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Effect of Blockchain Technology for Sustainable Performance in Supply Chain Management

Wpływ technologii Blockchain na zrównoważoną wydajność w zarządzaniu łańcuchem dostaw

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Abstract
This article discussed the major effect of blockchain technology for sustainable performance in Supply chain management (SCM). Blockchain technology is a technology that performs several operations without letting the information get lost. This digital technology of blockchain will show the potential to reshape the management of supply chain operations in various companies. We will investigate the impact of blockchain technology in relation to efficiency and sustainability. As an example recently the operations in the airport industry have been improving due to technological advances as blockchain technology is handling all the information in the warehouses about product delivery and services in SCM. This technology allows companies to track all types of transactions more securely and transparently and blockchain technology shows benefits, especially in terms of improving Operational Management. The technological disruptions that have an effect on operations must include A-CDM (Airport collaborative decision-making) disruption management and there should be a collaborative network where everyone shares mutual trust and common culture in order to avoid disruption. Airports are still under research in terms of managing blockchain technology efficiently and effectively. The database which is decentralized causes the transactions to be transparent, reliable, traceable, and efficient to supply chain management. This article will be useful to understand the importance of blockchain technology for maintaining sustainability in the operations of SCM along with that we will take an example of SCM in the airport industry to understand how this technology is used there.

Key words: blockchain technology, digital technology, Supply Chain Management, sustainable development

Streszczenie
W tym artykule omówiono główny wpływ technologii blockchain na zrównoważoną wydajność w zarządzaniu łańcuchem dostaw (SCM). Technologia blockchain to technologia, która wykonuje kilka operacji, nie pozwalając

na utratę informacji. Ta cyfrowa technologia pokaże potencjał do zarządzania operacjami łańcucha dostaw w różnych firmach. Zbadamy wpływ technologii blockchain na wydajność i zrównoważony rozwój. Przykładowo, operacje w branży lotniskowej poprawiają się dzięki postępowi technologicznemu, ponieważ technologia blockchain obsługuje wszystkie informacje w magazynach o dostawie produktów i usługach w SCM. Technologia ta pozwala firmom na bezpieczniejsze i bardziej przejrzyste śledzenie wszystkich rodzajów transakcji, a technologia blockchain przynosi korzyści, zwłaszcza w zakresie poprawy zarządzania operacyjnego. Zakłócenia technologiczne, które mają wpływ na operacje, muszą obejmować zarządzanie zakłóceniami A-CDM (wspólne podejmowanie decyzji w porcie lotniczym) oraz powinna istnieć sieć współpracy, w której wszyscy podzielają wzajemne zaufanie i wspólną kulturę, aby uniknąć zakłóceń. Lotniska wciąż są przedmiotem badań pod kątem wydajnego i efektywnego zarządzania technologią blockchain. Zdecentralizowana baza danych sprawia, że transakcje są przejrzyste, niezawodne, identyfikowalne i wydajne w zarządzaniu łańcuchem dostaw. Ten artykuł będzie przydatny do zrozumienia znaczenia technologii blockchain dla utrzymania zrównoważonego rozwoju w operacjach SCM na przykładzie SCM w branży lotniskowej, aby zrozumieć, w jaki sposób ta technologia jest tam wykorzystywana.

Słowa kluczowe: technologia blockchain, technologia cyfrowa, zarządzanie łańcuchem dostaw, zrównoważony rozwój

1. Introduction

In worldwide supply chain, the COVID-19 pandemic has demonstrated a serious lack of data exchange and visibility. Blockchain technology has become an important tool for establishing resilient supply chain management. Blockchain technology is built on the concept of a decentralized, replicated, and immutable digital ledger (Kumar et al., 2020) that allows parties to conduct business in a trusted and transparent way without the use of a central authority or intermediary. Once data has been input, it cannot be removed. Payment system applications, such as Bit coin, are by far the most prevalent (Adams et al., 2017). This uncontrollable technology is expected to offer considerable commercial value to a range of industries, including supply chain management (SCM), by increasing visibility, responsibility, and confidence in inter-organizational business collaboration. For instance, People can use blockchain technology to augment and track freight and passengers in real time from their point of origin to the complete supply chain. By identifying and confirming the time and location of actions, blockchain technology allows all parties in the supply chain to know who is doing what (Alam, 2016). SCM is being rethought, reinvented, and changed all around the world with the help of blockchain technology (Khokhar, Hou, et al., 2020). Furthermore, using this technology to optimize complex value networks aims to boost efficiency not only at the individual firm level, but also at the company-wide level in order to develop a sustainable SC that uses precious resources efficiently (Khokhar et al., n.d.). In logistics and supply chain, blockchain technology has a number of advantages. Improved security and cyber security, accountability and transparency, fraud prevention and traceability are only a few of the benefits (Dutta et al., 2020).

By the adoption of blockchain technology in SCM, it makes Operations management safer and more secure, efficient, transparent, transferable. Furthermore, this technology can improve SCM participant cooperation which has an indirect positive impact on supply chain cost and efficiency (Holbrook, 2020). Due to the traceability of blockchain technology throughout the supply chain, it can help increase customer trust. Furthermore, it encourages the prevention of counterfeit commodities throughout the supply chain, which has resulted in cost savings and increased efficiency (Queiroz & Fosso Wamba, 2019). The companies also tend to place a lot of emphasis on the adoption phase while overlooking other aspects such as required management, organizational strategies, and policies that lead to successful blockchain technology, as well as the connection of its three components' sustainability (Environmental, Social and Economic) (Saberi et al., 2018). This article aims to focus on blockchain-based supply chain and its contribution to three major areas of sustainability such as economic development, environmental performance, and social gains.

Correspondingly, our primary research focused on the significant implications of blockchain technology for achieving long-term SCM performance. For instance (Saberi et al., 2018) discussed numerous blockchain adoption challenges in the supply chain, as well as how they might affect local and global supply chain technology. It also takes sustainable view of performance, using the airport business as an example. We focus on sustainable performance, which is related to the concept of sustainability, in order to establish a link between blockchain technology and the three major areas of sustainability: environmental (such as waste management), social (such as public perception), and governance (such as governance) (such as corporate management) (Saberi et al., 2018). In order to achieve high sustainable performance, we also give a case study to analyze the implications of blockchain technology and the players' involvement within the supply chain associated to airport sectors. The first reason for considering the airport sector was that it is important in SCM. Second, because of the adoption of new and technologically advanced applications, blockchain technology has resulted in significant changes in the airport industry (Khokhar, Iqbal, et al., 2020). At last, The environmental, social, and economic impact of the airport industry is becoming more widely recognized, requiring a significant level of attention in the search for technical

and managerial solutions to achieve long-term performance while minimizing adverse effects of technological disruptions.

Through case study, we intend to answer two questions. First and foremost, what is the main relationship between blockchain technology and supply chain sustainability? Is blockchain technology having an impact on supply chain management? The study adds to the body of knowledge by examining the influence of blockchain on supply chain management and emphasizing sustainability performance. More particularly, this research can be used to learn about the managerial solutions needed to implement blockchain technology efficiently and successfully in the airport industry which is one of the most significant in SCM, from a sustainable performance perspective.

This paper is organized as follows. Section 2 provides an outline of the research's important components, like the important challenges associated with blockchain technology, airport sustainability, and organizational management. Section 3 explains the methodology utilized in this investigation. The Example related to Airport industry is described Section 4. The key findings are reported and written in section 5. Finally, in section 6, the study's conclusion and limitations are discussed, as well as future research objectives.

2. Literature Review

2.1. Blockchain technology

Blockchain technology has just recently gained attention as *one of the most promising technologies of the new economy* (Di Vaio & Varriale, 2020). The uses of blockchain technology in relation to the bitcoin cryptocurrency have received the most attention (Mattila, 2016). Blockchain technology consists of distributed ledger technology (DLT), which is a distributed transactional database in which personal information and trust in the collection and sharing of data are ensured by cryptography via a consensus method. As a result, Blockchain might be viewed as a ledger (Xie et al., 2018) in which transactions are stored in a blockchain that grows continuously when new blocks are added to it. The key features of blockchain technology, recognized as the main benefits, are decentralization, persistence, anonymity, and auditability. Due to this technology, the expenses can be significantly lowered and efficiency enhanced. In fact, blockchain technology is a new sort of disruptive Internet technology that is frequently employed by technological organizations to improve their manufacturing processes and reduce costs.

2.2. Block chain technology in the SCM

There have been several types of researches carried out by scholars about the blockchain technology in the management of supply chain operations. This technology is helping the companies to easily keep a record of all the products which are being delivered and then collected from the warehouses by keeping an extract track of the products. One of the benefits identified for the blockchain technology is that it facilitates the management of identities as well as the measurement of results and the performance of key SCM activities (Khokhar, Hou, et al., 2020). When talking about blockchain technology it can be divided into private and public blockchain technology, in the public technology of blockchain technology everyone is allowed to engage in all kinds of transactions while in the private technology of blockchain there are only certain individuals who are allowed in assessing the transactions. As with the advent of blockchain technology it is compared with internet and it is seen to create a groundbreaking performance in the number of industries. Previously, transactions were formerly stored in a centralized hub system, and information was communicated directly to participants. Supply chain management is the process of storing, transporting, and distributing finished commodities to final clients or consumers. (Kumar et al., 2020). Blockchain technology brings several advantages which includes increasing the efficiency of the supply chain with security and the synchronized transactions. The Table 1 shows the advantages of Blockchain Technology in SCM.

Table 1. Advantages of Block chain Technology in SCM, source: own compilation

Advantages of Blockchain in SCM	Description
Improves Transparency	Aids in the tracking of an item's state during a process. Data analysis tasks are automated. End-to-end transparency via a hierarchy of permission levels
Operational Efficiency	Improves the speed of the SC process from start to finish. To make the process more robust, it identifies problems and issues early on.
Improves Response time	Creates a dynamic, real time SC that makes greater use of its resources
Data Management	Enhances the security of the data saved. All information is captured in real time.
Intellectual Property (IP)	IP registration and protection.
Disintermediation	This results in a continuous flow of transactions. Boosts the speed Increases the level of trust among the process's stakeholders.
Traceability	For all modifications, there is a consensus method. Ensures that all transactions are secure.

2.3. Block chain and the sustainability of the environment

The sustainability of the environment is linked with the natural resources and the amenities of the environment (Wang et al., 2019). Within the context of supply chain management, it is rising during the early phase when the raw materials are processed which is that they are flowing from the environment naturally and then into the processes of production as well as consumption, then moving to the next phase where pollution is emitted from the economic activities. The sustainability of the SCM in relation to the environment requires effective and optimal management of the natural resources and it requires proposing a strategic framework for the green supply chain management (Khokhar, Iqbal, et al., 2020). As we discuss the nature of block chain technology its effect on reliability, traceability and the transaction processes which are synchronized while also maintaining the efficiency of the cost makes the management of the supply chain better and more effective. Particularly this block chain technology can help in enhancing the environment by using two effective indicators, firstly it is the tracking of the environment emission system, in this block chain technology helps in tracking those locations and areas where there are waste emissions, carbon emissions, or any kind of pollutants so that action can be taken for reducing these emissions to comply with the policies of the environment. In waste management, block chain technology allows to manage and track the areas where there is waste produced so that these wastes can be recycled and used for external usage (Dutta et al., 2020).

3. Application of Block Chain Technology In The Airport Industry

Our study is focused on the effects of supply chain management and the usage of block chain technology to effectively manage all activities. The transportation industry has seen the benefits of block chain technology in the airport sector.

The airport sector has been undergoing related changes over the past two decades as it has been significantly impacted by a new arrival of block chain technology (Cole et al., 2019). Considering the main impact of block chain technology, a very broad revolution is underway, stemming from the establishment of standards of operations for service performance in the airport (Saucedo et al., 2018) industry for the reason of adopting new technologies. According to the airport industry's mission and vision, which includes offering strict and responsive high-standard operation services, as well as collective passenger attitudes and demands. The factors which are critical for the airport sector are concerned for the levels of services and the standards of operation which are based upon planning, queuing time, and processing of the service time. The introduction of blockchain technology has made it easier to carry out all these concerns related to the services and the standards of operation in the airport industry (Corrigan et al., 2014).

Blockchain application new technology and A-CDM enable for automation at airports as much as possible to improve the flow of information and introduce digital services (Nadeem, 2018). Airports may improve their performance by implementing a variety of effective and efficient methods. Sustainability, For example, it is easier to send information to passengers, airlines, people, and other users while learning more about airport systems, which will provide value, as well as passengers and other partners, and this will allow the airport to get more information. As mentioned earlier, most airports and airport authorities should update their operations and the procedures are taken into account the perspectives of the passengers, so this will maximize their satisfaction by offering a more comprehensive service level for the customers. In Figure 1we can see the basic blockchain model that can be used in airport industry.

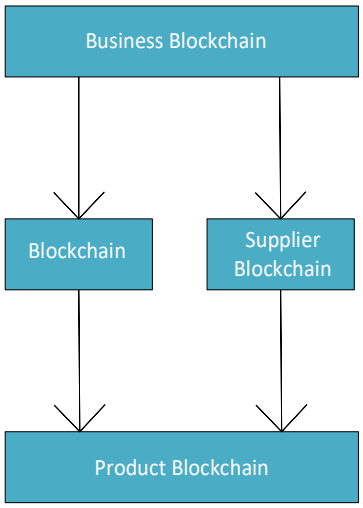

Figure 1. Model of blockchain, own interpretation

4. Cost Efficiency

The effectiveness of the application of block chain can also cause reductions in the cost in relation to the quality of the product, then the business transactions which are going on in the supply chain management among the supply chain partners. The disintermediated approach of using the block chain can reduce the cost of transactions which were seemed to be unfeasible several years before (Khokhar, Iqbal, et al., 2020). Additionally, the costs which are usually incurred at the products and services can be removed as this technology can reduce the overhead costs on these products like block chain can reduce the costs of manufacturing firms related to the network costs associated and also usher for the construction of a market in the industry of manufacturing. Results according to research show that before and after using the blockchain technology the profits have been increased due to the transparency and cost-effective nature of the block chain technology while also it maintaining the sustainability of the firm (Xie et al., 2018; Alam, 2016). Another promising application of this technology is that it helps in the allocation of resources efficiently and effectively and allows every business to have its assets managed according to the logistics. This helps to create a business model which is fair and as we discussed that in the operations of the airport industry it helps in carrying out the services efficiently for the passengers there.

5. Methodology

This section of the research paper describes how the research was carried out and what all sources of data were used to collect the information. In general, there are two sources of data collection methods which are the primary method and the secondary method of collecting data. In our research we have used the secondary data collection method in which we carry out research through different journals and articles, we have selected this method because firstly it is easier to carry out research through this method and also because we didn't even have enough participants who would help us provide opinions or answer our questions. This research is qualitative because there is mostly descriptive data here and not much statistical analysis is carried out because our topic is theoretically based and requires more descriptive justifications rather than statistical analysis. We have provided all relevant explanations and implications of our data in the section of the literature review.

A two-step research process was followed in this theoretical and practical study. First, we did a comprehensive assessment of the major contributions to blockchain technology in the literature. The link between technology, operations, sustainability, and supply chain management received special emphasis. We also looked at these issues and their intersections in the airport industry, which is constantly and profoundly shaped by deep technological developments but has yet to be completely investigated. The standard steps for conducting a broad literature review were followed. We began our research by conducting a keyword search in the Google Scholar database to find the most relevant studies. The study is used to combine specific keywords such as *Blockchain, Technology, Blockchain technology, Supply chain management, Sustainable performance, Blockchain-based supply chain, Blockchain sustainable supply chain, Supply chain and airport industry, Barriers in blockchain technology* and *Airport industry and disruption management*. We researched Google Scholar for journal articles, academic books, supply chain management related new articles from 2018-2022. As a consequence, we revised 20 references in total.

Second, we began our investigation in 2018 articles because blockchain technology had just recently begun to attract the attention of academics and it has turned into an intriguing research topic Third, the papers had to be written in English and include at least one of the selected words and concepts in the title, abstract, or keywords. In the implementation of blockchain technology in supply chain management, sustainability is a major topic.

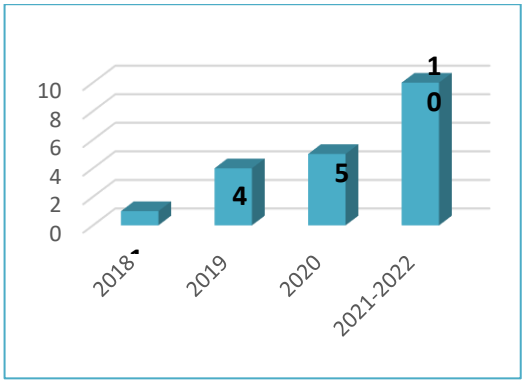

Figure 2. Distribution of 20 literature review collections during 2018-2022, own calculation

The usefulness of blockchain technology in supply chains is definitely increasing as evidenced by the 20 references gathered for this study, we anticipate that this research topic will grow as more organizations adopt blockchain technology in their supply networks Despite the fact that there is literature on blockchain and sustainability, the

potential indicators for sustainability have yet to be properly examined. This study aims to discover how to quantify sustainable indicators within a blockchain-based supply chain framework through a review of the literature. There is a summary of 20 literature review collections from 2018 to 2022 in the above Figure 2.

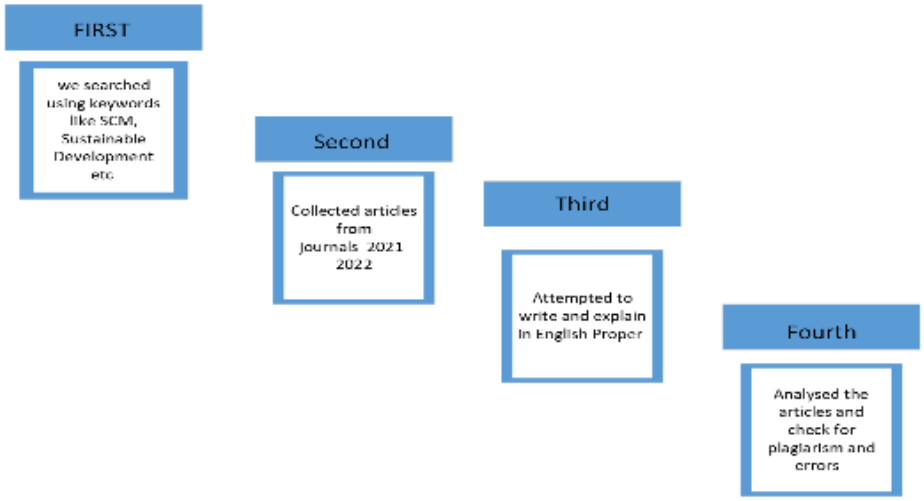

Figure 3. Phases of the research process, own interpretation

The above model (Figure 3) provides a clear description of how we carried out our research process and it is described in the stages moving from the 1st phase and finishing at the 4th phase. The airport industry has also been recently emphasizing the importance of sustainability, including the environment, social and economic dimensions as well. The literature review identified important elements related to how the operations are being carried out in the airport industry using the blockchain technology for improving the operations and the efficiency of the supply chain management activities.

The challenges of sustainable development require efforts that are collective and especially the three pillars of sustainability are important considerations for this research. The main criteria required for the environment include that the utilization of resources should be done effectively, then the wastages should be managed while social equity requires several issues about the health of the workers and the diversity of the workplace while providing equal opportunity to all members. Considering these three pillars of sustainability and also the adoption of block-chain technology in the airport industry where the services of the passengers are improved we have provided a framework and a collective advantage of the implications of the blockchain technology.

In this research we also analyzed the airport system in which its operations are going on like the transfer of luggage, then the department where all the flights are tracked where the blockchain technology is helping to keep a track of the systems and there isn't any kind of fraud or difficulty in the systems. A preliminary examination of the selected papers was done manually so that we ensure that the articles which we have chosen are related to the topic. For the term as said sustainable, we have used different forms to search for the relevant articles, and for blockchain technology, we have also checked the usage of technology in the airport industry because through our research we realized that the transport industry does have many positive benefits of it. There were some articles that were also paid and due to which we weren't able to access them, but somehow managed to gather information through the abstract.

The section of literature is considered the most important part of the research so we classified our research for literature in a professional manner by first introducing the important terms like blockchain and sustainable so that it gets easier to go with the flow and record the data. Lastly, the articles which were in deep detail and covered financial reports weren't much use to us so we have put our main focus on the collection of data qualitatively

6. Findings

In this research, we carried out a detailed discussion about the implications of blockchain technology in supply chain management and the role it has played in its sustainable development. With the evolution of blockchain technology, the findings indicate that it has created a chain of secure, decentralized ledgers, and digital networks without any threat of invasion of privacy of data. Blockchain technology has led us towards the identification of improving efficiency by the use of smart contracts through innovative applications which helps to save time and risks associated.

As the research also discussed how the airport has made use of the blockchain technology for airport collaboration decision making (A-CDM) for an efficient flow of information and to enable sustainability for the passengers by ensuring that the operations aren't delayed related to the functioning of the aircraft during the time of flights.

Furthermore, this technology has led to a reduction in costs by tracking all the data of passengers on time within seconds of computer processing.
Throughout the research, another important finding was that the adoption of blockchain technology in terms of ecological perspective has reduced the environmental footprint of logistics, which means the operations of logistics management have improved the process of manufacturing. As discussed above in the literature that blockchain technology can identify all sorts of non-renewable resources and remove them with renewable and energy-saving resources for benefiting the environment.
In general, some intriguing conclusions can be derived from the example provided analyze that this study could be useful as an indication for managers, particularly supply chain managers in the industries (e.g. Airport), in rethinking, redesigning, and remodeling organizational processes, as well as introducing and promoting training and educational programs for employees' and stimulates cultural change in digital. The disruptions that may cause by blockchain technology can be handled in this way by involving everyone in the process by making interactions. We found some insights into how blockchain technology can favorably improve Operations management in SCM for sustained performance by analyzing distinct approaches. Some of the issues related the technology are identified through the example and we approach these issues differently. Hence, it is quite difficult to obtain proof supporting key benefits and challenges of implementing blockchain technology in supply chain management but we researched and investigate blockchain technology in SCM. Throughout the research, we have discovered the influence of blockchain technology on sustainability has been steadily expanding in recent years, claiming that blockchain platforms have a beneficial impact on sustainability.

7. Conclusion

The aim of this study is to implement the use of blockchain technology in supply chain networks in this study. The emergence of blockchain-based supply chain management is discussed, which allows for the creation of shared, secure, decentralized ledgers, autonomous digital contracts (smart contracts), and reliable and secure networks. This article examines supply chain management's long-term sustainability in terms of environmental preservation, social equality, and governance efficiency. We compiled the papers using systematic literature analysis in light of three bodies of literature: Blockchain technology, Blockchain and sustainability, and Blockchain-based supply chain. Finally, our study provides new insights into how blockchain technology can dramatically improve OM in SCM for sustained performance. We have highlighted some advantages and disadvantages related to blockchain technology, especially in the example of the Airport industry. In general, as past studies have shown, blockchain technology can automatically construct a trust system for executing value exchange and increasing the performance of businesses. In fact, implementing blockchain technology may efficiently manage and overcome information gaps among supply chain parties. Given the increasing adoption of blockchain technology by businesses, an empirical analysis assessing the effects of blockchain technology on sustainability performance could be a potential research subject for future research with theory development. In the future, our study can be improved by taking into account other industries and making a comparison of how blockchain technology adopted in different industries as well. In this scenario, it's also worth looking into if and how cultural and social factors influence the benefits of blockchain technology in SCM for long-term success. Moreover, our research helps different organizations that can take advantage of implementing blockchain technology in SCM.

References

1. ADAMS R., PARRY G., GODSIFF P., WARD P., 2017,. The future of money and further applications of the blockchain, *Strategic Change* 26(5): 417-422, DOI: 10.1002/JSC.2141.
2. ALAM, 2016, Why the auto industry should embrace Blockchain, *Connected Car Tech*.
3. COLE R., STEVENSON M., AITKEN J., 2019, Blockchain technology: implications for operations and supply chain management, *Supply Chain Management* 24(4): 469-483, DOI: 10.1108/SCM-09-2018-0309.
4. CORRIGAN S., MARTENSSON L., KAY A., OKWIR S., ULFVENGREEN P., MCDONALD N., 2014, Preparing for Airport Collaborative Decision Making (A-CDM) implementation: an evaluation and recommendations, *Cognition, Technology & Work* 17(2): 207-218, DOI: 10.1007/S10111-014-0295-X.
5. DI VAIO A., VARRIALE L., 2020, Blockchain technology in supply chain management for sustainable performance: Evidence from the airport industry, *International Journal of Information Management* 52: 0-1, DOI: 10.1016/j.ijinfomgt.2019.09.010.
6. DUTTA P., CHOI T.M., SOMANI S., BUTALA R., 2020, Blockchain technology in supply chain operations: Applications, challenges and research opportunities, *Transportation Research. Part E, Logistics and Transportation Review* 142: 102067, DOI: 10.1016/J.TRE.2020.102067.
7. HOLBROOK J., 2020, *Architecting Enterprise Blockchain Solutions* 1-28, Wiley & Sons, DOI: 10.1002/9781119557722.
8. KHOKHAR M., HOU Y., RAFIQUE M. A., IQBAL W., 2020, Evaluating the Social Sustainability Criteria of Supply Chain Management in Manufacturing Industries: A Role of BWM in MCDM, *Problemy Ekorozwoju/ Problems of Sustainable Development* 15(2): 185-194.
9. KHOKHAR M., IQBAL W., HOU Y., ABBAS M., FATIMA A., 2020, Assessing supply chain performance from the

perspective of Pakistan's manufacturing industry through social sustainability, *Processes* 8(9): 1064, DOI: 10.3390/pr8091064.
10. KHOKHAR M., ZIA S., ISLAM T., SHARMA A., IQBAL W., IRSHAD M., 2022, Going Green Supply Chain Management During COVID-19, Assessing the Best Supplier Selection Criteria: A Triple Bottom Line (TBL) Approach, *Problemy Ekorozwoju/ Problems of Sustainable Development* 17(1): 36-51, DOI: 0.35784/pe.2022.1.04.
11. KUMAR A., LIU R., SHAN Z., 2020, Is Blockchain a Silver Bullet for Supply Chain Management? Technical Challenges and Research Opportunities, *Decision Sciences* 51(1): 8-37, DOI: 10.1111/DECI.12396.
12. MATILLA J., 2016, The Disruptive Potential of Distributed Consensus Architectures, *ETLA Working Papers.*
13. NADEEM S., 2018, *Can blockchain disrupt the traditionalairline distribution for the better?If so, what are the benefits of thisnew technology, and how canit be implemented,* University of Westminster, DOI: 10.13140/RG.2.2.29301.42726.
14. QUEIROZ M.M., FOSSO WAMBA S., 2019, Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA, *International Journal of Information Management* 46: 70-82, DOI: 10.1016/J.IJINFOMGT.2018.11.021.
15. SABERI S., KOUHIZADEH M., SARKIS J., SHEN L., FOISIE R.A., 2018, Blockchain technology and its relationships to sustainable supply chain management Blockchain technology and its relationships to sustainable supply chain management, *International Journal of Production Research* 57: 2117-2135, DOI: 10.1080/00207543.2018.1533261.
16. SAUCEDOJ., LARA M., MARMOLEJO J. A., SALAIS T., SAUCEDO-MARTINEZ, J. A., PEREZ-LARA M., MARMOLEJO-SAUCEDO J.A., SALAIS-FIERRO T.E., VASCANT P., 2018), Industry 4.0 framework for management and operations: a review Game-based Analysis of Management Engineering Problems View project Industry 4.0 framework for management and operations: a review, *Journal of Ambient Intelligence and Humanized Computing* 9: 789-801, DOI: 10.1007/s12652-017-0533-1.
17. WANG Y., HAN J. H., BEYNON-DAVIES P., 2019, Understanding blockchain technology for future supply chains: a systematic literature review and research agenda, *Supply Chain Management* 24(1): 62-84, DOI: 10.1108/SCM-03-2018-0148.
18. XIE Z., DAI S., CHEN H.-N., WANG X., 2018, Blockchain challenges and opportunities: a survey, *International Congress on Big Data* 14(4): 352-375, DOI: 10.1504/IJWGS.2018.10016848.