Blockchain and its Potential in the Digitization of Land and Real Estate Property Records

Vagelis Plevris
Department of Civil and Architectural Engineering, Qatar University, Doha, Qatar
vplevris@qu.edu.qa

Hassan Abdallah
Department of Civil and Architectural Engineering, Qatar University, Doha, Qatar
ha2003260@qu.edu.qa

Azzam Alnatsheh
Department of Computer Science and Engineering, Qatar University, Doha, Qatar
aa1802605@qu.edu.qa

Abstract

A blockchain, is a decentralized digital ledger that is distributed across multiple computers, recording transactions in a way that cannot be altered without the consent of the network and the alteration of all subsequent blocks. In the context of land and real estate property records, a blockchain could be used to securely and transparently track the ownership and transfer of properties. Using a blockchain to digitize land and real estate records can have several benefits. For example, it can help reduce the risk of fraud, as all transactions are recorded on a secure and tamper-proof ledger. It can also make the process of transferring ownership more efficient, as it can automate many of the steps involved and reduce the need for intermediaries. Additionally, a blockchain can increase the transparency of the property market, as all records will be publicly available on the ledger. In this work, we examine the current situation and the related problems in registering land and real estate property records, especially in developing countries, and we state the challenges and opportunities of the application of blockchain technology in this field. We investigate whether blockchain has the potential to bring a positive change and play a significant role in the real estate market in the future and what are the prerequisites to achieve that.

Keywords: Blockchain; Distributed Ledger; Digitization; Real Estate; Property

1 Introduction

Blockchain is a digital ledger used to record transactions that are decentralized and distributed across a network of computers. It allows for the creation of a secure and transparent record of transactions without the need for a central authority or intermediary. Blockchain technology is still in its infancy, but it has the potential to greatly affect the Architecture, Engineering, and Construction (AEC) industry in the future, possibly even transforming it drastically for the better. Cheng et al. (2021)examined the present situation, investigating the challenges, benefits and future research opportunities of using blockchain in the AEC industry. Tezel et al., (2022) investigated the application of blockchain in the Built Environment field, with emphasis on cyber security, trust and transparency and the influence of the technology on them. Plevris (2022) presented a brief introduction to blockchain technology and its applications in fields related to civil engineering and construction. According to the study, although there are several early-stage challenges, the technology has the

potential to become a force of positive change in the AEC industry. Plevris et al. (2022) identified six key areas of the industry where blockchain can be successfully applied: (i) Building information modeling and Computer Aided Design; (ii) Contract management and smart contracts; (iii) Construction project management; (iv) Smart buildings and smart cities; (v) Construction supply chain management; and (vi) Property ownership, land titles, asset management and maintenance in real estate. The present study focuses on the sixth of the above key areas. It examines the potential of blockchain in the digitization of land and real estate property records and the improvement of the efficiency and transparency of the property ownership process. Finally, it discusses the relevant challenges in its implementation.

1.1 The Importance of Blockchain

The importance of blockchain and the increasing interest of the scientific community in it can be realized by looking at the scientific literature on the subject. By searching the Scopus database[1] with the keyword "*blockchain*" in the "*Article titled, Abstract and Keywords*" fields, one gets 39,623 document results. The query was made on January 11, 2023. Of these documents, 38,562 (accounting for 97.3% of the total) were published in 2018 or later, as there were only 1061 published articles on the topic between the years 1990-2018 (of them 817, i.e. 77%, in 2018). A similar trend can be observed when the search is limited to "Engineering". The relevant search gives 16,939 document results. Fig. **1** shows the results for every year, from 2013 up to 2022, for both cases.

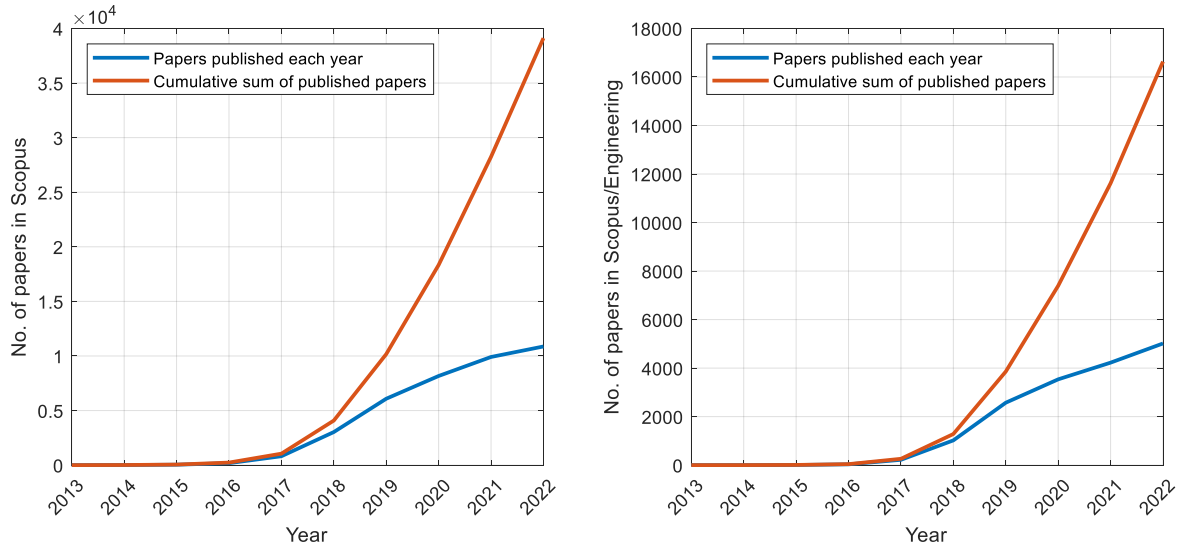

Fig. 1: Scopus Articles in "Blockchain" (Query Made on Jan. 11, 2023):
(a) All Fields, (b) Engineering Field

1.2 Literature Review

Latifi et al. (2019) investigated the applications of blockchain in real estate and how it can facilitate the industry. According to the authors, blockchain technology can sort out many of the classical issues that real estate is currently facing. By using the technology and by harnessing smart contracts, it is possible to provide liquidity to the markets, remove intermediaries and give satisfaction to all parties involved (tenants, owners, and investors). Saull et al. (2020) posed the question of whether digital technologies such as blockchain can speed up real estate transactions. The authors conducted group interviews to identify the parties involved and the individual steps of

[1] Scopus, www.scopus.com, accessed January 11, 2023.

transactions in real estate, concluding that wide collaborations in the industry are a prerequisite to help such technologies break through. The study of Kaczorowska (2019) investigated the possibilities and challenges of blockchain-based land registration. The author mentions the irreversibility of the transactions and the absence of an intermediary, highlighting the lack of independent verification and any external control, while also discussing the experience of specific countries in the implementation of the technology in land registration.

Many of the published works on the topic focus on applications in local markets or specific countries. Wouda & Opdenakker (2019) investigated applications of blockchain technology in commercial real estate transactions in the Netherlands, focusing on the development of a blockchain solution that can improve transactions related to office buildings. According to the authors, one of the major challenges is the difficulty in defining the property characteristics, due to the lack of data quality and structure. Veuger (2018) examined whether blockchain can change the game and the question of whether the entire value chain of the real estate market will embrace it in the future. The study is focused on the case of the Dutch real estate sector, but many of its findings have also a general value. The author states that the relationship between real estate and blockchain has yet to be proven in practice. In a follow-up work (Veuger 2020) it is stated that confidence in the blockchain is key for guiding that disruption. The work of Hoxha & Sadiku (2019) focuses on the case of Kosovo, studying the factors influencing the decision to adopt blockchain technology in real estate transactions in the country. According to the authors, sellers and buyers consider transparency and cost reduction as the most important factors in adopting blockchain in real estate transactions.

Ali *et al*., (2020)highlighted the limitations of traditional centralized land registry systems. Even if some of the related processes are nowadays digitized, problems remain, such as the lack of complete history of the land and no built-in mechanism for record tempering detection. They propose a transparent and trusted property registration system on a permissioned blockchain that addresses these problems. Konashevych (2020) focused on the constraints of blockchain use for real estate and property rights. According to the study, permissioned and private distributed ledger systems cannot be considered significant evolutionary steps forward in government systems. Such systems require a proper architecture of overlaid technologies to support changes in outdated and mistaken data, address issues of digital identity and privacy, legal compliance, and enforceability of smart contracts and scalability. Garcia-Teruel (2020) investigated the legal challenges and opportunities of blockchain technology applied in the real estate sector. According to the author, blockchain and the application of smart contracts can improve procedures, facilitate transactions and enhance interconnectivity. However, to not reduce the rights of the parties involved, the blockchain should have some special features, such as the possibility of being amended. Yadav and Kushwaha (2021) proposed a blockchain solution for the digitization of transactions in real estate that mitigates the possibility of falsifying documents and other fraudulent activities. The proposed system reduces overhead transmissions by around 50% by using a new consensus algorithm.

2 Distributed Ledger Technology

Distributed ledger technology (DLT) can be defined as a digital system that records the transactions of assets simultaneously, in multiple locations. It differs from traditional databases as it lacks a central data store or administrative function. Each node in a distributed ledger verifies and processes each item, creating a record and consensus on its authenticity. Distributed ledgers can be

used to store both static data, such as a registry, and dynamic data, such as financial transactions. Blockchain, a well-known application of DLT, is a decentralized, digital ledger that is used to record transactions across a network of computers. It grows constantly as new blocks with new recordings are added to it. Each block contains a link to the previous block and a timestamp, so the data in the blockchain cannot be altered retroactively without changing all the subsequent blocks and having the consensus of the network. This makes it a secure and transparent way to record transactions. The use of blockchain technology can revolutionize a wide range of industries, including supply chain management, finance, and more. There are several potential applications of blockchain technology in the construction and architecture industries, including asset tracking, i.e. tracking the ownership and transfer of immovable assets such as buildings and land.

2.1 Decentralized vs. Centralized Ledgers

A decentralized ledger is a record-keeping system that does not rely on a central authority but is rather maintained by a network of computers (nodes). In a decentralized ledger system, the nodes work together to validate and record transactions, and there is no single point of control or failure. This makes decentralized ledger systems highly resilient and resistant to tampering and censorship. On the other hand, a centralized ledger is a record-keeping system that is maintained by a central authority or organization. In a centralized ledger system, the central authority has complete control over the ledger and can decide which transactions are valid and which are not. This can make centralized ledger systems more vulnerable to tampering and censorship, as the central authority has the full power to alter or even delete transactions. Examples of such systems include traditional databases used by banks and government agencies. Both decentralized and centralized ledger systems have their advantages and disadvantages, and the appropriate choice of ledger system depends on the specific needs and goals of the application.

2.2 General Purpose Technologies

General Purpose Technologies (GPTs) are innovations that have a far-reaching and transformative impact on society and the economy. They can be implemented in many applications and sectors and have the potential to drive economic growth and productivity by enabling new products, services, and ways of operating. Some examples include the steam engine, electricity, and the internet. Such technologies have had a profound impact on society and have led to major economic and social changes, such as the industrial revolution and the information age. They are characterized by their ability to generate increasing returns and positive feedback loops, which can lead to rapid diffusion and adoption. On the other hand, they can also lead to disruption and creative destruction, as they can make existing products, services, and business models completely obsolete. GPTs often have high upfront costs and require significant investments in research and development, infrastructure, and human capital. However, they can also lead to significant long-term economic and social benefits, making them an important study area for policymakers, businesses, and researchers.

2.3 Blockchain as GPT

Blockchain has the clear potential to become a GPT due to its ability to enable new products, services, and ways of doing things across a wide range of applications and sectors. Some uses of blockchain include enabling transparent and secure supply chain management, facilitating the peer-to-peer exchange of assets, enabling the creation of smart contracts, and many more. It has the potential to transform industries by increasing efficiency, reducing the need for intermediaries, and increasing trust and transparency. However, it is still a new technology in its infancy, and its

adoption and impact will depend on many factors, including the development of supporting infrastructure and the creation of proper regulatory frameworks.

3 Technical Details

Blockchain relies on several novel technologies and advancements in mathematics and computer science, such as asymmetric cryptography, hash functions, Merkle trees, consensus mechanisms, and others. In the next section, we provide a very brief description of some of these. A more detailed description of these technologies can be found in (Plevris et al., 2022).

3.1 Asymmetric Cryptography

Asymmetric cryptography, or public key cryptography, is a method of encrypting and signing information that uses a pair of mathematically related keys: a public key and a private key. The public key can be distributed and shared freely while the private key must be always kept secret. This allows for the convenient and secure exchange of information between parties without the need for them to first establish a shared secret key. A common use of asymmetric cryptography is encrypting a message or document so that only a person with the private key can read it. Another one is digital signature, which is used to sign a document, guaranteeing the authenticity of the sender.

3.2 Cryptographic Hash Functions

A cryptographic hash function is a mathematical function or algorithm that takes an input ("message") and returns a fixed-size string of characters, often referred to as the "hash". One of the main properties of cryptographic hash functions is that they are highly sensitive to changes in the input. Although the same input will produce the same output always, even the slightest change to the input will result in a completely different output, which is known as the "avalanche effect". Another property is that it is computationally infeasible to generate the same hash output from two different input values ("collision resistance") or to determine the original input value from its hash value ("Preimage Resistance"). Some common uses of cryptographic hash functions include ensuring data integrity, generating digital signatures, and password storage.

3.3 Consensus Mechanisms

A consensus mechanism is a process used to ensure that all participants in a blockchain network agree on the state of the ledger. This is important because it ensures that all copies of the ledger are identical, which is essential for the integrity and security of the network. Proof of Work (PoW) is a popular mechanism used by some blockchain networks (including Bitcoin) to achieve distributed consensus. It involves network participants ("miners") competing to solve a computationally difficult problem and the first one to solve it is allowed to create the next block. The difficulty of the problem is adjusted so that it takes a certain average amount of time to solve, ensuring that the rate at which new blocks are created is kept constant. The main purpose of PoW is to prevent fraud and ensure the security of the network by making it expensive and time-consuming to produce fraudulent blocks. Since each block is linked to the previous one, tampering with a single block would require recalculating all subsequent blocks, which would require an enormous amount of computing power and time, making it practically infeasible to tamper with the blockchain without being detected. PoW has received criticism because of its high energy consumption and the potential for the centralization of mining power. Alternative approaches, such as Proof of Stake (PoS), have been proposed to address these issues. In PoS, the creator of a new block is chosen depending on their stake in the network, where "stake" refers to the amount of assets (such as

cryptocurrency) that a user holds. The higher the stake, the greater the chance a user will be chosen to create a new block and receive the block reward. A significant advantage of PoS is that it is much less energy intensive than PoW.

4 The Current Situation in Real Estate

4.1 Problems of the Traditional Real Estate Sector

The real estate industry is considered vital to the economy and plays a significant role in people's lives worldwide. The total value of the worldwide real estate market was calculated to be $3.7 trillion in 2021 and is projected to grow at a yearly rate of 5.2% between 2022 and 2030(Grand View Research Inc 2022).Investments in real estate typically provide better returns than the stock market while being less volatile and offering tax benefits. However, the industry has not undergone much change in recent years and is still reliant on outdated methods for transactions and record keeping, especially in developing countries. Problems such as limited participation, slow and costly verification procedures, and limited foreign investments, among others, plague the industry.Fig. **2** illustrates the current real estate ecosystem, the different parties involved, and the relevant interactions and transactions among them. This traditional system has several drawbacks and limitations:

- It involves many intermediaries that slow down transactions and increase the cost.
- It requires long and laborious due diligence and financial verification processes.
- Investing abroad is costly, difficult, and slow, due to the various requirements that need to be met, including obtaining international bank accounts, financing, accreditation, having a good credit score, and having access to fund managers, sponsors and even citizenship. Due to all these, the real estate business tends to be confined to specific geographic locations.
- Transactions are often made through wire transfers, which are costly and slow to verify.
- There is limited participation as the high cost of real estate investment makes it accessible only to the wealthy, although practically everybody is interested in housing.
- It does not support fractional ownership which would be convenient for very small investors with limited funds.
- The system suffers from low liquidity as traditionally, assets in real estate are hard to exchange or convert into cash due to their high value and the expenses associated with intermediaries, every time a deal is completed.

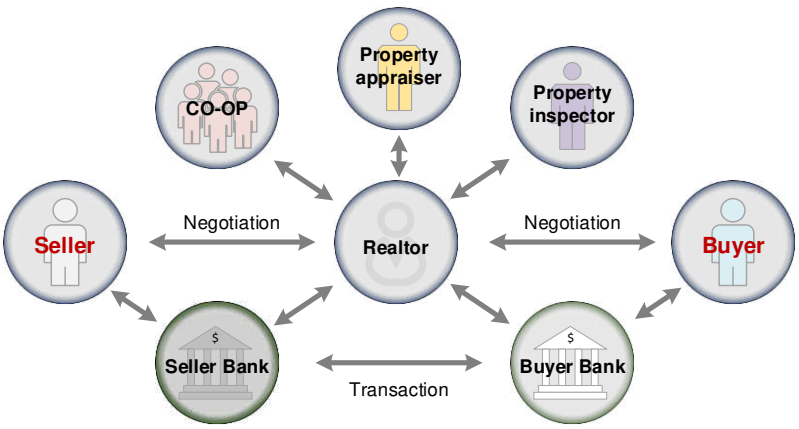

Fig. 2: An Illustration of the Traditional Real Estate Ecosystem

4.2 Solutions that Blockchain can Offer

The advent of blockchain technology can revolutionize the real estate industry by providing secure, tamper-proof digital records of ownership and transactions, stored in a decentralized way. Blockchain technology makes verification more efficient and eliminates the need for intermediaries, among other improvements.Below we discuss some of the benefits and solutions that blockchain technology can offer to the real estate industry, once it is embraced by it.

Decentralization: Decentralization in blockchain technology refers to the distribution of the system's components and decision-making authority among multiple actors, rather than being centralized in a single entity. In the context of real estate, this means that property ownership and transactions are recorded on a blockchain, rather than in a centralized database controlled by a single authority as is the conventional case today. In a decentralized blockchain system, there is not a single point of failure, and the information is shared among all the nodes, which makes it much harder to hack or tamper with the records. This reduces the cost of security and trust.

Immutability: The decentralized nature of blockchain allows for a more transparent and secure system. In the blockchain, the records that have been validated are irreversible. Thus, blockchain can ensure that the records are accurate, secure, and cannot be altered or deleted, providing a secure way to prove ownership, and simplifying transactions.

Intermediaries and Minimizing the Cost of Verification: In the traditional real estate ecosystem, the cost of verification can be quite high due to the need for various intermediaries, as illustrated in Fig. **2**, to verify ownership and transfer of properties and funds. By utilizing blockchain technology, the cost of verification can be greatly reduced. In a blockchain-based real estate system, each property and each individual will have a unique digital identity, which can be verified using digital signatures, this allows for a more efficient and secure verification process, as digital identities cannot be easily forged or tampered with. Overall, blockchain can greatly reduce the cost of verification in real estate by automating processes, increasing efficiency and security, and reducing the need for intermediaries.

Smart Contracts: Smart contracts are self-executing contracts, with the terms of an agreement being directly written into code. The code and the relevant agreements are stored and replicated on a blockchain network. Smart contracts allow for the automation of contract execution, which can streamline processes and reduce the risk of errors or disputes. Once the smart contract has been deployed to a blockchain network, it will automatically execute when certain conditions are met. Smart contracts can be used in a variety of applications, including supply chain management, real estate, and financial services. In real estate, they can be used to automate many processes, including the transfer of property ownership. This eliminates any need for intermediaries to manually verify and execute these transactions, reducing further the cost of verification.

Tokenization and Fractional Ownership: Blockchain technology allows for the full tokenization of real estate assets, making it possible for people with limited savings to participate in investments. Tokenization involves creating digital assets on the blockchain that represent ownership of a property. This process addresses issues of capital formation and liquidity, and it does not require intermediaries. Tokenization allows for the creation of a legal wrapper around the property, which makes it possible to securitize it and create an investment vehicle. It opens the door for more efficient foreign real estate investments and liquidity as anyone can purchase or sell small shares of the assets.

Providing a Universally Accessible Data Set: Throughout the entire life cycle of a building, it is important to track all information and data about it. Blockchain technology can provide a continuously updated record of everything about the asset, allowing for tracking and access to all necessary information and data. For example, any changes made to the building, such as repairs or renovations, can be recorded and tracked, and the entire record can be transferred to new owners when the property is sold. This way each property can have a universally accessible data set that includes information about past sales, repairs, and amenities, providing a digital history of actions and transactions. This will help stakeholders to prove ownership, increase transparency, and prevent fraud, which is important, especially in the case of countries where public authorities are not reliable.

Centralized systems may work well in developed countries where land records have been long certain and clear and there is trust. This is not the case in countries like India, where land records date back to the colonial era, and most land holdings have uncertain ownership. Putting these records on a blockchain could increase efficiency and reduce fraud Suganthe et al., (2021). Similarly, in various developing countries, property records are especially vulnerable to falsification and corruption and different parties can therefore claim varying degrees of authority over a specific piece of land. A decentralized approach can be used to increase the reliability of such systems (Khalid et al., 2022).

4.3 Challenges

Although blockchain can help revolutionize the real estate industry by making transactions faster, cheaper, and more secure, several challenges must be overcome before this can happen. Some of these challenges are summarized below.

Regulation: A major challenge that blockchain will face is related to governance and regulation. The technology is still relatively new, and there are no clear regulations in place for how it should be used in the real estate industry or in general. This can make it difficult for companies to know how to comply with laws and regulations. An adequate regulatory framework will provide market participants the stability they need to adopt the technology and fully engage with it, allowing blockchain innovation to flourish, but this may take time.

Interoperability: Different blockchain platforms have different technical standards, which can make it difficult for them to work together. This can be a problem for the real estate industry, where many different parties need to interact and share information, especially in a global market.

Data privacy: Blockchain technology is designed to be transparent and immutable, but this can be a problem when it comes to sensitive information like personal data. There needs to be a way to protect this data while still allowing for the benefits of blockchain.

Scalability: As the number of transactions on a blockchain network increases, the network can become slow and unwieldy. This can be a problem for the real estate industry, where large numbers of transactions need to be processed quickly.

Adoption: Finally, for blockchain technology to be successful in the real estate industry, it needs to be widely accepted and adopted. This means that all parties involved in a real estate transaction need to be willing to use the technology, which can be a difficult challenge to achieve.

5 Conclusion

The shift to a digital economy brings about new opportunities as financial and physical assets are given digital representations. By 2025, blockchains are expected to store around 10% of the world's

GDP, according to the World Economic Forum. Governments are working to adapt their laws and regulations to accommodate this change and take advantage of the new opportunities it presents. The impact of the blockchain technology on the economy and peoples' daily lives is uncertain, however, many experts believe blockchain could play a significant role across various industries in the future. This study examined the technical aspects and key concepts of blockchain and its application in the industry of real estate. While it is difficult to predict exactly how blockchain will impact the real estate industry in the long term, it certainly has the potential to bring a positive change and play a significant role in the future by increasing transparency, reducing errors and delays, and improving the overall efficiency of the industry. Nevertheless, there are also significant challenges that need to be tackled before this can become a reality, which can take time and effort.

Acknowledgement

The support of Qatar University is acknowledged, through the Student Grant entitled "Exploring the Potential of Blockchain Technology in Civil Engineering, Architecture and the Construction Industry" (QUST-2-CENG-2022-663).

References

Ali, T., Nadeem, A., Alzahrani, A. & Jan, S. (2020). "A Transparent and Trusted Property Registration System on Permissioned Blockchain." *2019 International Conference on Advances in the Emerging Computing Technologies (AECT)*10-10 Feb. 2020, 1-6. DOI: https://doi.org/10.1109/AECT47998.2020.9194222.

Cheng, et al. (2021). "When Blockchain Meets the AEC Industry: Present Status, Benefits, Challenges, and Future Research Opportunities." *Buildings*, *11*(8). DOI: https://doi.org/10.3390/buildings11080340.

Garcia-Teruel, R. M. (2020). "Legal challenges and opportunities of blockchain technology in the real estate sector." *Journal of Property, Planning and Environmental Law*, *12*(2), 129-145. DOI: https://doi.org/10.1108/JPPEL-07-2019-0039.

Grand View Research Inc. (2022). "Real Estate Market Size, Share & Trends Analysis Report By Property (Residential, Commercial, Industrial, Land), By Type (Sales, Rental, Lease), By Region, And Segment Forecasts, 2022 - 2030."

Hoxha, V. & Sadiku, S. (2019). "Study of factors influencing the decision to adopt the blockchain technology in real estate transactions in Kosovo." *Property Management*, *37*(5), 684-700. DOI: https://doi.org/10.1108/PM-01-2019-0002.

Kaczorowska, M. (2019). "Blockchain-based land registration: Possibilities and challenges." *Masaryk University Journal of Law and Technology*, *13*(2), 339-360. DOI: https://doi.org/10.5817/MUJLT2019-2-8.

Khalid, M. I. et al. (2022). "Blockchain-Based Land Registration System: A Conceptual Framework." *Applied Bionics and Biomechanics*, 2022, 3859629. DOI: 10.1155/2022/3859629.

Konashevych, O. (2020). "Constraints and benefits of the blockchain use for real estate and property rights." *Journal of Property, Planning and Environmental Law*, *12*(2), 109-127. DOI: https://doi.org/10.1108/JPPEL-12-2019-0061.

Latifi, S., Zhang, Y. & Cheng, L. C. (2019). "Blockchain-Based Real Estate Market: One Method for Applying Blockchain Technology in Commercial Real Estate Market." *2019 IEEE International Conference on Blockchain (Blockchain)*14-17 July 2019, 528-535. DOI: https://doi.org/10.1109/Blockchain.2019.00002.

Plevris, V. (2022). "A Brief Introduction to Blockchain Technology and its Applications in Civil Engineering and Construction." *1st International Conference on Advances in Civil & Environmental Engineering (1st ICACEE-2022)*, University of Engineering & Technology Taxila, Pakistan, 22-23 February 2022.

Plevris, V., Lagaros, N. D. & Zeytinci, A. (2022). "Blockchain in Civil Engineering, Architecture and Construction

Industry: State of the Art, Evolution, Challenges and Opportunities." *Frontiers in Built Environment*, 8. DOI: https://doi.org/10.3389/fbuil.2022.840303.

Saull, A., Baum, A. & Braesemann, F. (2020). "Can digital technologies speed up real estate transactions?" *Journal of Property Investment & Finance*, 38(4), 349-361. DOI: https://doi.org/10.1108/JPIF-09-2019-0131.

Suganthe, et al. (2021). "Blockchain enabled Digitization of Land Registration." *2021 International Conference on Computer Communication and Informatics (ICCCI)*27-29 Jan. 2021, 1-5. DOI: https://doi.org/10.1109/ICCCI50826.2021.9402469.

Tezel, et al. (2022). "Blockchain Opportunities and Issues in the Built Environment: Perspectives on Trust, Transparency and Cybersecurity." in *Industry 4.0 for the Built Environment: Methodologies, Technologies and Skills*, M. Bolpagni, R. Gavina, and D. Ribeiro, eds., Springer International Publishing, Cham, 569-588. DOI: https://doi.org/10.1007/978-3-030-82430-3_24.

Veuger, J. (2018). "Trust in a viable real estate economy with disruption and blockchain." *Facilities*, *36*(1/2), 103-120. DOI: https://doi.org/10.1108/F-11-2017-0106.

___. (2020). "Dutch blockchain, real estate and land registration." *Journal of Property, Planning and Environmental Law*, *12*(2), 93-108. DOI: https://doi.org/10.1108/JPPEL-11-2019-0053.

Wouda, H. P. & Opdenakker, R. (2019). "Blockchain technology in commercial real estate transactions." *Journal of Property Investment & Finance*, *37*(6), 570-579. DOI: https://doi.org/10.1108/JPIF-06-2019-0085.

Yadav, A. S. & Kushwaha, D. S. (2021). "Blockchain-based digitization of land record through trust value-based consensus algorithm." *Peer-to-Peer Networking and Applications*, *14*(6), 3540-3558. DOI: https://doi.org/10.1007/s12083-021-01207-1.

Cite as: Plevris V., Abdallah H. & Alnatsheh A., "Blockchain and its Potential in the Digitization of Land and Real Estate Property Records", *The 2nd International Conference on Civil Infrastructure and Construction (CIC 2023)*, Doha, Qatar, 5-8 February 2023, DOI: https://doi.org/10.29117/cic.2023.0112