Blockchain Technology in Real Estate: Potential Future and Challenges

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1 Introduction

The real estate sector is known to be slow to change and relies on traditional methods and approaches for its various segments. The real estate sector constitutes a good portion of the GDP of any country and all governments want to improve and develop this sector. The real estate sector opens important doors for the economy in terms of contribution to GDP and employment generation. Real estate assets are considered as an alternate asset class, and it is used by the investors to diversify their investments and to get alternative sources of income and return. It can be done through direct or indirect investments. Buying real estate assets with the intention of earning income through rental or resale is a method of direct investment in a property. A Real Estate Investment Trust (REIT) is an indirect investment and an investment fund which invests in real estate and pays out rental income to the REIT equity holder. Investors can put money into a collection of properties a REIT company manages which is quite similar to the concept of mutual funds in financial markets. The

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equity holders of REIT will benefit from the dividends earned. Real estate assets have a positive correlation with inflation and therefore provide an inflation hedge. So, the major benefits of real estate investment include passive income, regular cash flow, tax advantages (in some countries), and diversification. Real estate investments also have high transactional costs which include the transfer of ownership fee and legal and brokerage fees. The process of buying property is quite long and has several legal requirements. Another major disadvantage of investments in real estate is that they are difficult to liquidate, and it is not very easy to find potential buyers for the property. Buying and selling any real estate asset is not like the buying and selling of other assets and there are specific laws that govern how it may be bought and sold. The traditional real estate buying and selling process can be time-consuming, challenging, and full of back-and-forth discussions among sellers, buyers, and real estate agents. Renting of various kinds of properties is also an important segment of real estate segment. The whole process of renting or leasing both for the landlords and the tenants is a long and somehow troublesome process. Landlords are always looking for the best tenants and the tenants are looking for a perfect property that can satisfy their needs. Especially for commercial real estate renting and leasing is not just about simply finding a place to run the business but it can greatly impact the business. The right location for the accurate price on precise terms can make the office more productive, which ultimately makes the business more attractive to consumers and enhances profitability.

Till the last few the whole real estate industry was following the traditional methods of buying, selling, renting, leasing, and management but now the role of technology is becoming more prominent in the real estate industry. Therefore, the use of technology and innovation will transform this sector into a smart real estate sector. The most important technology that real estate is adopting is blockchain technology.

Since its introduction, Blockchain technology has become popular in several segments and the potential for the development of this technology is still huge. Blockchain is an information storage method that makes it not possible for the system to be reversed, hacked, or controlled. It is a distributed ledger that replicates and issues transactions across the network of computers which are connected in the chain and helps in the traceability and authentication of multistep transactions. The ultimate advantage of blockchain is that it can provide secure transactions, reduce intermediary costs, and accelerate data transfer processing.

Enabling cryptocurrency was the prime aim of blockchain technology but has since been widely pushed for its potential to transform various industries. Irrespective of the original purpose of blockchain technology, various segments are using it for their own benefits. These segments include the public administration, regulators, traders, healthcare sector, etc. In the domain of business blockchain technology is being used in financial institutions, financial markets, supply chain management, healthcare, media, real estate, and energy. Among all these segments, the use of blockchain in the real estate sector is increasing day by day. The real estate sector is also experiencing the use of blockchain which is being called "proptech" (Nasarre-Aznar, 2018).

2 Use of Blockchain Technology in Real Estate

In the real estate sector, the use of blockchain is possible at various stages of real estate transactions. The use of blockchain in real estate has a number of benefits including an increase of efficiency, reduction of time, reduction of information asymmetry, providing trust, verifiability, and transparency, help to reduce fraudulent transactions, and increase safety and trust as compared to centralized digital solutions of transactions.

In real estate, the term "tokenization" refers to the digitization of various financial instruments. The digital assets can be programmed to bring in ownership rights, transaction description, and rules can be created to guarantee asset issuance, distribution, and transfers follow specific regulations. Digital assets can be altered to fulfill all requirements of the issuer. The blockchain technology can bring alternative financing for real estate. Blockchain-based financial products facilitating investors and providing transparency for the investors. These technological solutions increase investor confidence and unlock access to a wider investor pool all over the world.

In many underdeveloped and developing countries, the land registry departments are engaged in the alleged mismanagement and manipulation of land records. The land registry department in any country can use blockchain technology for ownership transfer/registration of any property and by applying the land registry in blockchain, the security issue is fixed to a greater amount and makes the property transaction more secure. Another big advantage of using blockchain in the land registry process is the reduction of manual effort spent in record keeping. Krishnapriya and Sarath (2020) discussed the use of various algorithms which makes

the information for each transaction more reliable and secure. The Association of Registrars of Spain (CRE) announced the launch of a service called "Regturi" to register properties for tourist use, which is based on a blockchain.[1] Georgia, Sweden, Brazil, India, the Netherlands, Canada, India, the United States, and other countries are already testing and implementing blockchain-based land registration systems.[2] A blockchain ecosystem provides ownership rights efficiently, which eliminates the traditional paperwork and expense while promising transparency.

Infrastructure and construction projects are an important segment of the real estate sector. Blockchain can help infrastructure projects in two ways. One is to help with the funding gap by tokenizing infrastructure securities, either debt or equity and making it more accessible to a number of investors. Secondly, using blockchain for transparency for infrastructure projects. This involves sharing the data of purchase orders and invoicing between subcontractors and contractors and the technology can be used to provide better security, transparency, and management in infrastructure projects. The blockchain in infrastructure market is to reach $725.2 million by 2026 as per estimation as per report by a company IndustryARC.[3] Infrastructure projects can be linked to decentralized land measurement systems through blockchain technology and operational management efficiency is increased primarily by the reduction of time and resources needed to carry them out. In the infrastructure projects, another potential of blockchain technology is in the transportation sector and all tolling transactions may be maintained through the blockchain. Secure and speedy transactions between connected vehicles could lead to excellent advancements. Zhang et al. (2021) discussed that blockchain tokenization has features that can change the capital size of investment in infrastructure projects. The authors also found that the prospective use of tokenization has not yet been fully attained and the prime reasons include

[1] https://www.onlinemarketplaces.com/articles/spain-turns-to-blockchain-to-register-properties-for-tourists/.

[2] https://fcegroup.ch/en/news/text/id411-2022-09-25-how-blockchain-is-changing-land-registration-in-different-countries.

[3] https://www.industryarc.com/Report/18532/blockchain-in-infrastructure-market-research-report.html.

the regulation uncertainties, volatilities in the token market, and the non-existence of the public sector at large. As per report of OECD,[4] the current processes and systems can be improved by the use of blockchain technology by improving the infrastructure value chain.

A smart contract is a computer program that is self-executed and automates the activities required in contract and makes the transactions trackable and irreversible upon their completion. Szabo (1996) introduced the term "smart contract". In the real estate sector, the smart contract is between a landlord of the property and the tenants. The objective of the contract is to confirm that the lease agreement is signed by both parties, payment of lease rental amount is on time and the termination of the lease contract is executed as per contract. Karamitsos et al. (2018) discussed the presentation of the detailed design of smart contract and the authors also used case for examining the smart contracts for renting residential and business buildings.

The term "Smart city" has emerged as a new concept to provide high-quality facilities to the people by optimizing the city resources. Smart cities are being developed and involve excessive networking, service providing, and integration of transactions into the initial city planning. Smart cities provide the finest services for enhancing the daily life of people in certain areas including education, healthcare, transportation, and energy consumption. The use of blockchain technology can resolve the security concerns of smart cities. Blockchain technology is the best way to safeguard smart cities' communications by securing communications routes to guarantee confidentiality. The blockchain technology can also be used to improve the city management and providing of important public services to the people through efficient data collection and analysis. Bhushan et al. (2020) mentioned that the blockchain technology can solve the security issues of smart cities and various facilities like healthcare, transportation, education, and supply chain management, can be improved by the use of blockchain technology along with the improvement of financial systems and data center networks. In their paper, Biswas and Muthukkumarasamy (2016) suggested a security framework by combining the blockchain technology with smart devices to give a communication platform in a smart city which is considered as a secured platform.

[4] https://www.oecd.org/finance/Blockchain-technologies-as-a-digital-enabler-for-sustainable-infrastructure-key-findings.pdf.

Another prospective use of blockchain technology in the real estate sector is to reduce the fraud and error created by new transactions with an irreversible ledger that tracks all transactions. Traditional methods of property ownership registration are at risk of fraudulent activities and errors by the users. Blockchain offers a reliable and trusted way to store this information. This could help to reduce occurrences of fraud and scams in real estate transactions. The availability of more reliable property records on blockchain ledgers will provide an extremely valuable means for real estate analysts, regulators, and land management officials. The blockchain technology usage in real estate transactions will increase trust and efficiency, reduce corruption and fraud and reduce the cost. Bennett et al. (2021) mentioned the "hybrid approach", which is the concept of integration of blockchain technology with conventional databases in land administration. Saari et al. (2022) determined that existing land registries can be combined by the use of blockchain is a safer first step than replacing them. Implementing blockchain can decrease information asymmetries in real estate buying/selling transactions and will increase trust through verifiability. Goderdzishvili et al. (2018) concluded that blockchain-based ownership registry ensures transparency and reliability for the Georgian real estate sector. Kshetri (2022) mentioned that the digitization of land records can be done through blockchain, and it reduces traditional drawbacks like reduction in inefficiency and corruption in the Indian real estate sector. The prominent use of blockchain in real estate is the online payments and the remittance sector. Blockchain's core strengths can be used for handling a big amount of money changing owners on various property markets every day. The technologies allow for direct transactions between sellers and buyers, without the involvement of a supervising institution which verifies the legitimacy of those transactions. The process can be further strengthened by implementing smart contracts.

If blockchain achieves industry adoption across the whole real estate sector, then the risk of third-party intermediaries will be greatly reduced, and the blockchain-based systems will be able to inevitably validate the legitimacy of the ownership transfer of title. Blockchain platforms can connect sellers and buyers directly and it will eliminate intermediaries like real estate agents, and ultimately reduce the amount of commission given on transactions.

The real estate market can also benefit from joining the rapidly growing tokenization trend. Tokenization implies the blockchain tokens representing digital assets. This process can be applied to real estate assets as it is already used for a number of other asset classes. Tokenizing properties can bring more investors which will increase liquidity and transparency, and make investment in real estate more accessible, among many other benefits.

Another benefit of using blockchain technology in real estate is to manage, secure, and automate financing arrangements. Besides providing a shared ledger for tracking stakes, the blockchain offers smart contract-based mechanisms for stakeholders to participate directly in the project's management.

A big advantage of blockchain usage is in property management. Multinational property management firms experience ineffective management of their global portfolios. Blockchain usage in real estate management firms facilitates secure data sharing, streamlines rental amount collections to the landlords, and provides verification across the international portfolio. This expands operational efficiency and saves time and cost of managing the properties. The decision-making process is also assisted by big data generation due to blockchain technology usage.

Another advantage of blockchain usage lies in the accounting process of real estate assets. The investors and asset owners will get value from the cash flows recorded on-chain and real-time accounting. The annual financial statements can be prepared and conducted with the potential for real-time audits. This gives a huge advantage to various stakeholders of the real estate market and enables numerous developments in accordance with the regulatory supervision.

3 Potential Future and Challenges of Blockchain in Real Estate

The use of blockchain technology in the real estate sector has a number of benefits but at the same time contains a number of barriers. These barriers present challenges to the management of companies that affect the adoption of blockchain technology and innovation in real estate which can be called "smart real estate". Ullah et al. (2021) did a research on Australian real estate sector and concluded that blockchain adoption barriers are complicated. The authors mentioned several barriers that include high software and hardware costs, highly complex technology dissemination

systems, ignorance of government policies, and lack of regulations and standards.

Akhmetbek and Špaček (2021) did the research on real estate market of Kazakhstan and indicated that the key barriers to the potential use of blockchain technology include lack of legislation and also the difficulty of the technical execution of blockchain projects along with integration of technology with the existing systems. Lindholm (2021) did the research on the state of blockchain technology in the Finnish real estate industry and found that there is a disunity both in adoption of blockchain technology and knowledge in the Finnish real estate.

One challenge of blockchain usage in real estate is whether blockchain is necessarily able to perform the functions of land registries, notaries, real estate agents, and lawyers and can ensure a secure real estate transaction. There are some challenges that blockchain technology must overcome to be believed as reliable, legal, and secure system instead of the current real estate usage systems.

4 Conclusion

Real estate is taking a big dive into a decentralized digital world with business leaders and governments discovering and executing blockchain applications including real estate. Blockchain in real estate gives the highest level of transparency and reduces the overall process of transactions. The future of real estate incorporates consolidation of other emerging technologies such as machine learning and artificial intelligence with blockchain and brings an innovative change to the old and traditional real estate processes. The growth and development of the real estate industry is being hindered by various challenges. Nevertheless, blockchain technology can assist in addressing and resolving many of these issues and the application of blockchain in real estate has the potential to revolutionize the entire real estate sector.

Apart from the introduction and conclusion, the book consists of fourteen chapters covering a wide range of issues relating to the Blockchain Technology in Real Estate. The chapter following the introduction is on the blockchain technology transforming the real estate market, the chapter discusses the evolution and implementation of tokenization in real estate projects as well as the potential applications of blockchain in real estate transactions and property management. A key objective of the study is to identify some common themes among existing success and

failure of real estate tokenization projects to assist in developing a case for blockchain adoption across the real estate management process, while highlighting the existing risks and uncertainties associated with physical-metaverse interaction, regulation, registration, compliance, and security. Upon examining the existing evidence, it is evident that blockchain-based solutions will significantly transform the real estate market by automating registrations, fractionalizing property management, crowdfunding, promoting investor outreach, increasing flexibility, customization, administrative simplicity, operational efficiency, and increasing investor demand. In this chapter, it is noted that blockchain technology may provide substantial benefits to the real estate industry, however, there are several challenges facing the sector, such as fractional asset ownership, lack of market depth, overcautious regulation, asset recognition, single-asset tokenization, and cryptocurrency sentiment.

Chapter 3 explores the potential of blockchain technology to transform real estate asset management. This technology has the potential to provide unprecedented opportunities to the real estate sector; however, several challenges and limitations remain significant and require addressing in order to allow for further growth. This chapter provides an overview of these challenges and identifies their origins and discusses ways to address them so that blockchain can be effectively implemented to enhance transaction speed, reduce costs, and ensure data security. In addition to these advantages, a stronger real estate sector would contribute to a stronger and more integrated economy.

Chapter 4 describes in an observational and interpretative way the added value applying blockchain technology can have in the commercial real estate sector. The research goal is to analyze and structure commercial real estate characteristics, map its key stakeholders, their core processes, and how information is being used to answer where and how blockchain technology can add value. The chapter will zoom in on blockchain applications in commercial real estate processes and their challenges. Finally, by concluding the chapter focuses on wrapping up the results from the various studies referred to give a comprehensive overview of promising applications, their opportunities, and challenges.

The fifth chapter is devoted to Blockchain-based Life Cycle Assessment framework for building materials selection. The chapter provides insight into how real estate companies deploying blockchain-based solutions are faced with a plethora of competing technologies, each with a large number of unique parameters that must be adjusted by an expert.

The chapter proposes a Blockchain-based Life Cycle Assessment (LCA) framework to guide construction materials choice. LCA is a multi-criteria evaluation method based on ISO 14040 and 14044 standards and can be applied to additional standards depending on the sector studied and the objectives of the study. It aims to assess the potential environmental impacts of a product or activity. It is characterized by a holistic approach to the problem, considering the entire life cycle of the product studied.

The sixth chapter focuses on cryptocurrency and real estate transactions. This chapter examines the development of financial technology in the twentieth century and its role as a significant feature of contemporaneous technological advancement. Blockchain technology and cryptocurrencies are among the most significant financial innovations within the FinTech sector. It is expected that the use of cryptocurrencies in real estate transactions will reshape the whole market and could be the main game-changer for the industry. Researchers, policymakers, and real estate market participants are currently discussing how digital currencies can potentially benefit the real estate market. The purpose of this chapter is to contribute to the academic literature on the future role of cryptocurrencies in the real estate market in the following ways: Firstly, the chapter provides evidence on the imperativeness of cryptocurrencies and blockchain in the real estate industry. Secondly, the chapter outlines the potential benefits of digital currencies in the context of real estate transactions. Finally, the chapter examines how crypt-based real estate transactions are conducted.

The seventh chapter discusses the potential intersection of real estate and the metaverse, which is a virtual world that has become increasingly popular in recent years. Real estate in the metaverse refers to the ownership of virtual land, which can be used for a variety of purposes such as building virtual homes, businesses, and even virtual amusement parks. This virtual land can be bought, sold, and traded just like physical real estate, creating a new market for investors and developers. The chapter explores the benefits of investing in virtual real estate, including the ability to reach a global audience, reduce costs, and experiment with modern designs and structures. It also discusses the challenges and risks associated with this new industry, such as security concerns and lack of regulation.

Chapter 8 discusses asset tokenization as a new trend in the real estate industry that has attracted the attention of investors, developers, and regulators. It is the process of converting real estate assets into digital tokens that can be traded on blockchain-based platforms. This chapter describes recent developments in asset tokenization in the real estate

industry and examines the empirical methods used to assess its potential benefits and risks. As part of the chapter, the author conducts a review of the current literature and identifies several empirical studies that analyze, among other things, the impact of asset tokenization on real estate markets, investment behavior, and financial stability. Furthermore, the chapter highlights regulatory uncertainty, cybersecurity threats, and potential market manipulation risks associated with asset tokenization. Chapter 9 underscores the importance of distribution of proptech benefits to stakeholders of real estate market, this chapter will focus on the perspective benefits of the adoption of the technology and the distribution of gains to various stakeholders.

The tenth chapter explores the challenges posed by fragmented data in the real estate industry and its impact on transactions. Fragmented data refers to the scattered and disjointed nature of information within the industry, hindering decision-making and impeding transactions. The presence of data asymmetries further exacerbates these challenges, creating an imbalance of power and a lack of transparency. Real-world examples of successful blockchain applications in real estate demonstrate its transformative power. The integration of fragmented data holds immense potential for transforming the real estate landscape, unlocking new opportunities, improving decision-making, and creating a transparent and efficient ecosystem. The continued use of artificial intelligence, machine learning, and blockchain will play pivotal roles in shaping the future of real estate data integration. In the eleventh chapter, the significance of the Digital Building Logbook—the first application of blockchain in real estate—is highlighted. A Digital Building Logbook is the mother use case for blockchain in real estate, hence the need for conducting research to approach this chapter as an exploratory study. Based on my own practical experience, along with scientific and applied research, this chapter will provide a reasoned answer to this question.

Chapter 12 discusses land title administration challenges worldwide, with a summary of the most recent literature. It focuses discussion on five main challenges in land title administration and highlights the importance of blockchain technology in resolving these issues globally, demonstrating how blockchain technology can improve land record system efficiency, transparency, and security, thus making title verification easier. In spite of three major challenges associated with this technology, the adoption of blockchain technology in land title administration can enhance efficiency, resolve issues, strengthen regulators' position, and promote investment

in land. Chapter 13 presents a brief overview of the current situation with respect to tokenized real estate. A comparison is made between the active secondary markets for tokenized or fractionalized assets in developing countries and developed countries in the chapter. An overview of the process involved in tokenizing the real estate industry in the two countries is presented in the chapter. The chapter suggests that organizations involved in real estate tokenization in developing countries should learn how to increase the success of tokenization in the industry based on critical reviews expressed in the media and academic papers.

In the concluding chapter, the authors establish and emphasize the lack of international (harmonization) in legislation applicable to blockchain applications in cross-border real estate transactions. According to the general theory, blockchains could theoretically address the major problems the real estate industry is experiencing today, including lack of transparency, inefficiencies, fraud and corruption, excessive costs, and also issues surrounding trust. An overview of the legal framework for blockchain applications in international real estate transactions is provided in this chapter. Furthermore, this chapter discusses various legal issues that may arise from blockchain applications, with an emphasis on the smart contract challenges that may arise with regard to the application of the law of contract as well as the potential for blockchain to disrupt the real estate industry.

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