopt blockchain without relevent national or international regulations. This may spread an unhelpful generalization of blockchain systems, causing small and medium enterprises, farmers, and other small scale members of the supply chain to avoid blockchain technology.

A second common challenge is scalability. Although data handling has come a long way and verification durations can be reduced substantially with blockchain accounting, due to complexity of data produced throughout supply chain processes, the amount of time spent data handling and verifying is still not yet acceptable for IoT environments, where timing is crucial. The case studies mention that available DLT systems can be used for small scale operations, whereas it is better with large scale operations for organizations to build their own blockchain system, though this generate additional costs for implementation.

Thirdly, a common challenge is the requirement to technologically and socially understand blockchain systems. With digitally driven global trade, blockchain implementations require considerable network size and speed. Hence, it constitutes a critical problem if only small parts of a supply chain have the required infrastructure, while the rest do not. Simply put, old-fashioned, conservative social mindsets along with lack of current technological understanding for blockchain implementation in supply chains, are challenges which must be faced. Another major challenge refers to one of the main features of blockchain systems, which is transparency. This research shows that complete transparency is not a desirable feature for blockchain implementation in certain sectors. Transperency issues primarily came up under data privacy concerns for pharmaceutical and food supply chains. If blockchain implementation is not successful, disruption in logistics processes creates difficulties with supply chain transparency and traceability. The option of deploying a private permissioned blockchain is an alternative when transparency is a main concern, though it will likely be costly. For implementations that provide their customers direct public access to the blockchain, privacy concerns are more likely to arise.

In addition to these concerns, the risk of cyber attacks appears to be another major challenge for blockchain implementation. Digitalization, while providing many benefits, also opens sectors to cyber crime. Though one of blockchain's main features is security provided by the distributed network structure, the relevant studies deem extra countermeasures necessary regarding cyber attacks.

Finally, adopting blockchain can be a great challenge in itself. While common standards for distributed ledger systems remain elusive, it is unrealistic to think of blockchain as a "one-size-fits-all" type of technology. It is difficult to create a supply chain where all parties, small and big, are users of a blockchain ledger, without a standardized environment, along with sound regulatory, technological, privacy, and scalability strategies. All these unsolved challenges have led people who use and operate supply chains to be reluctant to invest in blockchain technology, which, for certain sectors, is still considered risky.

5. Conclusion

Global supply chains are a key area for applying blockchain distributed ledger technology. The reasons why supply chains are a potentially high-gain area for blockchain implementation include its complex network structure comprising of multiple stakeholders, eliminating intermediaries and paperwork, and increasing transparency, traceability, and efficiency.

The earliest blockchain-supply chain case studies found in the WoS database are from 2018, while the majority of

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

studies were published in 2020. While this small time window offers a perspective on trends in these case studies, it also limits the possible scope of the study.

Overall the case studies regarding blockchain implementation in supply chains are dominated by food supply chain cases. Most of the food supply chain case studies sought traceability, efficiency, and transparency enabled by blockchain, as a way to increase efficiency in the supply process while improving cost effectiveness. This tendency was mirrored in case studies of retail, pharmaceuticals, general logistic processes, automotive, maritime, construction, and green operations. In the case studies reviewed, the most commonly mentioned supply chain beneficial features of blockchain were traceability and transparency, while immutability and trust also displayed importantly in the literature.

Benefits of blockchain implementation in supply chains from the case studies mostly refer to the features of distributed ledger systems. The main benefits of using blockchain in supply chains include real time data handling with monitoring and controlling of data in a virtual environment, less paperwork, increased efficiency with faster response time, increased supply chain visibility, and reduced geographic limitations. Blockchains also gain advantage from flexibility, as data transparency provides data accessibility and information sharing among the participants of the ecosystem, increasing communication potential. Interoperability, which connects all network users in a secure environment, increases efficiency and transparency. The immutability feature of blockchain increases trust by preventing counterfeiting, while also eliminating intermediaries, increasing efficiency, improving supply chain operations, and helping achieve supply chain strategies.

Blockchain, however, comes with its own challenges, including the current uncertain regulatory environment, scalability complexities, adequate technological understanding and requirements, issues involving transparency and privacy, as well as cyber threats. Diverse laws and regulations prevent the efficiency of international trade applications, and cause reluctancy to adopt blockchain supply chain solutions. For data handling in small scale operations, available DLT systems can be used, while for large scale operations it is better for organizations to build their own blockchain system, although that generates additional implementation costs. Conservative decision-making processes can make it difficult for an organization to accept technological developments, thus diminishing the impact of blockchain features if not preventing the organization from adoption. Transperency issues have been mentioned involving data privacy concerns, with complete transparency not a desirable feature for blockchain implementations in certain sectors. With a lack of common standards, it is unrealistic to think of blockchain as a "one-size-fits-all" type of technology. Finally, while blockchain digitally speeds up supply chains, it also opens them to the threat of cyber attacks.

Our paper contributes to the literature by showcasing the use of blockchain in supply chains via multiple case studies, by learning from early adopters of blockchain technology in supply chain practices, and by providing information regarding the main expectations supply chain stakeholders bring when considering blockchain implementation for their processes. Though our aim in analyzing multiple case studies for this research was to enable a wider range of analysis and minimize researcher bias, the study still had a number of limitations. These include having analyzed the benefits and challenges captured from cases in specific supply chain domains in a way so as to provide only generalized results, as well as conducting the electronic search only in the Web of Science database.

To conclude, this study was essentially a review of case studies, revolving around a number of research questions that were asked of each case study. Therefore, our learning aim from early adopters was limited to the main trends in blockchain adoption and reasons for organizations to get involved. Building on this, further research should be conducted to understand what the various features of blockchain really mean for organizations and how they function in real life. Traceability, for example, could be a good topical starting point to focus on developing a further understanding of how global supply chains increase traceability using blockchain. An additional research paper might still review several cases, but this time looking at the details of each case for the predefined blockchain feature. A similar approach could be used to examine blockchain implementation in certain sectors. In this manner, focusing on how global food supply chains solve the problem of provenance through blockchain technology, or how global supply chains are increasing the efficiency of their operations through the use of blockchain, could help spread the knowledge gained at global-enterprise level to local players. Better

Learning from Early Adopters of Blockchain Technology: A Systematic Review of Supply Chain Case Studies

Sevda Dede, Mesut Can Köseoğlu, H. Funda Yercan

understanding "how" blockchain technology contributes to solving certain business problems at this early stage might also require qualitative in-depth interviews.

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