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Tokenization of Real Estate: the Future Trend in Investments

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Abstract

Real estate is considered one of the most attractive investment assets. At the same time, real estate transactions remain a complex process, despite the many implemented solutions that facilitate this process. Although there are the numerous advantages, one of the key drawbacks of real estate investments is the lack of liquidity. Thus, even though global real estate investments amount is about twice as large as investments in stock markets, the number of investors in the real estate market is significantly lower.

When manipulations with securities have long become available in a couple of clicks in a mobile application, real estate transactions continue to be associated only with a headache. A new method of making transactions — tokenization — will simplify the purchase and sale of real estate.

After the advent of blockchain technology, real estate tokenization is one of the latest trends in this industry, in which physical assets are converted into digital tokens, which makes them more accessible and easier to buy/sell. Instead of registering ownership in the traditional way, investors will be able to become co-owners of a tower in Shanghai in a couple of clicks.

Thanks to tokenization, real estate will not only become liquid and transparent, but will be able to open the market even for retail investors.

However, there are a number of stop factors such as the lack of clear legislative, technological and environmental regulation in many countries of the world.

The purpose of this thesis is to analyze in detail the general framework in tokenization of real estate investments, potential benefits of blockchain technology and future perspective and obstacles of legislation in the world of investment.

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Today is one of the most long-awaited days in my life and I can finally say with confidence that despite all the difficulties that I have encountered on my way, I have overcome this milestone. It was definitely the most interesting time in my life, but at the same time the most difficult. When I received an offer from Ca' Foscari University, I was the happiest person, because it was the educational institution that I dreamed of obtaining my foreign degree. Admission, study, passing endless exams and writing a thesis was an unimaginable challenge for me, as was life in a foreign country in general.

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Dedication

To my dear and beloved grandmother, who believed in me until the last minute of her life and waited for this day more than myself

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Terminology

AML shall mean anti-money laundering

Blockchain shall mean the type of DLT based on a Peer-to-Peer (P2P) network model consisting time-stamped records of data (blocks) that are securely linked together via cryptographic hashes in an immutable way.

CIS countries shall mean Commonwealth of Independent States is a regional intergovernmental organization in Eurasia, which was formed following the dissolution of the Soviet Union in 1991. Consist of Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan and Uzbekistan.

DFA shall mean Digital Financial Asset

Digital meters shall mean digital square meters

DLT shall mean Decentralized Ledger Technology

ESMA shall mean European Securities and Markets Authority

FCA shall mean Financial Conduct Authority

FINMA shall mean Financial Market Supervision Authority

SEC shall mean Securities and Exchange Commission

ICO shall mean Initial Coin Offer

KYC shall mean Know-Your-Customer

P2P shall mean Peer-to-Peer

Smart contract shall mean

STO shall mean Security Tokens Offering

Token shall mean a digital unit of computer code representing or, where applicable, incorporating an asset.

Tokenization shall mean the fact of digitalizing assets using the distributed ledger technology.

Introduction

According to Vintage Market Research (2022) the global real estate market valued $3,14 Trillion in the end of 2022 and is planned to reach a value more than $4,50 Trillion by the year 2030. In addition, according to various estimates, global investment in commercial real estate has reached an unprecedented level of 800 billion US dollars last year. It is very interesting, isn't it?

Throughout history, the real estate market has been characterized by a lack of liquidity and high entry requirements, demanding substantial capital and time investments from investors. Real estate transactions, being among the most illiquid assets, involve complex, time-consuming processes and significant capital outlays.

In the digital age, the question arises of how to secure real estate transactions conducted in a digital format. The answer lies in the digitization of real estate assets, making their management far more accessible. This transformation is referred to as "real estate tokenization."

Tokenization has been gaining momentum in the real estate sector in recent years. Many people have only recently heard this word, and the vast majority of people do not know at all that tokenization is a rapidly advancing field within the financial industry. It offers the opportunity to invest in digital tokens supported by tangible assets and securities.

Tokenization is the process of translating ownership of a real estate interest into virtual tokens residing on a blockchain. This foundational technology shares its essence with the popular cryptocurrency Bitcoin.

When considering the intersection of real estate and blockchain, the immediate correlation might not appear evident. At best, one could connect conventional blockchain applications like shared registries, immutability, and security, but nothing unique. However, as we delve deeper into the persistent challenges faced by the real estate sector, the integration of blockchain technology into real estate emerges as a logical progression in the industry's technological evolution.

As mentioned above, tokenization is based on blockchain technology, which is a form of distributed ledger that safeguards duplicate data copies within a network of authorized participants. Unlike a centralized database, blockchain lacks a single vulnerable point for data, making unauthorized access or modification of data is practically impossible. By

leveraging the secure, unchangeable attributes of blockchain technology, tokenization streamlines digital ownership through secure transaction records and fast settlement procedures.

Tokenization coupled with blockchain presents a myriad of benefits compared to conventional real estate practices. These encompass heightened liquidity, improved transparency, elevated security, and streamlined management. However, the tokenization process is intricate, entailing both technical and legal complexities. Businesses aspiring to introduce a virtual token backed by real estate must meticulously address a diverse array of issues throughout the planning, development, and launch phases of their real estate token venture.

Real estate stands as a unique asset category, providing investors with a reliable income stream and the potential for long-term appreciation. Presently, prominent real estate investors typically consist of corporate entities boasting substantial income and equipped with robust financial and legal resources. Tokenization, on the other hand, proposes a transformation through the adoption of smart contracts, facilitating the inclusion of a fresh wave of participants—individuals—into the realm of real estate investment.

The process of real estate tokenization has brought about a seismic shift in this industry, enabling individuals to venture into real estate investments situated thousands of kilometers away, even on the opposite side of the globe, with just a few clicks. The opportunity to become a co-owner of real estate through a modest cash investment of as little as $100 has never been as accessible as it is now.

This work explores the blockchain technology and it’s utilization in the realm of real estate investments, with a specific emphasis on commercial real estate. Nevertheless, it is worth noting that there is a proliferation of captivating applications and blockchain initiatives extending their reach to various other categories of tangible assets. These broader applications will also receive a cursory examination in the first Chapter. In addition, in this section we will delve into concepts such as smart contracts, tokens and tokenization, revealing their exact meanings and explaining the mechanisms of their functioning.

First, we will undertake an examination of traditional real estate investments, along with an exploration of existing strategies for fractionalization of real estate, in order to increase liquidity. In the second Chapter, we will engage in a comprehensive discourse exploring

the entire life cycle of a tokenized security. This journey will includes various phases, starting with transaction structuring, progressing through issuance, primary distribution, post-tokenization management, and concluding with secondary trading.

Within this research, both the technical aspects and the regulatory framework that governs the tokenization of real estate from multiple perspectives will be considered.

Key points will be considered in Chapter 3 and real cases of real estate tokenization from different countries will be studied. Then we will have a look at the advantages and disadvantages in this area and conclude with a discussion about the future of real estate tokenization.

Tokenization has the capacity to usher in a fresh era of real estate investment, characterized by expanded options and greater flexibility for all involved parties. However, achieving this transformation will require collective world collaboration. Let's embark on an exploration to acquire comprehensive knowledge about real estate tokens and the intricate process of tokenization.

Chapter I. Blockchain Technology

1.1 Blockchain

Before delving into the explanation of real estate tokenization, it is essential to understand the basics of blockchain technology. In order to evaluate a revolutionary technology and understand how special it is, let's first consider the prerequisites for its emergence.

On September 15, 2008, the largest investment bank Lehman Brothers declared bankruptcy. On this day, a real bomb in the world of finance exploded in the United States and it was considered as the culmination of the mortgage crisis, accompanied by devastating losses. Thousands of innocent people who trusted the government and financial institutions lost their homes, jobs and huge amounts of money. This crisis revealed a serious problem in society and people began to realize that it was necessary to make changes in the system to which they entrusted their wealth to an intermediary. This is how the idea of *decentralizing* the system arose.

Less than two months after these events, a unique financial system was created, which has existed in the world for almost 15 years! On October 31, 2008, when an unknown group of people under the collective pseudonym Satoshi Nakamoto published an article "Bitcoin: Peer-to-Peer Electronic Cash System", the history of the world's first Bitcoin cryptocurrency began. In this article, he described the future bitcoin protocol – a set of rules according to which the system being created was supposed to work. All parts of the system were known before Nakamoto. The cryptographic algorithms underlying Bitcoin already existed. Distributed data storage in decentralized networks was also used.

Nakamoto's genius was that he was the first to assemble the individual pieces into a whole, build a system and make it work. Based on previous work by Stuart Haber, W. Scott Stornetta and Dave Bayer, Satoshi used an innovative combination of computers distributed around the world, a traditional ledger system and cryptography to enhance security (Nakamoto, 2008). The proposed system was truly revolutionary, nothing like this had ever existed before. Shortly after the publication of the protocol, on January 3, 2009, Satoshi generated the first block of a continuous sequential chain of information named *blockchain*.

“We have proposed a system for electronic transactions without relying on trust”

(Nakamoto, 2008).

Blockchain is often talked about in the context of Bitcoin and cryptocurrencies such as Ethereum, Litecoin and others, most of which are blockchain implementations. However, at its core all of them are just DLT systems that can be used for a wide range of applications.

It is very important to understand the difference between DLT and blockchain. A *DLT – Distributed Ledger Technology* - it is a generic term to describe any system that distributes information across multiple computers, which could be spreaded around the world. The main purpose of DLT is to reduce the risk of centralized storage (Dexter, 2018).

Blockchain technology is the type of DLT based on a Peer-to-Peer (P2P) network model consisting time-stamped records of data (blocks) that are securely linked together via cryptographic hashes in an immutable way. As a result, a chain of blocks is formed in which the history of all transactions or data is stored. Hence the term “blockchain". In addition, it is not just a chain. It maintains a strict sequence.

What are these blocks and what is the chain? Blocks are data about transactions and contracts within the system, presented in the cryptographic form. All blocks are arranged in a chain, that is, they are interconnected. To write a new block, it is necessary to sequentially read information about the old blocks.

Since each block contains information about the previous block, therefore, blockchain transactions are irreversible in the sense that after they are written, the data in any block cannot be changed retroactively or removed without changing all subsequent blocks. In addition, this technology supports single recording. This means that new information can only be added; old information cannot be edited. It means that it is secure and immutable forever (Don, 2018). All these functions make the blockchain virtually unchanged.

To gain access to the information stored in a particular block, a hacker needs to go through the entire chain of blocks, which requires huge computing power. Thus, as a result, hacking and changing information become unprofitable for the culprit. Therefore, storing information about transactions in the blockchain guarantees their originality and reliability. Moreover, any approvals and confirmations can easily happen on the Blockchain network, since all parties are online. These confirmations can be stored with a timestamp for future use.

A distributed ledger database is the only source of truth. Since everyone on the network has a copy of the database, the reconciliation is performed automatically. Any changes in the database are transmitted to each node (system) in the network and are almost instantly updated in their database copy. As a result, any chances of mismatches/errors are eliminated.

All data in the blockchain is accumulated and forms a constantly updated database. It is impossible to delete anything from this database or to replace the block. And it is "limitless" - an infinite number of transactions can be recorded there. This is one of the main features of the blockchain.

The work of the blockchain can be compared with Torrent[1]. The functioning of torrents takes place in P2P mode (peer to peer – a computer network where all participants are equal). When we download a file from the tracker, we do not use a central server or storage. The file is directly downloaded from the same torrent participant as you. If there are no participants in the peer-to-peer network, then you will not be able to download files either. Similarly, in the blockchain. All operations are carried out directly between the subjects. And they are carried out due to the fact that all participants are connected to the same network – Blockchain.

The key feature of the blockchain is *decentralization* - there is no central server in the chain that could be broken or hacked. The whole chain is distributed: it is supported by computers all over the world. Each participant is a server. This is a great advantage over the traditional financial system.

The traditional system of financial transactions is considered *centralized* because there is a third “trusted” party (intermediary) who verifies the transaction and charges a commission for it. For example, if you want send money to your friend, bank (intermediary) will verify this transaction and will charge fee. (Don, 2018a).

The term *decentralization* consist of two parts where *de-* is the latin prefix denoting separation, cancellation, termination, and where *centralization* is a management system in which there is a centralized body that creates and regulates rules for all other organizations. Thus, *decentralization* is the absence of a center of control, autocracy and

[1] Torrent – is a decentralized, peer-to-peer (P2P) file-sharing network. https://www.utorrent.com/

full responsibility of one person. Another words, we want to remove the need of the single "middle man" from the system.

The functioning of the blockchain and its security is provided by miners and other participants of the blockchain, which are called nodes (Gupta, A. et al., 2020). The more active nodes there are in the blockchain, the faster transaction information is processed.

As regarding the *trustless* of the blockchain system, we do not give our trust to a "middle man", but we can be sure of the safety of our wealth (or information), which will still be protected. All participants supporting the operation of the chain are equal among themselves. There is no server or any processing center here. It turns out that the whole blockchain is not built on trusting relationships. Because there is no "middle man", at first glance. However, in essence, each blockchain user acts as a "middle man". The decentralization of the network makes it possible to transfer data between entities representing different countries, jurisdictions simply by agreement with each other directly. Without any intermediaries or regulators. The blockchain is built in such a way that operations cannot be blocked. Therefore, decentralization allows each user to feel independent.

In order to fully understand exactly how the blockchain can give us a decentralized and trustless system, Dexter (2018a) suggests considering this conception by analogy with the blockchain in The Village Story mode:

Let's move into the past and imagine a small village in the absence of computers, phones and other technologies. The village is home to 10 families engaged in agriculture, hunting and fishing, as well as barter trade. The farmer gave the hunter milk, and in return, the hunter gave meat to the farmer, sometimes lending goods while promising to bring something in return soon.

Trade relations were built on mutual trust until there were too many loans and it became difficult to keep track of all the "promises". Sometimes people argued over forgotten or never given promises.

The villagers gathered and decided to appoint someone who would keep track of all loans and promises in the ledger. That is how Ledgerman appeared, whom the whole village trusted. He got to work and the village started trading again.

Over time, the ledger was replenished with promises and Ledgerman, becoming an important person, requested payment for each promise that he tracked. Ledgerman accumulated a lot of wealth and power, began taking bribes and increased fees.

Chaos broke out in the village again and disgruntled residents eventually deposed Ledgerman. Citizens realized that power and trust in the arm of one person would only bring corruption and they began to create a new way of doing business.

One smart village citizen came up with a brilliant idea to keep accounting books all together instead of only one person holding a ledger.

The essence of the idea was that representatives of each family gathered daily at the appointed time for a meeting and wrote down all the promises in their ledgers. In addition, all promises were audited at the weekly meeting and, in case of discrepancies, all entries from each ledger were reconciled. Thus, there was no need to trust anyone anymore.

This brilliant Village-Square System eliminated the need for a middle man, decentralized the bookkeeping, does not require trust and eliminated fees. However, in order to more sophisticated implementation this concept of a Village-Square System on a widespread application in the real world, it is necessary to use computer technologies.

Satoshi Nakamoto was the first who implemented a more sophisticated Village-Square concept realization and created a reliable, decentralized and secure system that tracks transactions with minimal effort on the part of people.

1.2 Areas of application of the blockchain

Blockchain technology has great potential, and it is applicable not only to the world of finance. It can be used in any multi-step transaction, where it is important to ensure visibility and traceability (Don, 2018a). Blockchain is used in all areas where the speed of information transfer with a high degree of its protection is necessary.

There are many types of activities in which blockchain can be successfully used: the banking sector, the healthcare sector, transport and real estate. Blockchain can even be used in the work of public authorities (for example, when conducting elections and processing the results of referendums), in the activities of public and non-public corporations, public organizations and individuals.

The technology is used to launch and operate cryptocurrencies and digital currencies, when concluding smart contracts for the supply of goods, when generating non-fungible tokens (non-fungible tokens, NFT), in the banking and legal spheres, when administering networks and in the gaming industry.

Examples of the use of blockchain in various spheres of life, in addition to finance:

Healthcare

Currently, the healthcare sector is facing a number of problems, such as human errors leading to death, the security of patients' medical records, lack of transparency in the pharmaceutical supply chain, lack of interaction between databases containing patients' medical records, and the fragmentation of health-related information, such as patient medical history or medical records personnel (Alkhaldi, 2020).

Blockchain technology could be the answer to these health problems and potentially revolutionize the way medical data is processed. Blockchain features such as ensuring the immutability of information and the ability to track data changes make this technology suitable for storing, managing and data exchange of electronic medical records of patients, as well as for tracking the progress of patients after discharge from the hospital and improving authentication and confidentiality.

Blockchain solutions can be used to store and analyze research data. IBM’s Blockchain Platform is supporting streaming service for MiPasa project, which using data tools analysis of the COVID-19 coronavirus (Novikova, 2020). The project is able to mitigate the impact of the COVID-19 if governments, hospitals and other data providers contribute information with researchers fighting the outbreak.

The production and distribution of counterfeit medicines is one of the biggest health problems. The introduction of blockchain solutions into the supply chain will solve the problem of counterfeit medicines and track the origin of the drug at every stage of its life cycle. With such an organization, the distribution of a fake drug will be almost impossible, and drug consumers will be able to verify the authenticity of purchased products by scanning a QR code and viewing information about the manufacturer.

For example, the Chinese courier company SF Express uses blockchain technology to track the supply of medicines during the COVID-19 pandemic (Novikova, 2020). Their solution will be able to track, verify and register every transaction in the logistics process,

as well as determine the priority level of each order. The French pharmaceutical company Blockpharma offers a blockchain application based on machine learning that allows patients to check whether the medicine they have purchased is counterfeit by tracking the supply chain and checking all shipping points (Alkhaldi, 2020).

Tracking Fake Products

Counterfeiting is one of the most serious problems facing the luxury goods industry today, especially with regard to fashion items such as clothing, shoes, wallets, jewelry and watches. Estimating the scale of the fake luxury goods industry is incredibly difficult due to its size and scale. Statistics show that most counterfeit goods come from China, and the most copied product is shoes (Supra, 2022).

Three major brands at once – Louis Vuitton, Cartier and Prada - will use the capabilities of blockchain technology to combat counterfeiting in the fashion industry. To do this, the companies have developed the Aura consortium. The technology will allow customers to guarantee the authenticity of goods. Using the Aura platform, users will be able to compare product IDs with database data to track their production path.

Art and antiques are another segment of the luxury market that can suffer from fraud and that can benefit from blockchain solutions. To combat this and help verify the legality of the items they sell, art galleries and antique dealers are starting to use private blockchains. For example, IOST has partnered with Grimm's Antiques, an antiques dealer from China, to help create blockchain records of antiques by including verification and evaluation records in a secure blockchain. Verisart uses blockchain to help galleries and artists verify works of art through the creation of customized NFTs. Another major gallery, Thomas Crown Art, has also implemented blockchain technology to create individual certificates of verification of works of art for the artists with whom it works (Supra, 2022).

Intellectual Property

Nowadays, an artist can easily share his work online, which creates some problems regarding copyright protection. Ascribe startup from Berlin considers this a serious problem and is going to change the situation using blockchain.

Ascribe service is going to help authors document their intellectual property rights and transfer or sell it without relying on third parties for legal registration. The company uses a distributed registry so that authors can register their work. As registered owners of their

intellectual property, they will be able to protect it from theft or abuse, transfer it to someone else or sell it safely. Since all records are stored in a publicly accessible database, authors can protect their rights with the help of this independent registry.

Ascribe is not only suitable for digital art, photography and design — the company also works with real art, for example, sculpture or installations. All that is required to register your work is to take a picture of it and upload it to the system.

The company's technology takes into account that there are a limited number of authorized copies of digital works, and legitimizes each copy in the system: for example, a one-of-a-kind painting or a limited number of photo prints. It is claimed that with the help of blockchain—based technology, the service can track the journey of each registered file and record where it is placed - thus, the rights holders can prove their copyright and have claims to those who steal their work.

The company is also working on machine learning technology, with which it is possible to identify a copy of the work on the network, even if the watermarks have been erased.

Charity

Charity is an industry in which huge amounts of money are involved, but the main problem in this area has always been the issue of trust. Most often, those who donate cannot track in any way whether the money has reached those in need or has settled in someone's pockets. Basically, philanthropists face the following problems: the lack of visible results of their assistance and information about to whom and in what amount money or resources were provided; significant time delays; a large number of fraudsters; legal difficulties and corruption. Blockchain can completely change the principles of charity platforms due to transparency of financial flows, increased transaction speed, reduced administrative costs, absence of geographical restrictions and demonstration of results.

In October 2017, Connie Gallippi, founder of BitGive Foundation, announced the launch of a beta version of GiveTrack, a multi-purpose blockchain-based donation platform that allows donors donate Bitcoin to charitable causes. GiveTrack users who send cryptocurrency to charity can monitor in real time how it is used (Castor, 2017).

The Water Project is the long-standing nonprofit partner of BitGive Foundation and non-governmental organization that provides water supply in Kenya. It provides clean water

to a local Chandolo primary school and a community of more than 500 people. The BitGive Foundation has published a three-minute video in which he talked about the changes in Kenya that have occurred thanks to cryptocurrencies. This caused an influx of donations, the largest of which were 38 bitcoins sent on September 13, 2016 by an unknown donor!

British Blockchain Platform Alice.si (si means “social impact”), using "smart" contracts based on Ethereum, "freezes" donations until charities can demonstrate concrete results that are verified and confirmed by an independent third party. This means that the donation is guaranteed to reach the goal. If not, the money is returned to the donor.

Real estate

Real estate has always been considered one of the most reliable investment segments. According to IMARC Group latest report (Market research report, 2022), the global real estate market size reached US$ 7,063 Billion in 2022. Despite its global economic, environmental and social significance, the digital maturity of the real estate sector is consistently assessed as low compared to many other industries, which indicates a significant potential for productivity improvement due to the wider introduction of digital technologies (Saari et al., 2022).

The real estate market preserves the old traditions of making transactions. Be sure to see the object live, evaluate, hold several meetings and attract third-party specialists. At the same time, the whole world has been playing out different scenarios for a long time and introducing new technologies - blockchain. Such serious problems faced by the real estate sector as non-transparency, inefficiency, fraud and corruption, high costs and trust problems can be solved with the help of this technology.

Blockchain in real estate allows excluding the involvement of third parties in the transaction, but at the same time have a sense of security in the same transfer of funds. For example, investor wants to buy an apartment. To be sure that he will not be deceived when transferring money, investor gives them to the bank and they lie there until the seller registers the property. At the same time, investor feels uncomfortable whether something will happen to the bank while he is sorting out the documents. The seller is worried about whether all the money will be transferred and how quickly?

With blockchain, such issues are excluded. Everything is fast, safe, and most importantly transparent. You no longer have the opportunity to stay without money and without an apartment. Investor sends money to the seller, the transaction data is encrypted and transmitted to the blockchain participants. After their confirmation, the transaction is saved in the database and the money is transferred to the recipient after the conditions of the smart contract are fulfilled. Transaction data will appear on thousands of computers around the world and information about the transfer of ownership rights can be confirmed at any time.

Thus, the system excludes the work of lawyers, realtors and even notaries. How quickly these professions will cease to be in demand is still a matter of time and technology development. A new era of real estate investments using blockchain started literally four years ago, but already in this short time there has been a real technological revolution of the entire real estate industry and more and more successful cases can be seen in various countries of the world. A vivid example of which can be considered in the case of SAPEB AnnA described below.

In June 2019, villa AnnA in Paris became the first European real estate in history to be fully sold using a blockchain transaction. A luxury building located in the Boulogne-Billancourt urban area was divided into 100 tokens and sold for 6.5 million euros. Each of the tokens, in turn, can be divided into 100,000 units, the cost of each is 6.5 euros. The villa was successfully sold with the transfer of rights to two french real estate companies – Sapeb Immobilier and Valorcim. The transaction was carried out on the French blockchain investment platform Equisafe, based on the Ethereum token (Rosen, 2019).

1.3 Smart contracts

One of the newest results of the blockchain evolution and the latest fashionable invention of the technology world has become a *smart contract*.

Smart contracts are paperless digital code existing on a blockchain that automatically implements and enforces self-executing agreements between buyer and seller without human intervention (Dilendorf, 2020).

Smart contract defines a set of promises on pre-written terms agreed upon by the parties to the transaction. In fact, it is a computer program where the parties prescribe the terms

of the transaction and sanctions for their non-fulfillment, confirming the contract with a digital signature. Further, the system independently monitors and ensures the fulfillment of obligations. It also makes a decision: to complete the transaction and issue the required (money, shares, real estate), impose a fine or penalty on participants, close access to assets.

The principle of smart contracts was first described by the American cryptographer Nicholas Szabo back in 1994 in his conceptual article entitled "Smart contracts" long before the advent of blockchain technology. However, smart contracts became more widespread with the advent of the Ethereum cryptocurrency, the idea of which was proposed by the Belarusian founder of Bitcoin Magazine Vitalik Buterin in 2013. Finally, in December 2017, Belarus became the first country in the world to legislate smart contracts.

Smart contract is an alternative to legal contracts. In legal contracts, the third party is the judicial system of the country where the contract is concluded, which is responsible for the execution of the contract.

A smart contract is exactly the same contract, but only digital. Its execution is guaranteed by a computer program, the foundation of which is a strict mathematical system. An important feature of smart contracts is that they can only work with assets located in their digital ecosystem.

Under traditional conditions, if one party does not fulfill its contractual obligations, the other party can go to court. This can take considerable time and resources. Contractual agreements implemented in the form of smart contracts will be executed automatically without the participation of a third party (Uzsoki, 2019).

The demand for smart contracts is growing at an exponential speed. According to the GlobeNewsWire, in 2020, the Global Smart Contracts Market size was 144.95 Million USD. By 2028, it is projected to reach 770.52 Million USD (Peranzo, 2023). The rising application of smart contracts in various industries such as banks, government, healthcare, financial services companies, and real estate are expected to fuel the market growth.

To know how smart contract works, first need to understand what it consists of:

- identification of the parties. Each party wishing to conclude a smart contract must have identification data on the blockchain that confirms its identity or the right to representation;
- subject of the contract. The subject should be within the context of the smart contract environment;
- definitions of conditions. The parties agree on the terms of the contract, such as price, terms, rights and obligations of each party. These conditions can be written in the code of a smart contract or presented in the form of data transmitted to the contract;
- signatures. Two or more parties must provide their consent to the fulfillment of the proposed conditions and perform actions to sign the contract.

A smart contract contains a set of conditions that must be met for its activation and execution. For example, a smart contract contains a condition that a certain amount of money must be transferred to a certain address before a certain date.

When all the conditions specified in the smart contract are fulfilled, it is automatically activated and executed without the need for the intervention of a third party or intermediaries. If the agreed amount of money was transferred to the address specified in the contract, then it can automatically perform the actions that were also specified in the terms. For example, to transfer this money to another party.

The status and execution of a smart contract are usually displayed on the blockchain and are available to all network participants: this allows to check and confirm the results of contract execution and ensure transparency of interactions.

Ethereum (ETH) is the leading blockchain platform used for executing automated contracts. Smart contracts on Ethereum are typically created in Solidity, a Turing-complete programming language with powerful capabilities, and then transformed into low-level bytecode that can be executed by the Ethereum Virtual Machine.

Smart contracts on the Ethereum blockchain have the ability to be destroyed using a self destruct function. However, this feature can be both beneficial and problematic for developers. On one hand, it provides the option to delete contracts and transfer Ether in emergency situations, such as during an attack. On the other hand, it can complicate the development process and potentially create a vulnerability for attackers. In cases where

security issues or the need for functionality upgrades arise, developers terminate the contract and introduce a new version after addressing any errors or making improvements.

Smart contracts provide a secure method for conducting real estate transactions that require trust, transparency, and anonymity among all parties involved.

There are various ways in which smart contracts can be utilized in the real estate industry (Peranzo, 2023):

Identity Management

In order to protect themselves from the damaging consequences of identity fraud - such as unauthorized access to bank accounts and emails - users need effective safeguards.

Although there are technologies available that can help prevent such crimes, their effectiveness is limited because they do not give individuals complete control over their data and the ability to choose what information they share.

Smart contracts based on decentralized, distributed ledger technologies, known as Digital Identifiers (DIDs), address these concerns. By allowing individuals to have full control over their data and determining how it is shared, DIDs enhance data security and minimize the risk of data mismanagement or breaches.

Property Ownership Transfer

Due to the lack of clarity in traditional contracts, the transfer of property ownership in real estate transactions becomes a source of stress and risk for both parties. Smart contracts help to alleviate the overall ambiguity found in these traditional contracts.

Typically, the seller is reluctant to transfer ownership until they receive payment, while the buyer is equally hesitant to release funds without acquiring the property. Notaries partially address this issue, but they increase the costs associated with transferring property ownership and cause delays.

Smart contracts offer a solution to these problems and expedite the process of changing property ownership. These contracts are automatically executed once the necessary conditions are met.

For instance, once the buyer transfers payment to the seller, the smart contract can automatically change the ownership of the asset. Alternatively, a notary can promptly

inform a buyer that the previous owner has paid off the mortgage on a specific property, allowing them to make a safe purchase.

Hassle-free Lease Agreements For Rentals

Renting out properties has become effortless thanks to the implementation of smart contracts. Rent Peacefully is one of the platforms dedicated to facilitating this process. It enables property owners to rent out and list their properties using blockchain technology through the use of smart contracts.

The property owner initiates the smart contract process by inputting the leasing conditions into a newly created contract, which includes details like rent amount, property management fee, and payment frequency.

Once both parties have reached an agreement, the occupier can conveniently review the lease's terms on the online platform and digitally sign the smart contract.

To make the agreement legally binding, the property owner also digitally signs the contract, thereby converting it into a legally recognized digital smart contract.

Real Estate Investing

The emergence of blockchain technology introduces a fresh avenue for engaging in real estate investments. Tokenized fractional ownership serves as an innovative approach in blockchain-based investing, enabling investors to swiftly purchase and sell tokens, as well as trade a portion of their tokenized ownership instead of the entire property. Moreover, this method allows for the implementation of smart contracts to ensure that these real estate transactions generate income for holders, either through rental payments or dividends.

Smart contracts' growing popularity stems from their obvious advantages:

Autonomy: smart contracts are typically made directly between individuals or legal entities, meaning that intermediaries are not involved. The presence of a lawyer is not necessary to validate the contract, allowing the parties to minimize or exclude any unnecessary individuals who are not involved in the agreement.

Security: the primary aim of a smart contract is to guarantee transaction security. The information stored within the blockchain is immutable and cannot be altered or erased. In case one party fails to meet its obligations, the other party is safeguarded by the

stipulations of the smart contract. The smart contract code is secured through cryptographic techniques, further enhancing the security of its implementation.

Speed: smart contracts save valuable time by automating the document processing task that would otherwise take a long time if done manually, thereby eliminating the delays associated with it. Furthermore, personal participation is not typically required in smart contracts, further enhancing the efficiency and speed of the process.

Cost-effectiveness: one way smart contracts can be beneficial is by reducing costs and eliminating the need for intermediaries. This can result in substantial savings for businesses and individuals. Additionally, smart contracts offer a chance for parties to collaborate on more advantageous terms, further enhancing their cost-effectiveness.

Accuracy: The use of smart contracts minimizes mistakes caused by humans, as they operate on algorithmic principles. By incorporating an automated transaction system, the execution of contracts becomes highly precise and greatly reduces the likelihood of errors.

Although smart contracts offer great potential, they also come with disadvantages:

The complexity of the implementation and limitations of the blockchain platform: it can be quite time-consuming, expensive, and arduous to integrate smart contracts with real-world components. Moreover, proficiency in a specific programming language for writing smart contracts necessitates additional training and expertise. Additionally, various platforms possess distinct capabilities; some may lack functionality and scalability, posing challenges in the utilization of smart contracts.

The inability to modify the smart contract presents a paradoxical situation. Surprisingly, one of the key benefits of smart contract can also lead to conflict. If the parties come to a more favorable agreement or if new factors emerge, the terms of the smart contract become unchangeable, thus preventing any future modifications. Due to this, the development of new blockchain platforms should include provisions for additional agreements.

Errors in the smart contract: While it is true that smart contracts can eliminate the risk of human error in work, there is still a possibility of errors or vulnerabilities in the code of the smart contract itself. Numerous instances of platforms being hacked and funds being stolen due to code errors exist. Even a minor mistake can result in significant consequences such as financial loss or breach of contract terms.

Lack of regulation: Despite being potentially legally binding, there is still a lack of clarity regarding the acceptance of smart contracts by traditional legal systems. The absence of specific laws governing smart contracts makes it challenging to determine their validity in a court of law. Additionally, the international nature of blockchain technology raises concerns about enforcing smart contracts across different jurisdictions. Identifying which jurisdiction's laws are applicable and resolving disputes that span multiple borders may present difficulties.

Privacy Intrusion: While transparency is often valued, there are situations where privacy becomes necessary for users. Certain platforms are attempting to provide their users with "smart confidential contract", although this approach is uncommon. Moreover, implementing new technology can potentially bring about additional expenses. It takes a skilled developer to create a reliable smart contract.

Overall, this technology still raises many questions. However, what does the future look like? Will there be a new technology that will overcome its limitations or completely replace it?

1.4 Tokenization of Assets

The massive transition to a decentralized economy has created many new opportunities. Blockchain technologies have found various ways of application in the global financial ecosystem. Asset tokenization has become one of the most notable ways to simplify and expand the capabilities of the traditional financial market.

With its help, it became possible to unlock illiquid assets and provide additional profit. That is why tokenization technology is attracting more and more attention from private companies and government agencies wishing to open up new opportunities for raising capital.

Tokenization is a digital asset fractionalization, involves transforming securities, precious metals, real estate, goods, and other assets into digital tokens that are tradable and exchangeable. These digital tokens derive their value from real-world assets, making them highly stable and resistant to market volatility when compared to other cryptocurrencies.

Investors now have the opportunity to enter markets that were previously out of reach, thanks to tokenization. This process also offers a low barrier for entry when it comes to investing and allows for portfolio diversification. Additionally, by utilizing blockchain technology, investors can benefit from a transparent calculation system and secure ownership of their assets.

Tokenization establishes a connection between tangible assets and their digital counterparts, enabling their exchange, safekeeping, and transmission within the virtual realm (Stefanoski et al., 2020).

In a general sense, tokenization transforms the value held in a physical or non-physical object into a token that is typically manageable within a blockchain system. Put simply, tokenization has the ability to convert nearly any asset, whether tangible or intangible, into a digital token, allowing for digital transfers, ownership, and storage without requiring a central third party or intermediary.

Most often, such assets are tokenized:

Securities. Tokenized to expand their use as a trading instrument, enabling financial assets and documents to be represented as tokens. For example, such types of securities like stocks, treasury bonds, futures, collateral-trust certificates, shares, investment contracts, any put, call, option, index of securities and other can be tokenized.

Artwork: Tokenizing artwork enables the fractional ownership of valuable pieces of art, making it more accessible to a larger number of investors.

Real estate: Ownership rights of real estate, such as houses or plots of land, can be tokenized, even allowing for shared ownership through fractionalization. Tokenization can also be applied to loans for construction and deposits in real estate-focused investment funds, although this is more relevant to securities.

Intellectual property: Tokenizing intellectual property, such as patents, trademarks, or copyrights, can allow for easier licensing, distribution, or sale of these assets.

Goods and services: Tokenization is utilized by business owners as a marketing strategy to attract financing or as an additional channel to attract customers. This enables the tokenization of rights to certain goods or services.

Raw material assets: Tokens can be issued on the blockchain to represent ownership of various raw materials, including agricultural products, metals, and energy carriers. The tokenization of precious metals like gold and silver, as well as oil, natural gas, and precious stones, is becoming increasingly popular.

Token is defined as digital representation of an asset or unit of value that is issued and tracked on a blockchain network (Smith et al., 2019). Tokens can represent various types of assets such as cryptocurrencies, utility tokens, security tokens, or even physical assets like real estate or art. These tokens are created, managed, and transferred using smart contracts or protocols on a blockchain platform. Tokens can be traded, exchanged, or utilized within a specific ecosystem or decentralized application (DApp) that is built on the blockchain network.

There are several popular classifications of blockchain-based tokens assets. These classifications are based on their functionality and purpose within the blockchain ecosystem. Some of the most popular classifications include:

Utility Tokens: These tokens are primarily designed to provide access to a product or service within a blockchain network. They can be used as a form of payment or as a means to access specific features or resources within the network and are not investment contracts.

Payment Tokens: These tokens are specifically designed to be used as a medium of exchange or digital currency. They can be used to facilitate transactions and store value.

Stablecoins: is a type of cryptocurrency that is pegged to a stable asset, such as fiat currency or precious metals. They aim to minimize price volatility and provide stability to users.

Non-Fungible Tokens (NFTs): NFTs represent unique digital assets or collectibles, such as artwork, virtual real estate, or in-game items. Unlike other cryptocurrencies, NFTs cannot be exchanged on a like-for-like basis due to their individuality.

Governance Tokens: These tokens are used to participate in the governance of a blockchain network. Token holders can vote on proposals and decisions related to the protocol, making them an integral part of the network's decentralized governance structure.

Security Tokens: They provide digital representation and fractional ownership of physical assets. These tokens represent ownership of real-world assets, such as real estate, commodities, or artwork and are subject to securities regulations. They often offer investors specific rights such as dividends, voting rights, or profit-sharing. By being on the blockchain, they possess similar legal structures to conventional securities but also offer additional technological functionalities (like automatic payments, transparent record of ownership, and unchangeable ownership history) (Smith et al., 2019). In the blockchain industry, there are three primary categories of security tokens including asset-backed crypto tokens, equity tokens, and debt tokens. Among these variations, the asset-backed crypto token holds significant popularity among traders, investors, and speculators.

Tokenization, which shares similarities with securitization, involves the creation of security tokens through a process known as an initial coin offering (ICO). By using a security token offering (STO), as opposed to other types of ICOs that generate equity, utility, or payment tokens, a digital representation of an asset can be created.

A Security Token Offering (STO) is a public offering token that is representing a security. The owner of the token obtains e.g., rights in a company or contractual claims to assets as promised by the security (Stefanoski et al., 2020). This means that a security token could represent ownership in a company, a stake in real estate, or participation in an investment fund. Following their creation, these security tokens can be traded on a secondary market.

The asset would be listed on the platform with the target price and token quantity determined by the asset's value. Registered users can view all the details of the asset, including location, cost, expected returns, and other information. If a user decides to buy tokens for the asset, they must pay the appropriate amount based on the number of tokens purchased. If the STO is successful in raising the target amount, investors will receive their tokens and ownership of the asset will be transferred. If the STO fails to raise the required funds, investors will be refunded and the original asset owner will retain ownership. Once investors receive their tokens, they can benefit from monthly returns and capital appreciation as the token value increases (Gupta, et. al., 2020).

The asset can generate revenue which can then be distributed to investors based on the number of tokens they own. This process can be automated and effectively executed through a smart contract. The smart contract can incorporate functions to calculate

ownership percentages and smoothly transfer the proportion of profits to the investor without any scope for frauds or discrepancies (Gupta, et. al., 2020). In addition to distributing dividends, the smart contract can also include features for investors to vote on decisions.

According to Smith et al. (2019) the major types of security tokenization players currently shaping the tokenization landscape are:

Issuance platforms: These platforms offer a variety of services, from customized branding to exclusive offerings, to assist asset owners in launching their security tokens.

Compliance providers: These provide services, which are integrated with the issuance platform, include KYC (know your customer/client), anti-money laundering (AML), the maintenance of a list of approved investors, and the verification of asset transfers, among other functions.

Regulators: Regulations can vary in different jurisdictions, and new regulations are continuously being developed as the industry evolves. These are just a few examples of the regulatory bodies involved in security tokenization: Securities and Exchange Commission (SEC) in the United States; Financial Conduct Authority (FCA) in the United Kingdom; European Securities and Markets Authority (ESMA) is an independent EU authority; Financial Market Supervisory Authority (FINMA) is the Swiss financial regulator; and others.

Broker-Dealers: These are entities involved in the trading of securities and aiding large investors in this process. When carrying out trades for a client, they are referred to as brokers, whereas if they conduct trades for their own benefit, they are known as dealers.

Trading platforms: There are several trading platforms that are emerging as major players in security tokenization. Some of the notable ones include: OpenFinance Network, tZERO, TokenSoft, Polymath, Securitize, etc.

Legal firms: Law firms that provide legal advice and services related to token offering structures, compliance with regulatory requirements and securities legislation. In addition, they offer legal guidance on blockchain technology and security token offerings

Custody: Custodial solutions involve holding securities on behalf of investors, ensuring the safety of assets and reducing the possibility of theft or loss. Third-party providers play the role of safeguarding these assets, which becomes more complex in the digital realm

where digital assets are involved. This complexity arises from the need for advanced key management systems to ensure the security of their customers' holdings.

The main benefits of tokenization of assets are (Gupta, et. al., 2020):

Liquidity: Tokenization allows fractional ownership of assets, enabling a larger pool of investors to participate. This can lead to greater liquidity in the market, as token holders can easily buy and sell their tokens on secondary markets.

Faster and cheaper transactions: Transactions can be completed more quickly and at a lower cost due to the use of smart contracts. By automating certain aspects of the exchange process, the need for numerous intermediaries is reduced. As a result, buying and selling become more efficient, with faster execution of deals and reduced transaction fees.

Transparency: The security token has the ability to incorporate the rights and legal obligations of the token owner into the token itself, along with an immutable record of ownership. These attributes open up the potential to increase the transparency of transactions, ensuring that you know the parties involved, understand your own and their rights, and have information about the previous owners of the token.

Accessibility: Tokenization allows investors to access a wide range of assets that were previously unattainable or restricted due to high costs or regulations. It democratizes investing by making traditionally illiquid assets more accessible to smaller investors.

There are several risks and challenges associated with asset tokenization:

Regulatory challenges: As the tokenization of assets is still a relatively new concept, it faces regulatory hurdles in many jurisdictions. The lack of clear regulations and legal frameworks can create uncertainty and increase compliance costs for token issuers and investors.

Market volatility: Tokenized assets are still subject to market volatility and can be affected by external factors such as economic conditions, market sentiment, and regulatory changes. Investors in tokenized assets should be aware of the risks associated with such volatility.

Technological risks: Tokenization relies on blockchain technology, which is still evolving and faces technological risks such as hacking, system failures, and scalability

issues. Any technological vulnerabilities can potentially compromise the security and integrity of tokenized assets.

Lack of liquidity in certain markets: While tokenization aims to enhance liquidity, it may not be suitable for all asset classes or markets. Certain illiquid assets may still face challenges in finding buyers or may experience limited trading activity on secondary markets.

Valuation Challenges: Determining the precise value of tokenized assets, particularly those that are unique or difficult to sell, can present difficulties. It is crucial to have reliable data sources and appropriate valuation models in order to establish fair and transparent pricing for these assets.

There is no doubt that the tokenization process is in its early stages of development, but its potential is enormous. In order for this field to flourish, it requires regulatory adjustments to accommodate tokens globally. Nevertheless, there are already entities and regions that have embraced tokenization, providing a diverse range of tokenized assets for individuals and corporations worldwide.

Chapter II. What is the Tokenization of Real Estate?

2.1 Real Estate traditional investments

Real estate investment involves acquiring property with the aim of generating income, as opposed to using it as a primary place of residence. In more straightforward terms, real estate consists of tangible assets such as land and everything situated on it, including natural resources, buildings, infrastructure, and other tangible properties. While these assets are typically immovable, they can be transferred, and real estate investments are generally seen as a secure investment option.

One of the conventional approaches to engage in real estate investment is acquiring land or property directly through the services of a real estate broker. The traditional form of real estate investment entails buying a property with the goal of either leasing it out or selling it at a profit or both. Typically, investors must provide a substantial initial capital investment to secure the property, and they bear the responsibility for all facets of the investment, including tenant procurement, property management, and the oversight of essential repairs and maintenance. While traditional real estate investing can yield profits, it also demands a considerable commitment of time, energy, and financial assets.

Real estate is an interesting and very attractive asset category. According to direct property indexes, an average institutional real estate portfolio provides moderate returns with low risk and offers reasonable diversification potential. These three attributes collectively present a compelling argument for a substantial capital allocation to real estate (Baum, 2020).

2.1.1 Classification of Real Estate

Real estate can be divided into different types depending on its purpose. Here are some of them (Anjali, 2019):

Residential Real Estate: Real estate comprises residential properties, including single-family homes, duplexes, triplexes, townhouses, bungalows, and others, all intended for residential use. This can encompass newly built properties or houses being resold by their owners, regardless of their construction history.

Industrial Real Estate: Industrial real estate encompasses extensive properties designed for the establishment of factories, distribution centers, manufacturing units, warehouses, and similar purposes on a large scale.

Commercial Real Estate: Office properties, such as complexes or buildings, can be subdivided into numerous smaller units that are either leased to tenants or utilized for various business operations.

Retail Real Estate: These properties serve as locations for showrooms, restaurants, shopping malls, standalone retail stores, outlets and more. These properties may comprise either single units or multiple units strategically positioned in prime areas.

Agricultural Real Estate: Any vacant land used for farming, ranching, or agricultural activities also qualifies as a type of real estate.

Fix and Flip Properties: Residential properties that are in a state of disrepair and are priced attractively are commonly referred to as "fix and flip" properties. Buyers who engage in renovation and repairs to enhance their condition and subsequently sell them at a higher price acquire these properties.

Mixed-Use: A single real estate development that combines two or more distinct property types, as mentioned earlier, like a structure featuring both residential and commercial units. This approach is employed to achieve diversification and reduce the potential risk of project failure.

2.1.2 Types of traditional real estate investment. Advantages and disadvantages

Real estate investments offer several benefits, including the potential for competitive returns relative to the associated risks, substantial tangible asset value, and attractive and steady income from rental and leasing proceeds (Gupta, et. al., 2020) and revaluation potential realizable with a subsequent sale.

Participation in real estate investments provides an excellent way to generate passive income in the long term, and is suitable for practical investors seeking more control over their investment endeavors.

Another advantage is its ability to act as a safeguard against market fluctuations. Real estate can provide a protective barrier during periods of stock market instability. While

conventional investments may underperform, real estate investments may retain their value or potentially see an increase in value.

Investing in real estate with the objective of generating income through renting or selling, as opposed to using it as a primary dwelling, represents a form of *direct property investment*. Real estate investors commonly buy houses, apartment complexes, and commercial properties to lease to tenants. Direct real estate investment can be executed through various approaches, but the most prevalent approach involves acquiring a property through a mortgage, a concept referred to as "leverage." The appeal of leverage is a significant factor that draws many real estate investors, as it enables the acquisition of properties that might otherwise be beyond their financial reach (Visniauskas, 2020).

Traditional real estate investment has several disadvantages. Firstly, the high initial cost of purchasing property poses a significant barrier, demanding a substantial upfront investment and potentially leading to significant ongoing expenses (Gupta, et. al., 2020).

The problem associated with direct investments also lies in the need to apply for a mortgage and receive a significant amount from the bank. Obtaining financing from the bank requires compliance with strict creditworthiness criteria and strict lending standards of the bank (Visniauskas, 2020). Many investors find it challenging to meet this financial requirement, making it difficult for them to invest in real estate.

Additionally, the system faces issues related to its lack of liquidity. Real estate investments are characterized by their high illiquidity, and, in order to continue receiving rental income from the property, the owner must consistently find suitable tenants. Furthermore, it is not possible to sell a portion of the asset; rather, the entire underlying asset must be sold (Gupta, et. al., 2020).

Moreover, the real estate market is burdened by substantial transaction costs, and the process of finalizing a real estate deal is time-consuming.

Generally, real estate transactions involve significant private market investments within a nontransparent data environment. These results in an investment ecosystem characterized by protracted transaction and settlement procedures that encompass numerous intermediaries (such as agents, sellers, buyers, financiers, insurers, and others), duplicated verification processes, and redundant information stored in separate databases and registries. The complexity intensifies as one progresses further down the value chain,

with tasks like lease management, insurance, maintenance, payments from lessees to lessors, remittances from lessors to investors, and reporting all becoming unwieldy and time-consuming processes (Smith et al., 2019).

Due to the specific market features of the commercial real estate sector, it is typically challenging retail investors to engage in direct investments in commercial real estate (CRE). Nonetheless, various financial instruments have been designed to mitigate the obstacles and expenses associated with granting retail investors access to CRE exposure, offering them indirect investment avenues. Among the most prevalent options are public and private real estate investment trusts (REITs), real estate investment funds (REIFs), and real estate crowdfunding platforms.

Real Estate Investment Trusts (REIT). A REIT is an entity like a trust, corporation, or association that either owns or provides financing for income-generating real estate (Gupta, et. al., 2020). It is required to distribute at least 90% of its taxable income as dividends to its REIT shareholders. The revenue generated by a REIT comes from various sources, including rental income from its portfolio of owned assets, interest earned from financing real estate holdings, proceeds from the sale of managed assets, and management fees. Investors have the option to invest their money in a pool of properties managed by a REIT company and receive dividends from the income generated. However, investors are also responsible for taxes and may incur losses (Visniauskas, 2020).

According to Smith et al. (2019), upon creation, REITs issue shares to investors through three different methods:

In the case of a *private* REIT, it is offered through a private placement to eligible investors, which includes accredited investors or Qualified Institutional Buyers (QIBs).

If the REIT is *publicly traded and listed on an exchange*, it can be acquired through the exchange, and the transaction cost will be determined by the broker's fee, which can be as low as 0%. The price will be determined by the prevailing market price at the time of the transaction, and liquidity will be influenced by the general market conditions. However, due to the presence of market makers, retail investors are unlikely to encounter any trading limitations.

If the REIT is *publicly offered but not listed on an exchange*, it can be acquired through a private transaction facilitated by a broker, who earns a commission from the issuer,

which can be as high as 10%. Pricing will be determined by either the Net Investment Methodology or the Appraised Value Methodology (not the present market value), and liquidity will be constrained by the issuer, which typically repurchases shares at a reduced price.

Numerous REITs have issued their shares and are listed on public stock exchanges in cities like New York, London, Madrid, and others. A REIT is a corporation that allocates its investments into commercial properties, including shopping malls, hotels, office buildings, and medical facilities. One notable illustration of a REIT is Empire Realty Trust (ESRT), which possesses one of the most iconic structures in history: the Empire State Building situated in New York City (Visniauskas, 2020).

REITs are generally readily marketable, as they are traded on stock exchanges. However, buying them can pose challenges due to the lengthy registration processes on traditional online brokerage platforms. This marketable aspect helps alleviate some of the traditional downsides associated with real estate. In traditional real estate transactions, assets can be illiquid, meaning they may take a significant amount of time to buy or sell. In contrast, REITs can be sold within seconds through your investment account.

Another often underestimated advantage of REITs is their remarkable resilience to bankruptcy, even in times of significant economic turmoil. During the period spanning from 2007 to 2010, which marked the most severe recession in the United States since the Great Depression, just one publicly-traded REIT declared bankruptcy. (Visniauskas, 2020).

REITs serve as a solution to the liquidity challenge in the real estate sector, but they come with several drawbacks. In historical terms, public REITs have typically delivered lower returns compared to their private counterparts. Furthermore, they often trade at a premium relative to their Net Asset Value. Additionally, the total value of commercial real estate assets held by REITs is considerably smaller than the total commercial real estate market, which means that a significant portion of the commercial real estate market remains beyond the reach of investors.

Furthermore, retail investors are reliant on REIT managers and lack the ability to tailor their real estate investments to their specific preferences. An investor may desire access to a particular type of asset in a specific geographic location, but currently, REITs do not offer the flexibility to make such granular investment choices (Gupta, et. al., 2020).

Additionally, certain REITs impose substantial management and transaction fees, resulting in reduced returns for investors.

Crowdfunding. Real estate crowdfunding has piqued the interest of young entrepreneurs and small to medium-sized property developers. This type of investment holds the promise of addressing the financial challenges faced by less financially well-off buyers, while also eliminating geographical constraints in raising capital. Additionally, lowering the minimum investment amount for investors is likely to expand the potential pool of buyers and the available capital resources (Baum, 2020).

Crowdfunding, also known as peer-to-peer (P2P) lending, refers to the pooling of both equity and debt to fund various projects through an online platform. These platforms facilitate connections between lenders and project sponsors, creating investment opportunities. In the context of real estate crowdfunding, the capital raised is directed toward acquiring, developing, or renovating a real estate asset, with the ultimate goal of utilizing or selling the property.

This financing approach enables real estate firms to secure funding without relying on traditional banks or credit unions as intermediaries. Rather than obtaining a loan from a bank, crowdfunding platforms act as financial intermediaries, and individual investors contribute their funds to specific projects online.

Crowdfunding offers a great way to diversify an investment portfolio without the necessity of making a substantial initial investment in real estate projects. In contrast to REITs and similar diversified alternatives, there is complete clarity regarding the specific project where investments are being allocated and the destination of the funds. This enables individuals to independently investigate the prospective real estate project and make well-informed decisions when selecting their investments.

Given that real estate crowdfunding projects are not subject to trading on the stock market, the success of an investment is not contingent on the overall market conditions. Therefore, returns are not directly influenced by market fluctuations.

A significant challenge in crowdfunding investments is the limited ease of selling or the absence of liquidity. In many instances, crowdfunding platforms do not have a secondary market available. In addition to other factors, dividends earned by investors are subject to

taxation. Furthermore, individuals using crowdfunding platforms might incur an extra charge for utilizing their services (Visniauskas, 2020).

Real estate funds (REIF). A real estate fund is a collective investment vehicle primarily dedicated to investing in real estate assets or securities linked to real estate. These funds enable both individual and institutional investors to gain access to a diversified portfolio of real estate properties, eliminating the need for them to directly purchase, manage, or finance these properties.

There are three types of real estate funds:

- Real estate exchange-traded funds (ETFs)
- Real estate mutual funds
- Private real estate investment funds

Real estate funds differ from real estate investment trusts (REITs), which often exhibit correlations with the stock market due to their potential for public trading. An exception to this is real estate exchange-traded funds (ETFs), which are also traded and typically consist of aggregated REITs (EquityMultiple, 2022).

Investors have the opportunity to diversify across different geographical regions, borrowers, sponsors, and managers, as well as a range of securities including equity, preferred equity, and debt, along with various types of properties.

A common setup for a private real estate fund involves it being a closed-ended entity, typically organized as a limited liability partnership with a finite lifespan. In the fundraising phase, which usually cover 12 months, an investor signs a subscription document, pledging a predetermined sum of money to the fund. Investors assume the role of limited partners within the fund, while the sponsoring organization functions as the general partner, taking charge of actual investment choices and fund management responsibilities.

Limited partners of the REIF usually allocate their commitments across approximately 10 to 20 investments, which are gradually paid out over a span of three to four years following the fundraising. The standard duration of holding the underlying investments fluctuates between two to five years, contingent on the investment approach (Tomperi, 2010). In the event of successful investments, limited partners retrieve their initial capital along with potential capital gains upon the sale of the investments.

The particular goals, approaches, and property categories that a real estate fund focuses on can vary widely, encompassing residential and commercial real estate, industrial properties, retail spaces, and specialized real estate assets. Investors in these funds usually earn returns through rental income, property appreciation, or dividends derived from real estate-related investments held within the fund. Real estate funds offer a means to diversify a portfolio and access the real estate market without the obligations and risks linked to direct property ownership.

While high-net-worth individuals in Europe have favored private real estate investment funds, they generally remain inaccessible to the majority of retail clients. This limitation is primarily attributed to the substantial minimum investment criteria, which can vary across different European countries, ranging from 125,000 EUR to 1 million EUR or even higher (Visniauskas, 2020).

This investment model offers two primary advantages:

- Passive investment approach: Given that investors are classified as limited partners, the fund's managers are responsible for the complete management of the assets.

- Potentially attractive returns: Depending on the fund's risk profile, investors may anticipate annual returns falling within the range of 10% to 18%.

On the other hand, the majority of Real Estate Investment Funds (REIFs) typically involve substantial leverage, meaning they are funded in part through debt. In times of market instability, elevated unemployment rates, or other macroeconomic challenges that introduce financing risks, this type of investment can potentially lead to a partial or complete loss of invested capital.

Despite the various financial tools mentioned above, which address several issues related to conventional real estate investments, the primary challenge remains the risk of illiquidity. As an alternative mean of addressing liquidity concerns, along with informational and structural issues in real estate investments, the utilization of blockchain technology presents significant potential for a transformative shift in this domain. However, before delving into the concept of real estate tokenization, it is important to first explore the idea of fractionalization.

2.2 Real estate fractionalization

The prospect of introducing liquidity into the ownership structure is an enticing proposition. Without any doubt, the appeal of this asset class would significantly increase if it could be easily and affordably traded. Is it possible for the digital realm to provide real estate investors with transactions as seamless as those experienced with Alipay[2] or OneTwoTrip[3]? Can real estate titles be transformed into a digital format?

The fractionalization of real estate assets, which involves dividing real estate holdings into smaller components, is a well-established concept in the field of real estate finance.

If real estate assets were readily divided into smaller units or fractions, it would likely enhance the risk-return profile of conventional real estate portfolios. Simultaneously, this division would boost the liquidity of individual assets.

Baum (2020) has suggested several ways, which have different legal implications, for dividing a real estate asset into its individual components or achieving fractionalization:

- split the freehold ownership between several legal persons;

- sub-divide the building physically;

- create a time share structure;

- use tranching;

- syndicate ownership of the asset.

Joint ownership

Joint owned property is defined as one with more than one owner with either equal or unequal share in the property, depending on the nature of ownership. This is any property held in the name of two or more parties, like husband and wife or business partners. It gets done to safeguard the property, help maintain it, and allow for easy property inheritance through the survivorship clause.

[2] Alipay is a one of the largest payment systems included in Alibaba Group. https://global.alipay.com/platform/site/ihome

[3] OneTwoTrip is an online service for booking hotel rooms, buying air, railway tickets and car rental around the world. https://www.onetwotrip.com/

There are four main types of joint owned properties – tenancy in common, community property, joint ownership, and tenancy by the entirety (Vaidya, 2023).

In France and other southern European countries joint owners also share asset-related debts proportionally. To mitigate risks of disputes, 'jointly owned in undivided shares agreements' can be used, outlining management rules, expense division, and other details. When these agreements have an indefinite term, none of the joint owners can force property sale. If one joint owner blocks asset sale, others can seek permission for sale from the regional court, involving a notary (Baum, 2020).

Physical sub-division

Sub-division defines as the procedure of splitting a solitary property into smaller, separate physical parcel of land. This may encompass dividing an extensive land area into individual plots or partitioning a structure into numerous units or apartments. The process of physical sub-division typically involves adherence to zoning regulations, land use planning, and legal requirements to guarantee that the subdivided properties adhere to local laws and can be legitimately owned and traded.

An asset can typically be divided l in a vertical manner, horizontal division. In the UK, there is a horizontal division, commonly known as a "*flying freehold*." A "flying freehold" refers to a situation where a portion of a property extends either above or below a neighboring property or their respective land or airspace.

Time-shares

A timeshare is a form of shared ownership arrangement for vacation property, where several buyers collectively own portions of access, often divided into one-week periods, within the same property. This timeshare concept can be adapted to various property types, including vacation resorts, apartments, and campgrounds. These arrangements can have varying durations, with some lasting for a lifetime and others having a specific number of years.

In Europe, dividing ownership into time-shares or 'multi-ownership' is not inherently allowed within existing regulations. It is simpler to view a time-share as a license or the right to use a property for a specific period each year (a simple contract). However, certain legal systems have implemented a version of time-share ownership.

Timeshare ownership ultimately translates into a significant and costly challenge, involving annual maintenance fees, additional expenses, interest payments, and the necessity to secure your desired vacation dates ahead of others.

Tranching

In French, the term "tranches" translates to "portions" or "slices". Tranching of real estate typically refers to the practice of dividing or segmenting real estate assets into distinct tranches or portions, often for investment or financing purposes. This process involves categorizing properties based on various criteria, such as risk levels, property types, or geographic locations, in order to create separate investment opportunities or financing arrangements for each tranche. Tranching allows investors and lenders to tailor their involvement in real estate projects to specific preferences or risk tolerances.

Tranching is more commonly encountered in the context of securitization, where income streams from commercial real estate, are bundled into different classes of bonds. These bonds have varying interest rates and priorities, and they are known as commercial mortgage-backed securities, among other types (Baum, 2020).

Syndication

Real Estate Syndication is a cooperative investment approach where numerous investors combine their financial resources and expertise to purchase, develop, or oversee a property or a collection of properties. In syndication, there exists an arrangement between a sponsor and an individual investor or a group of investors. The sponsor is responsible for are responsible for identifying, acquiring, and managing the real estate investments, locating and overseeing the asset, while the investors contribute capital. Both parties receive a portion of the profits, which is determined by their level of time commitment and the amount of money they invest.

This collaborative method allows participants to access larger and potentially more lucrative real estate ventures than they could pursue individually.

Investors provide capital to the syndicate without actively engaging in its administration and depend on the sponsors' experience in overseeing investments and making profits.

Real estate syndicates cooperate with a number of professionals to ensure the safety of their investments. These professionals include real estate managers, real estate brokers, lawyers and accountants.

All of these efforts to establish fractionalized or synthetic property exposures have failed, primarily due to limited interest in real estate investments during periods of significant market downturns (Baum, 2020). The only exception is the Real Estate Investment Trust (REIT), which is still an effective way of investing.

The idea of possessing and trading fractions of tangible real estate might have appeared implausible to many in the past. However, thanks to the emergence of blockchain technology, real estate tokenization is now opening up fresh avenues for shared ownership and investment in the property market.

Fractional ownership of real estate offers a completely innovative approach to entering the real estate market. Through well-planned fractionalized real estate tokens, astute investors can potentially construct personalized portfolios comprising various real estate assets. This approach also enables prospective homebuyers to take gradual steps towards residing in and eventually owning their dream home, while companies can craft tailor-made real estate products to suit specific needs and preferences.

Tokenization has the potential to enhance accessibility and liquidity in real estate investments. Instead of acquiring an entire property, investors now have the option to purchase tokens representing a share of the total property. This simplifies the investment process and contributes to the development of a more liquid market.

A real estate market based on blockchain tokens is expected to offer increased efficiency in both fractionalized primary and secondary markets.

The primary market could be improved by the introduction of more effective demand via fractionalization, supported by smart contracts, and the secondary market could be enabled by blockchain-based ownership records.

If supporters of real estate tokenization are accurate in their predictions, tokens would draw a myriad of individual investors.

2.3 Tokenization of real estate

Real estate tokenization involves the conversion of the value of real estate assets into digital tokens on a blockchain, allowing for their digital exchange and ownership transfer.

Instead of handling real estate interests through traditional paper-based methods, buyers can engage in digital transactions using tokens (Dilendorf et al., 2020).

Tokenization enables the division of information about an asset into smaller units, referred to as tokens. These tokens can encompass different attributes of the property, such as its size, number of floors, or parking availability. This approach enables a more precise description of the asset, emphasizing its strengths, streamlining search and comparison with other properties in the market. Consequently, it enhances the effectiveness of marketing efforts and sales. Additionally, tokenization can be advantageous for automating the real estate valuation process, resulting in quicker and more accurate property assessments.

The token stands as a symbol of the property, embodying a full set of entitlements and responsibilities (Polymesh, 2023). In essence, anyone in possession of a real estate token has a right to the underlying real estate asset, including any potential gains or losses linked to it.

A token has the potential to represent various aspects, such as ownership of the underlying real asset; ownership of an entire property; equity interest in a legal entity that possesses the asset, interest in debt secured by the asset, right to share in the profits generated by utilizing the property and other related attributes.

There is no need to invest in cryptocurrency to purchase a share in real estate using a token. Real estate tokenization can be implemented on various blockchains, including Ethereum, Binance Smart Chain, and Polygon. A smart contract, tailored to the chosen blockchain, is established to encompass details such as the quantity of tokens generated, the associated rights linked to token purchase, and the public key.

Blockchain technology is used for the tokenization of real estate, enabling the creation of a digital image of object (Shariy, 2022). Within this digital framework, information such as the architectural design of the building (for commercial properties), its geographical location, ownership details, and investor rights is securely stored within a smart contract. The value of the property is assessed and then distributed among a predefined quantity of tokens.

Investors are not restricted to being in the same country or city as the property they invest in. Once tokens are acquired, they can be stored, passed on through inheritance, or traded

on the secondary market. Consequently, real estate tokenization offers increased liquidity when compared to the conventional real estate market.

With real estate tokenization, the sale of tokens can occur at any time, whereas selling real estate in the traditional manner is often a more complex process.

Blockchain technology can be involved to tokenize a wide range of real estate assets, encompassing various types such as single-family homes, multi-family buildings, self-storage facilities, office complexes, farmland, warehouses, and retail properties. This means that virtually any real estate asset, whether retail, residential, or raw land, can undergo tokenization.

There are basically three types of real estate tokenization (Polymesh, 2023). They are:

Residential Tokenization: This includes residential assets like apartments within multi-story residential buildings. By subdividing these properties into smaller units and tokenizing them on the blockchain, property owners can efficiently tap into a market with a vast pool of potential buyers, enabling quicker returns.

Commercial Tokenization: This procedure involves the tokenization of commercial real estate, including office buildings, retail stores, and shopping malls. It streamlines commerce by breaking down investments into more manageable sizes and simplifying the process of attracting investors from across the globe.

Trophy Tokenization: It involves transforming iconic buildings in prime, thriving locations into digital tokens, unlocking their real estate potential.

Tokenization is not limited to primary assets like land, buildings, or apartments alone. Through a more comprehensive approach to tokenization, communal services (such as water, gas, and electricity), infrastructure elements (like roads, parking, and transportation), the surrounding environment, and various other factors can also be considered. Consequently, the extent of tokenized assets can be tailored to the specific aims and objectives of a given project.

Numerous properties have already undergone tokenization, including the luxury AnnA villa in Paris, along with various buildings in the United States, Hong Kong, the UK, Russia, and Switzerland. Tokenizing real estate opens up investment opportunities for both institutional and individual investors, allowing them to participate with smaller amounts of capital. While institutional investors possess substantial funds to acquire

expensive real estate, private investors often face limitations in this regard (Shariy, 2022). Consequently, breaking down real estate into fractional components reduces the entry barrier for private investors, enabling broader participation.

2.4 The lifecycle of a tokenized security

Tokenization of real estate involves intricate technical and legal procedures. Companies aiming to create real estate tokens need to carefully address a multitude of legal and related issues associated with their offerings. These issues are exceedingly complex, demanding the guidance of proficient experts in real estate, securities, tax, blockchain law, and other relevant fields.

According to KPMG collaboration report (Hobler et al., 2020) the tokenized security's journey can be broadly categorized into five key phases:

1) Firstly, in the initial phase of deal structuring, it is essential to make critical choices regarding the terms and conditions of the security token. This process is a fundamental component of any securities offering, regardless of the technology utilized. It's important to note that tokenization is not a mean of evading compliance with relevant legal and regulatory obligations. Instead, technology is employed to enhance operational processes and facilitate innovative financial solutions.

2) The digitization phase involves the process of transferring information that has historically been stored in physical paper documents onto the blockchain and encoding it into smart contracts, resulting in the issuance of security tokens.

3) The primary distribution phase is when tokens are allocated to investors in return for their investment capital, and the investors' details are documented on the digital Read-Only Memory (ROM).

4) Post-tokenization management encompasses corporate actions such as distributing dividends and conducting shareholder votes, many of which can be automated using smart contracts embedded within the token.

5) The post-support stage in asset tokenization involves the ongoing management, governance, and support activities necessary to ensure the success and compliance of tokenized assets in the secondary market.

2.4.1 Phase 1: Deal structuring

The initial stage of real estate tokenization involves several important factors including the type of asset, type of shareholder, jurisdiction, and relevant regulations. Before the process of digitizing real estate begins, developers must establish and enforce guidelines for both current and potential investors.

Tokens with security features are usually issued by a corporation, an individual, or any entity. They offer specific rights to the holders, including ownership of an asset, repayment of a predetermined amount of money, or entitlement to future profits. The design and format of a security token are vital as they determine the investor's rights and responsibilities towards the underlying asset, as well as the type of returns they can expect. Additionally, it serves as a basis for analyzing the tax implications of gains and losses related to the security token.

Type of interest

Creators of digital tokens have the option to tokenize various aspects related to real estate. This can include tokenizing the real estate property itself, an ownership stake in a legal entity that possesses the real estate, a mortgage tied to the property, a right to participate in the income or profits generated by the property, or any other customized variation. The specific type of interest being tokenized can influence which regulations are applicable to the token (Dilendorf et al., 2020).

Fractional ownership permits multiple investors to possess a stake in an asset, and the use of security tokens allows for various classes of shares and flexible fee structures, all with minimal operational expenses. This provides issuers with the opportunity to precisely determine their desired investor base, including their desired level of investment and expected liquidity demand.

Legal and regulatory regimes

The entity responsible for tokenized securities issuance should consult experts to make well-informed choices regarding the jurisdictions to incorporate into the product's framework. The regulatory landscape governing tokenized securities differs from one jurisdiction to another, and the varying tax systems across jurisdictions can significantly affect the pricing and cost efficiency of tokenized securities. Additionally, issuers should also obtain guidance on where their target investors are located, as this will bring about

regulatory considerations concerning the promotion and sale of tokenized securities (Hobler et al., 2020).

The regulatory framework includes mandates concerning licensing, monitoring and managing risks, as well as reporting obligations. These obligations apply to token issuers, their service providers, as well as individuals who invest in tokens.

Within the existing regulatory structures, the generation, ownership and exchange of security tokens, as a rule, are subject to regulation similar to traditional securities. Consequently, comparable governance and regulatory aspects should be considered, including aspects like legal ownership, investor compliance procedures like Know Your Customer (KYC), financial accounting, and thorough investment due diligence.

Valuation

Valuation encompasses various factors, including cash flow generation, transaction costs, and market liquidity. Tokenization maintains the core cash flow potential of an asset but adds value by improving liquidity and substantially reducing costs, especially for fractional ownership and secondary trading. Large commercial properties, being unique and requiring substantial upfront investment, often face long transaction periods and high ownership retention due to costly transactions. Publicly traded Real Estate Investment Trusts (REITs) offer liquidity but involve time-consuming and expensive processes, making them impractical for single asset or small portfolio owners. In contrast, tokenization greatly reduces time and costs, making it an ideal choice for such owners seeking fractional ownership and secondary trading opportunities.

Taxation

Both issuers and investors should seek advice from tax professionals to create a comprehensive tax strategy when dealing with digital assets tied to real estate value. It is crucial to recognize that ordinary tax rules for direct real estate ownership may not automatically apply unless the digital asset directly represents fractional ownership in the real estate.

Holding shares or partnership interests in digital form and executing transactions through smart contracts typically shouldn’t change the applicable tax provisions. However, the specific tax treatment may vary among jurisdictions, depending on individual facts and circumstances (Hobler et al., 2020).

2.4.2 Phase 2: Digitization

Asset digitization involves the procedure of generating a digital counterpart or replica of an asset, whether it is a tangible or financial asset. These digital replicas inherently retain the characteristics of the original assets. In the course of digitizing assets, the ownership rights linked to a physical asset are transitioned and traded within a digital environment. In the case of real estate, using the asset digitization platform, we partially divide ownership into units (tokens) representing fractional ownership shares in digital format.

During the digitization phase, data that was traditionally stored in physical documents or paper is transferred onto the blockchain. This data gets encoded into smart contracts, leading to the issuance of security tokens. Through the utilization of these security tokens and smart contracts, transactional details related to real estate are securely registered on the blockchain ledger. Essentially, digitizing real estate involves establishing a legal framework around each property to securitize it and construct an investment instrument. This process may involve creating funds or trust structures (SPV) to hold the primary assets and guaranteeing that holders of tokens are provided with legal documentation that grants those rights and/or ownership.

Special Purpose Vehicle (SPV)

The conventional method of real estate securitization has traditionally involved the creation of a special purpose vehicle (SPV), and it is expected that tokenization will follow a similar approach. SPV is a legally recognized entity that assumes ownership of real estate assets and is responsible for their management.

The SPV is responsible for verifying the documentation through the relevant authorities, and its establishment depends on the successful completion of this paperwork scrutiny. If any discrepancies arise, either in the asset information or in the SPV's details, the entire transaction is canceled due to non-compliance with legal requirements (Gupta, et. Al., 2020). The rationale behind choosing a Special Purpose Vehicle instead of directly tokenizing an asset is primarily because, in many countries, there are insufficient legal and technical frameworks to facilitate the direct tokenization of property rights.

An SPV can take various forms, such as a trust, limited partnership, corporation, limited liability company, or other entities, each with its own pros and cons (Dilendorf et al., 2020). When appropriately organized, the assets and liabilities of the SPV are legally

distinct from those of the developer (the company establishing the SPV), which has implications for accounting, taxation, and bankruptcy proceedings. This separation enables the tokens to be evaluated as investments independently, without consideration of the developer's creditworthiness. Nonetheless, configuring the SPV, determining its ownership structure, and managing transactions between it and the developer are highly intricate tasks that demand the expertise of experienced professional advisors.

After establishing the legal framework, the next step involves making critical technological decisions:

Selecting Blockchain / Token

Select the best blockchain platform on which the token will be recorded, determine the specific data and transfer restrictions to apply to the real estate token. Factors like cost, transaction speed, transparency, community reviews, and security should be taken into account while selecting the blockchain ledger (Khanna, 2022). The most common protocols currently used for asset tokenization are: Ethereum, Binance Smart Chain, Polymath, Stellar, etc.

KYC/AML verification

This step include registration of entities on the platform where the asset owners can be connected with the investors (Gupta, et. al., 2020). Both real estate owners and investors are required to register on the platform and undergo Know Your Customer (KYC) and Anti Money Laundering (AML) verifications. A third-party provider will carry out these verifications for all users on the platform. Users are required to electronically submit essential identity information to the platform. Once the KYC and AML checks are successfully completed, users gain access to the platform's services.

Smart contract creation & token issuance

The process of creating tokens, as well as security tokens, is called *minting* (Saher, 2022). Within a Distributed Ledger Technology (DLT) environment, it is possible to mint customized tokens to represent ownership rights. For this to occur, the issuer must possess an issuer wallet, which serves as the issuer's account for releasing tokens onto the blockchain. The ability to sign transactions using this wallet is directly tied to the issuance of tokens. Essentially, whoever has control of the private keys associated with the wallet also controls the tokens.

Smart contracts play a pivotal role in the creation of these tokens, as they are responsible for automating various tasks on the blockchain. To tokenize an asset, issuers are required to develop these smart contracts, along with applications that can interact seamlessly with these smart contracts and the underlying blockchain protocols. This entire process is integral to the issuance and management of tokens representing ownership rights.

Issuer & investor asset/key custody

In order to convert an asset into tokenized form, it is essential to have a custody solution in place. When tokens are generated within an issuer's account, often referred to as a wallet, the control of this account relies on the use of private keys. Safeguarding these private keys is crucial to retaining control over the account, even following the initial issuance of tokens. There are various technology solutions available to ensure this ongoing control.

Typically, in institutional settings, a *multisig* (multisignature) approach is employed. Multisig functions require multiple signers to authorize a transaction, ensuring that there is no single point of control over the account. This approach eliminates the vulnerability associated with a single point of failure and enhances security.

Define token configuration & offering parameters

Once determinated token's name and ticker symbol, selecting the appropriate token standard for tokenized asset becomes another crucial aspect of asset tokenization. Various standards exist for coding smart contracts, and the choice of which standard to use depends on the specific use case and the desired functionalities for each token. Additionally, these smart contracts can be written in different programming languages, such as Solidity for Ethereum, based on the particular blockchain platform and requirements (Saher, 2022).

After specifying all the necessary parameters and features for token, the next step involves identifying the details of the token sale.

The specific parameters for configuring token sale will vary depending on the structure of offering and the legal obligations it must adhere to. Important factors to keep in mind when configuring your token offering include:

- Payment method;
- Token pricing;

- Target fundraising amount for the token sale;
- Individual investor contributions (if applicable);
- Timing and duration of the token sale;
- Accessibility to all investors or the need for an investor whitelist (often mandated for regulatory compliance, particularly for KYC purposes);
- Token sale owner, which refers to the wallet overseeing the token sale.

Security Token Offering (STO)

Once all the required information and legal documentation are prepared, the next step involves generating the token and initiating the token sale. As previously mentioned, this is achieved by developing a smart contract designed to operate on the selected blockchain network. Additionally, the creation of the token sale is also accomplished with a smart contract, specifically known as a Security Token Offering (STO) token sale script.

The asset will be listed on the platform, with the target price and the quantity of tokens determined based on the asset's value. Registered users can access comprehensive information about the asset, including its location, cost, expected returns, and other relevant details.

When a user decides to purchase tokens for the specific asset, they will make the payment corresponding to the number of tokens they wish to buy. If the Security Token Offering (STO) succeeds, meaning it raises the required amount of funds, investors will receive their respective tokens, and the asset's title will transfer offline to the Special Purpose Vehicle (Gupta, et. al., 2020).

However, if the STO does not reach its funding target, and it falls short of the amount needed to acquire the asset, the funds paid by existing investors will be refunded, and ownership of the asset will remain with the original owner.

Once investors have acquired their tokens, they can benefit from monthly returns generated by the tokens and potential capital appreciation resulting from increases in token value. Additionally, investors have the option to freely trade these tokens on various exchanges in the secondary market, ensuring liquidity for their investments.

2.4.3 Phase 3: Primary distribution and secondary trading

This phase revolves around token distribution. The newly minted tokens are brought to the market for purchase and marketing activities for tokenized asset sale have begun. Real estate tokenization platforms offer multiple payment choices for property purchases. When acquiring digital real estate tokens, various payment methods are welcomed, including cryptocurrencies, stablecoins, and fiat currencies, among others. Nonetheless, cryptocurrencies can be subject to price fluctuations, so to mitigate exposure to this volatility, payments in stablecoins are accepted. Stablecoins typically maintain a value tied to conventional fiat currencies (Saher, 2022).

There exist two primary methods for token distribution

Primary Distribution

It is the process of distribution of minted tokens to investors in exchange for investment capital. Information about investors is recorded on the digital Read-Only Memory (ROM) (Hobler et al., 2020).

Secondary Trading

Secondary trading is a crucial phase within the tokenization process. It encompasses all the necessary steps to enable and facilitate the listing, trading, management, and reporting of tokenized assets in secondary markets. This phase usually commences after the primary offering is concluded, and tokens have been distributed to investors' accounts.

Secondary trading is where the benefits of tokenization in terms of enhancing liquidity become evident (Khanna, 2022). Tokenized assets are made available on one or more secondary market platforms, which can include digital asset exchanges (DEX) or alternative trading systems (ATS). These platforms facilitate the trading of these assets among investors.

2.4.4 Phase 4: Post-tokenization management

Post-tokenization management includes activities like dividend distribution and shareholder voting. Smart contracts encoded within the token have the capability to automate these procedures (Khanna, 2022). Smart contracts additionally enable the swift settlement of token transfers. Issuers maintain authority over the ultimate acceptance or rejection of investors who meet predefined criteria before token transfers are concluded.

Every transaction occurring during the existence of a security token is permanently recorded on the blockchain, ensuring its immutability (Hobler et al., 2020).

The real estate property has versatile utility, serving various purposes such as commercial or residential rentals, or even operating as a hotel business. Regardless of its use, income can be generated from this asset. Profits can be allocated to investors in proportion to the number of tokens they possess.

The smart contract can have the functionality for computing ownership percentages and smoothly transferring the corresponding profits to investors, without any fraudulent activities or discrepancies. This algorithm is triggered by the SPV at the end of each month. Initially, it verifies whether the entity invoking the contract is indeed the Special Purpose Vehicle. Subsequently, for each token holder, it calculates their token ownership proportion and determines the dividend to be distributed accordingly (Gupta, et. al., 2020). The contract then deposits the dividends into the respective token holders' accounts. A blockchain transaction is generated to record the allocation of dividends to each Tokenholder's account.

In addition to the dividend distribution function, it is also possible to incorporate extra capabilities for enabling investor voting in the event of decision-making processes.

Post-tokenization management will persist until either the maturity date or the redemption date is reached.

2.4.5 Phase 5: Post-support

Post-support is the last but the most crucial step in the tokenization process. This stage encompasses various processes and tasks aimed at maintaining the functionality, security, and compliance of tokenized assets in the secondary market. The real estate software development company provides additional support to the investors for overcoming mortgage-related obstacles, resolving legal concerns, tracking all the activities of the real estate token holders regularly, monitoring liquidity, and more.

Here are some key elements and activities:

Reporting and Compliance: Regular reporting on the performance and financial status of the asset is essential. Compliance with regulatory requirements, such as Know Your Customer (KYC) and Anti-Money Laundering (AML) checks, must be maintained.

Security: Ongoing security measures are vital to protect the integrity of the asset and the interests of token holders. Regular audits and updates to security protocols may be necessary.

Legal and Regulatory Compliance: Staying up-to-date with evolving regulations and ensuring that the tokenized asset remains compliant with the law is crucial for long-term sustainability.

Asset Performance Tracking: Continuously monitoring the performance of the underlying asset and making strategic decisions to maximize returns for token holders.

Redemption or Maturity: Depending on the structure, some tokenized assets may have a predefined maturity or redemption date. Managing the process of redemption or maturity is part of the post-support stage.

It is a critical phase in the lifecycle of tokenized assets and requires careful planning and execution to achieve long-term objectives.

Chapter III. Legal issues and future of real estate tokenization

3.1 Legal regulation of tokens in the world

In recent years, there has been a substantial surge in regulatory attention directed towards digital assets, a trend that is poised to persist. The imperative for a swift and comprehensive global regulatory policy framework and supervisory system has become evident due to the risks posed to market integrity, necessitating heightened consumer protection (PwC, 2022). These risks are compounded by the rapid pace of innovation and a lack of emphasis on risk management.

International standard-setting entities are expediting efforts to encourage global cooperation in this regard. Numerous local authorities have publicly declared their intentions to establish themselves as global hubs for digital assets, technology, and innovation.

On the whole, numerous countries are engaged in activities encompassing research, definition, consultation, negotiation, and legislation to incorporate digital assets within existing financial services frameworks. However, the speed of these actions, the approaches adopted, the scope of services and products covered, and even the definitions and terminology employed remain considerably fragmented.

The legislation of the countries is not unified — this is a function of international law. That is why in the field of securities, tokens, cryptocurrencies, issuers should better take into account the requirements of all jurisdictions of presence and investors. For example, a token offer that complies with the legislation of the European Union may not comply with the requirements of US laws, and vice versa. In reality, there may be situations in which one country considers a token as a security, while another country takes a completely different approach.

In this regard, restrictions may be provided for some investors. For example, some platforms may provide that citizens of certain countries against which sanctions have been imposed (Belarus, Cuba, Iran, Iraq, Myanmar, Venezuela, Syria, Russia) cannot be investors. And a REIT in the USA is only available to accredited investors.

Any concept or mechanism involved in the exchange of beneficial ownership units in real estate or investment funds will be categorized by stricter regulatory frameworks as a security token. While tokenized debt structures often face fewer regulatory hurdles than

other token offerings, robust regulatory regimes, such as that in the United States, typically classify tokens as securities and subject them to corresponding regulations. In contrast, the European Union adopts a more practical approach, with Switzerland maintaining a more relaxed stance (Baum, 2020). Within the EU, tokens are typically classified as either utility tokens, subject to minimal regulation, or security tokens, which are subject to regulatory oversight.

As blockchains operate on a global scale, a significant challenge arises concerning conflicts of laws, particularly in determining which national regulations should govern a specific token. This intricate situation can aptly be termed "regulatory ambiguity," a phenomenon that curtails innovation and creativity while elevating the expenses and uncertainties associated with business endeavors.

There were no countries that completely lacked any form of blockchain regulations. However, the stringency of regulations varied significantly among nations. For instance, Belarus, Malta, and Bermuda have established regulatory frameworks that are relatively more lenient and accommodating to cryptocurrency enterprises, while China and India have implemented stricter regulations and, in some cases, outright bans (Money-Gate, 2023).

One can only speculate about the potential for regulatory arbitrage, especially considering the proactive efforts of countries like Singapore, Switzerland, Liechtenstein, Luxembourg, and numerous other smaller jurisdictions actively marketing themselves to attract new enterprises (Baum, 2020).

The phrase "crypto-friendly regulations" denotes governmental laws and regulations that are supportive of cryptocurrency enterprises and their activities. These regulations may include aspects such as licensing, taxation, and banking rules, among others (Money-Gate, 2023). Countries with crypto-friendly regulations tend to be more attractive to cryptocurrency businesses due to the more advantageous and foreseeable legal framework they provide. Nonetheless, it's crucial to bear in mind that regulations are subject to change, so staying informed and seeking legal advice when needed is essential.

In addition to the above, there are several other countries with favorable crypto-friendly regulation, such as Malta, Estonia, Bermuda, Belarus, Cayman Islands, Japan and United Arab Emirates (Money-Gate, 2023).

There exist multiple compelling justifications for the importance of regulating the token industry. To begin with, regulatory measures play a pivotal role in protecting consumers from fraudulent or illicit practices. Furthermore, these regulations contribute to upholding the stability and soundness of the financial system by deterring activities like money laundering and other unlawful actions (Money-Gate, 2023). Lastly, regulation serves as a means to offer businesses and investors clear guidance, fostering an environment conducive to innovation and the advancement of the industry.

3.1.1 Regulation Authorities of security tokenization in different countries

Regulations can vary in different jurisdictions, and new regulations are continuously being developed as the industry evolves. These are just a few examples of the regulatory bodies involved in security tokenization:

The Securities and Exchange Commission (SEC) in the United States holds the mandate of safeguarding investors, upholding the integrity of markets, and fostering capital formation. Its jurisdiction extends to the regulation of the issuance and trading of securities, including security tokens.

The Financial Conduct Authority (FCA) in the United Kingdom serves as the governing authority responsible for supervising financial markets and ensuring consumer protection. The FCA has issued directives and regulatory measures pertaining to security token offerings (STOs) and the functioning of security token exchanges.

The European Securities and Markets Authority (ESMA) is an autonomous EU body with the mission of upholding the stability of the European Union's financial system and guaranteeing the well-being of investors. ESMA issues directives pertaining to security token offerings (STOs) and the trading of security tokens on secondary markets.

The Financial Market Supervisory Authority (FINMA) serves as the financial regulatory body in Switzerland, tasked with overseeing banks, insurance firms, and securities dealers. FINMA has issued directives regarding the regulatory structure governing security tokens within Switzerland.

The Monetary Authority of Singapore (MAS), functioning as Singapore's central bank and financial regulatory body, has instituted guidelines and regulatory measures pertaining to security token offerings and the functioning of security token platforms.

3.1.2 Global standard-setters

International regulatory authorities have grown more vocal about the potential risks that the digital asset market may pose to the overall stability of the global financial system.

In October 2022, *the Financial Stability Board (FSB)* released a proposed framework and set of recommendations for regulating crypto assets and global stablecoin arrangements on an international scale. The FSB highlights several hurdles concerning the local enforcement of regulations and supervision for crypto assets (PwC, 2022).

The FSB (2022) in its report points out several issues pertaining to the domestic implementation of regulation and oversight for crypto assets. These include:

- the scope and effectiveness of current regulatory authority, its limitations, and the need for cross-border collaboration;
- risks associated with aspects like wallet and custody services, trading, as well as lending and borrowing activities;
- the widespread adoption of Distributed Ledger Technology (DLT).

The FSB anticipates that national regulators will establish regulatory structures for digital assets that mirror those already established for conventional financial systems. These authorities should engage in cooperation and coordination, both within their respective countries and on a global scale, to promote uniformity and the exchange of information (FSB, 2022). The FSB plans to assess the advancement in implementing its recommendations by the end of 2025, evaluating the regulatory steps taken by FSB member jurisdictions and the resulting outcomes (PwC, 2022).

In December 2022, *the Basel Committee on Banking Supervision (BCBS)* released its final rules on the prudential treatment of cryptoasset exposures (Bank for International Settlements, 2022). Unbacked cryptoassets and stablecoins lacking effective stabilization methods will face a cautious prudential approach. As per the final standard, banks are mandated to continuously categorize cryptoassets into two distinct groups (PwC, 2022).

Assets falling under Group 1 include tokenized traditional assets that carry an equivalent degree of credit and market risk as their non-tokenized counterparts (referred to as 1a assets). Additionally, this group comprises cryptoassets equipped with effective stabilization mechanisms, linking their value to one or more conventional assets, such as stablecoins (referred to as 1b assets) (Bank for International Settlements, 2022).

Cryptoassets falling within Group 2, and failing to satisfy the classification criteria for Group 1, will be subject to a more conservative capital treatment. This category encompasses tokenized traditional assets and stablecoins that do not meet the conditions for Group 1 classification, along with all unbacked cryptoassets (PwC, 2022).

Both Group 1 and Group 2 cryptoassets are subject to supplementary operational risk, liquidity, leverage ratio, large exposure, supervisory review, and disclosure requirements. The BCBS intends to put these standards into effect by January 1, 2025, and integrate the content into the consolidated Basel Framework before that date.

In October 2021, *the Financial Action Task Force (FATF)* released revised guidelines outlining a risk-centric strategy for virtual assets and providers of virtual assets. These guidelines aim to assist regulatory bodies in formulating regulation and supervisory directives for virtual asset-related activities. Simultaneously, they provide Virtual Asset Service Providers (VASPs) with insights into comprehending and fulfilling their anti-money laundering (AML) and counter-financing of terrorism (CFT) responsibilities.

Regulators are encouraged by the FATF to adopt a risk-centric approach, remain technologically impartial, and ensure fair competition while preparing for the future. This should be done while acknowledging the borderless and internet-driven characteristics of virtual assets. Additionally, the guidance clarifies which activities fall within the scope of FATF recommendations for Virtual Asset Service Providers (VASPs). Furthermore, all jurisdictions are mandated to enforce specific Anti-Money Laundering (AML) and Countering the Financing of Terrorism (CFT) requirements, obligating financial institutions to exchange transaction data that exceeds a predefined threshold (FATF, 2022).

The guidance advises Virtual Asset Service Providers (VASPs) such as exchanges, banks, Over-the-Counter desks, hosted wallets, and other financial entities to disclose specific personally identifiable information about both the sender and recipient for cryptocurrency transactions exceeding USD/EUR 1,000 worldwide. This rule aims to block terrorist financing, discourage payments to sanctioned individuals, entities, and nations, facilitate law enforcement access to transaction details, aid in reporting suspicious activities, and counteract money laundering (PwC, 2022).

As of July 2022, the FATF reported that most jurisdictions have made only minimal advancements in implementing the requirements, with the vast majority not having fully

adopted its Recommendation (PwC, 2022). This Recommendation establishes the worldwide Anti-Money Laundering (AML) and Countering the Financing of Terrorism (CFT) standards for virtual assets and Virtual Asset Service Providers (VASPs). Countries are anticipated to guarantee that VASPs are subject to AML/CFT regulations, hold licenses or registrations, and are governed by robust monitoring systems (FATF, 2022).

In the European Union, cryptocurrency regulation is referred to as *MiCA*, which stands for the *Markets in Crypto-Assets Regulation*. MiCA represents the initial cross-border regulatory and supervisory framework for crypto-assets and was initially introduced in 2020 in response to a global stablecoin initiative. The expected implementation date for MiCA is in 2024, pending approval by the European Parliament. It aligns with the European Commission's aim to establish a regulatory structure that facilitates the adoption of distributed ledger technology (DLT) and crypto-assets within the financial services sector. MiCA's primary objectives encompass ensuring legal clarity, safeguarding consumers and investors, upholding market integrity and financial stability, while also promoting innovation and addressing the challenges stemming from fragmented national regulatory frameworks (PwC, 2022).

Broadly speaking, most business activities associated with crypto-assets within the European Union are expected to fall within the purview of MiCA. Furthermore, non-EU crypto-asset companies engaging in activities for EU clients are likewise obligated to adhere to these regulatory requirements.

This regulation establishes consistent prerequisites for all crypto-related activities, with a particular focus on the issuance of cryptocurrencies. Crystal compliance team (2022) reports that within the framework of MiCA, cryptocurrencies are categorized into four distinct groups:

- Crypto-assets;
- Utility tokens;
- Asset-referenced tokens;
- Electronic money tokens (e-money).

Within 18 months from the implementation of MiCA, the European Securities and Markets Authority (ESMA) will release guidelines specifying the criteria and conditions

for categorizing digital assets as either falling within the scope of MiCA or exempt from it.

The services regulated under MiCA lays down the following (Crystal compliance team, 2022):

- offering and marketing of crypto-assets;
- the issuance of stablecoins and E-money tokens;
- establishment of licensing regulations, including operational terms and reporting obligations for crypto-asset service providers (CASPs);
- measures to prevent market manipulation and safeguard clients of crypto-asset service providers;
- requirements for environmental and climate-related disclosures;
- measures to combat money laundering.

Additionally, MiCA mandates crypto issuers to release a "crypto-asset white paper" containing details about their project.

Furthermore, the European Commission in the process of implementing the following EU legislation pertaining to crypto-assets (PwC, 2022):

- a directive that introduces targeted adjustments to the existing extensive framework of EU financial services legislative and regulatory instruments. These adjustments are made to accommodate the MiCA regime and the Pilot DLT Market Infrastructure Regulation (PDMIR);
- the PDMIR, effective from March 23, 2023, establishing a sandbox regime for private sector entities involved in developing infrastructure for the trading and settlement of crypto-assets;
- the EU regulation on digital operational resilience for the financial sector (DORA), which received final approval in November 2022 and is currently awaiting signature and official publication.

While the recommendations and guidance might lack legal binding, they offer crucial guidance to national authorities. Companies should assess the policy standards with regard to their probable incorporation into local regulations and take an early action to move to meet the new requirements.

3.2 Benefits and Challenges of tokenization

Real estate tokenization on a blockchain allows for the instant synchronization of ownership and transaction data for a real estate asset among a group of participants, offering various efficiency and optimization benefits.

According to Abhijith (2023), the tokenization of real estate offers numerous *benefits* when compared to the traditional market structure:

Transparency and Efficiency. Blockchain technology introduces an intensified degree of transparency into the real estate sector. By storing data on a decentralized ledger, all transactions become visible to every participant within the network. The public ledger meticulously documents all details pertaining to a transaction, providing a valuable resource for prospective investors. Furthermore, once transactions are completed, they are immutable, rendering them resistant to alteration, manipulation, or cancellation. This enhanced transparency fosters trust and confidence in the market while mitigating fraudulent activities.

In addition to transparency, real estate tokenization also leverages the benefits of efficient smart contracts, automatically executing purchase orders.

Liquidity. Selling real estate can be a cumbersome and time-consuming process. Real estate tokenization effectively addresses this problem by alleviating illiquidity concerns. There's no longer a need to fret about finding a buyer since security tokens can be bought and sold at any time.

Transforming illiquid real estate assets into "tokens" essentially shifts a direct property investment into an indirect one (Deer, 2022). This approach offers issuers increased liquidity as the pool of potential buyers is no longer restricted to those capable of purchasing the entire asset upfront. Furthermore, tokenization facilitates fractional ownership, expanding investment prospects to a broader range of potential investors.

Fractional Ownership. Another notable advantage is the opportunity for partial ownership of real estate. Fractional ownership facilitates the ability to invest even a modest amount of money.

Additionally, fractional ownership opens the door to diversifying your assets. With limited capital, you can acquire assets in various locations, reaping the benefits of diversification. For instance, if you have $300 to invest in real estate tokens, you can

allocate $100 to each of three different assets around the world to enhance diversification (Abhijith, 2023).

Absence of intermediaries. When contemplating real estate, we often associate it with real estate agents and brokers. However, with real estate tokenization, it is possible to leave those concerns behind. The conventional practice of paying substantial brokerage fees and commissions is no longer a necessity. In fact, the funds saved can be utilized to acquire additional security tokens.

Faster Settlement and Automation. Traditional real estate transactions can be time-consuming, often-taking days or even weeks to finalize. In contrast, the purchase and sale of security tokens can be executed rapidly. Time is a precious resource, and real estate tokenization offers a means to save it. Leveraging the speed of blockchain technology, transaction efficiency is notably enhanced.

Using smart contracts can automate various aspects of real estate transactions, including title transfers, document authentication, dividend disbursements, and compliance procedures. This automation can enhance efficiency and simplify the process, resulting in time and cost savings for all stakeholders.

Reducing geographical barriers. The widespread reach of public blockchains enables asset tokenization, granting accessibility to investors across the globe. This effectively dismantles geographical barriers and links worldwide markets (Deer, 2022). For instance, a real estate asset in London can now undergo tokenization and be offered to investors in Moscow, and vice versa, as long as the blockchain platform involved adheres to applicable KYC & AML regulations.

Now, let's examine some downsides or *limitations* of real estate tokenization.

Blockchain technology has been in existence for several years, but the full integration of tokenization into the mainstream real estate market has not yet been realized. Several factors contribute to this (Polymesh, 2023):

- absence of established processes for real-world asset tokenization: one reason is the lack of well-defined procedures for tokenizing real-world assets;
- shortage of personnel and backend support: another factor is the insufficient availability of personnel and backend support required to execute these processes effectively;
- market confusion and limited knowledge of blockchain technology;

- concerns about Technological Vulnerabilities and Asset Recovery

However, the primary obstacle to real estate tokenization remains regulatory compliance. A robust regulatory framework is essential for broader adoption and to instill trust among investors. Clear and structured regulatory rules would facilitate the rapid expansion of the real estate sector (Abhijith, 2023). In addition to regulatory concerns, a lack of clarity on tax implications is another challenge that real estate tokenization faces.

The legal landscape for tokenization is still in its infancy, like a budding idea waiting to bloom. When it comes to tokenized real estate assets, they often find themselves entangled in the web of securities laws. This means that the creation and functioning of real estate security tokens must dance to the regulatory tune, following the rules set by authorities, which could involve requirements like exemptions for "accredited investors" or the need for formal registration.

The current favorable stance of regulators and jurisdictions towards tokenization may not necessarily persist in the future, despite guidance provided by various global regulatory authorities regarding security tokens (Hobler et al., 2020).

As a result, the legal and regulatory requirements and limitations related to the issuance, distribution, ownership, trading, and governance of security tokens may undergo alterations down the road. This potential for modification could introduce ambiguity for both those issuing security tokens and investors, which might affect their adoption and the liquidity of the secondary market.

While decentralized networks come with numerous advantages, participants may find themselves uneasy due to diminished privacy and control. Some individuals might grapple with uncertainty regarding how to meet regulatory obligations related to reporting and auditing. There is also a desire among some to safeguard specific information from investors and the broader secondary market; the data necessary for primary investors may not always be suitable for disclosure to a wider audience (Polymesh, 2023).

Therefore, it is crucial for technology to possess the capability to automate controls and strike a harmonious equilibrium between privacy and transparency. The privacy of data stored on public blockchains can be safeguarded using protocols like Zero-Knowledge Proof (Hobler et al., 2020). This technology allows one party to prove their knowledge of specific data to another party without disclosing the actual data itself. As blockchain

protocols continue to evolve and become more refined, they have the potential to offer data transparency while also safeguarding against illegal or improper hiding of information, all without exposing sensitive business data.

The inherent liquidity of tokenization can lead to significant price fluctuations, which are influenced by shifts in demand for the underlying asset. Security tokens may experience frequent buying and selling, particularly when held by short-term investors. Therefore, it is advisable to assess a token's historical performance to avoid highly volatile options.

In conclusion, individuals looking to engage in and reap the benefits of tokenization should seek guidance from legal, financial, and real estate experts and professionals.

3.3 Tokenization of Real Estate in the world: Case Studies

3.3.1 Case 1. "Hello World" - The first real estate transaction in Baar, Switzerland

Investing in real estate in Switzerland may be one of the best decisions in your life, but it can turn out to be a very complicated task. When buying a house in Switzerland, an investor faces a whole system of intermediaries involved in transactions in this market, including banks, large investment funds, agencies and third parties such as notaries and legal entities. The value transferred between the buyer and the seller is partially redirected these intermediaries, which quantifies the main inefficiency of this system (Blockimmo, 2018). In addition, the transparency of transactions is violated, not to mention the amount of time spent to process the transaction. However, despite this, the strictly regulated market works well, like a Swiss watch.

Swiss property law has not undergone any major changes since 1907, which is a testament to the effectiveness and clarity of the system (Don, 2018). The market's complex laws, regulations, and taxes serve an important purpose, helping stabilize prices and ensuring the majority of property is not foreign owned. But high entry barriers further increase dependence on intermediaries and create an inaccessible market - the main investments are made behind closed doors and by small groups of well-known investors before the general public has any desire or opportunity to invest (Blockimmo, 2018).

Despite all this, while other countries are arguing about whether to ban bitcoin and what blockchain technologies threaten the banking system, Switzerland is creating the most developed ecosystem for crypto startups and ICOs. Since 2013, the ancient town of Zug

in eastern Switzerland has become the largest international center for the development of blockchain technologies. Zug is the capital of Swiss Crypto Valley and the home of the Ethereum Foundation, the headquarters of Monetas, Lykke and dozens of other blockchain projects (Baynazarov, 2017).

In March 2019, the project of "Hello World" has gone out into the world as the first Swiss property in Zug's Crypto Valley, which is now, also has a 'digital twin' on the blockchain. The first property based on blockchain technology was tokenized via the transaction platform of Swiss startup blockimmo. The tokenized property is located at Grabenstrasse 3 in Baar, in the canton of Zug, and consists of 18 apartments and the 'Hello World' restaurant. Approximately 3 million CHF ($2.98 million) – representing 20% of the overall property value, was tokenised as part of the deal. Four investors took an ownership stake in the property by buying the tokens (Rabbitte, 2019). The inaugural tokenized real estate transaction in Europe was achieved through the collaborative endeavors of three Zug-based firms: blockimmo, Swiss Crypto Token and Elea Labs.

Swiss Blockchain technology startup Blockimmo was central to the transaction in providing the tokenisation platform to complete the activity. For achieving this technological milestone, Blockimmo partnered with Elea Labs and Swiss Crypto Tokens, equally hailing from the small Alpine country (Rabbitte, 2019).

Blockimmo is a blockchain-powered startup located in the heart of Zug aiming to create a global real estate market that is more efficient than the current stock market. They achieve this by providing a regulatory compliant ecosystem enabling fractional property investments and ownership, representing properties as security tokens on the Ethereum blockchain. This new financing and investment method is a product of blockimmo.

'With this market launch and ground-breaking first deal, this technology is now live. We are digitalising real assets together with our partners. We are thankful for the opportunity to shape in a sustainable way the real estate industry and the blockchain community and we look forward to the next step,' says founder and managing director of blockimmo Bastiaan Don (Simpson, 2019).

They partner with financial institutions and other strategic partners worldwide to grow the cross-border market. With a focus on delivering value one step at a time, blockimmo's ultimate goal is to become the industry leader in decentralized real estate marketplaces.

Blockimmo is a platform that enables investment and sale of Swiss real estate through tokenizing properties into asset-backed tokens sold via crowd-sale. This decentralized marketplace makes it possible for users to sell tokens at any time and place, with simplification of processes that remove intermediaries. By moving transactions on-chain, Blockimmo eliminates the bottleneck in the current system, reducing the dependence on intermediaries through automation, improving transparency, and reducing fees by an order of magnitude (Blockimmo's Whitepaper, 2018).

The platform also manages the system's complexity by abstracting legal and regulatory processes from buyers and sellers. Properties are tokenized and transitioned to their on-chain representation with their rights and ownership controlled, enforced and represented via Ethereum smart contracts. These asset-backed tokens are then sold via crowd-sale in small stakes across many investors creating a community of people, organizations, and smart contracts where ownership and trade of the tokens take place, ultimately benefiting IMMO token investors, as well as the seller and buyer of real estate (Blockimmo's Whitepaper, 2018).

Additionally, on the other hand, blockimmo is compliant with laws and regulations and seeks to bridge the gap between on-chain transactions and the real world, through combining anti-money-laundering (AML), know-your-customer (KYC) and manual processes (blockID.ch) (Blockimmo, 2018). As a result, in blockimmo users receiving value for their investments while revolutionizing real estate ownership and trade (Bitcoin Exchange Guide News Team, 2019).

There is a wide variety of properties that may be listed on blockimmo:

- Commercial non-residential investment for single or multiple owners worldwide;
- Plots development project for single or multiple owners depending on the project type;
- Residential investment for single or multiple owners (Swiss citizen or B, C, L-permit only);
- Residential private for single owner (Swiss citizen or C-permit only).

The property owners of development projects can raise funds in the same manner a commercial investment property is sold by offering investors equity in exchange for investment in their property (tokens) (Blockimmo's Whitepaper, 2018).

To begin real estate investment on Blockimmo, users are required to complete the verification and approval process on the Blockimmo website (Bitcoin Exchange Guide News Team, 2019). The process involves the users providing and verifying information. During this process, the system asks the future investor where the money that the investor plans to invest (AML) comes from and he/she has to identify him/herself. Depending on the amount investor wants to invest, this identification will be by taken some photos or by using webcam (or smartphone) for video identification (Blockimmo, 2018). After completing the registration process, users will be able to view the available investment property and will be able to choose the object that best meets their capabilities and desires. After the start of the sale of the selected property, users begin to receive notifications.

There is no minimum capital requirement on Blockimmo. Users can invest in real estate with as little as 1 ETH and start to receive a passive income proportional to investor's share of a property's tokens for beginning to grow real estate portfolio.

Investors will be able to get their share of the invested real estate after the massive sale of real estate is completed. The quantity of passive income earned from an investment will depend on the quantity of shares owned by users in the related property token. Every property is associated with a distinct ERC-20 token, and upon investment, users are allocated the tokens that represent their ownership share of the property (Bitcoin Exchange Guide News Team, 2019).

Upon obtaining properties, users have access to regular performance reports published by Blockimmo and can monitor the rental income through the investor portal.

In blockimmo platform, there are no direct fees from investors. The investment platform for users is free, but a total commission of 1% (programmed in a smart contract) is automatically deducted from each dividend payment (Blockimmo, 2018).

As it previously was mentioned, the transaction 'Hello World' was supported by Elea Labs, which validated and provided the real estate data of the property. Elea Labs is a Swiss company that combines on their team real estate veterans and digitally driven pioneers, which aims to ensure that each building has its own identity or "Property DNA" (Simpson, 2019). This makes the property real — all data about a property is backed up and stored decentralized.

Bitcoin Suisse supported the transaction through its subsidiary Swiss CryptoTokens, another crypto-startup established in 2018, for the purchase of real estate in Baar. The transaction was secured using the Swiss CryptoTokens stable coin, which is linked to the electronic version of the Swiss franc, known as CryptoFranc (XCHF). This was done in order to avoid the risks associated with fluctuations in cryptocurrency prices. CryptoFrank serves as a liquidity tool for the Swiss blockchain ecosystem (Rabbitte, 2019).

The completion of this first tokenization in real estate should now send a strong signal to more European regulators, inviting them to follow the path for facilitating crypto innovation (Rabbitte, 2019).

3.3.2 Case 2. Legend Siam Theme Park STO in Pattaya, Thailand

Legend Siam Theme Park is a world-famous holiday destination located in Pattaya (Thailand) and it is the first large-scale cultural theme park curated by Via East West Capital (VEWC). It aims to popularize Thai culture and symbolism, which also entails a comprehensive experience for both families and individuals around the world. The size of the theme park is 65 acres with a total value of USD 131 Million (VEWC, 2023). It has 1,000 slots available for car parking and 100 slots available for buses and with the capacity to hold 20,000 visitors.

The Legend Siam Theme Park opened its doors to visitors in 2019 and has already become one of the favorite places to relax. Park is currently operating at full capacity, with a total of 8 attraction points in operation. Attraction points such as 100 seated Show Theatre, Mirror Mezz, Haunted House, Temple Fair, Siam Village Time Machine, Queen of Naga, Lord Indra Erawan Elephant, and the floating market, which will thrill the crowd. There are about 140 shops that offer local Thai products and food – including main restaurants for all-day dining that can be seated up to 800 people (Bussiness Wire, 2019).

Legend Siam is currently seeking USD 50 Million from investors to expand the business. In exchange for the aforementioned sum of funds, 25% of the equity shares which is equivalent to 1,000,000 shares, will be tokenised by VEWC (Bussiness Wire, 2019).

Via East West Capital is a Southeast Asia-based capital investment firm focused on acquiring, repositioning, and managing real asset investment and tokenized asset investments (VEWC, (2023a).

According to past results, investments in the theme park turned out to be stable for investors. VEWC serves as a platform that allows investors to monitor their investments with full transparency in real time, which will also be accompanied by monthly performance reports. Due to the ease of access to information, this allows investors to adjust their investments according to their preferences (VEWC, 2023).

The token presents holders with a unique opportunity to gain an indirect fragmented equity ownership stake in this iconic property. One of the notable benefits of the tokenization is that it simplifies investment for businessperson from across the globe. The investment tracking process is also made available to investors using blockchain technology (VEWC, 2023).

VEWC tokenized Legend Siam Coins (LST) on their private blockchain with the price $50.00 per 1 LST. With nodeblock technology, investors can manage their investment with 100% transparency (VEWC, 2023). According to Shen King, CEO of VEWC,

> "This addition to our business is just a natural extension of our vision for a crowd-financed world, and we provide 100% transparency to all our investors." (Fries, T., 2019).

Increased productivity, saving time and costs, automate communication with investors in a private and secure environment. The offerings are opened to foreign accredited investors or otherwise qualified purchasers.

The tourism industry in Thailand is one of the key activities of VEWC, as it is stable and brings high income to the country. The number of international tourists arriving in Thailand in 2018 reached 38.12 million people, an increase of 7.1 percent year-over-year (VEWC, 2023). By investing into Thailand's tourism industry, investors profit from growing revenues.

While the nascent security token industry continues to develop, VEWC sees a future of increased demand. According to King,

"We predict a rise in the potential and demand for tokenized securities because digital ownership on the blockchain provides so many advantages over legacy investments, and tech-savvy investors are seeing the value proposition in real-time." (Fries, T., 2019).

3.3.3 Case 3. Group of companies Airplane in Russia

In Russia, tokenization of assets is also seen as a good prospective. Therefore, last summer in 2022, a new type of instruments officially appeared on the Russian market — digital financial assets (DFAs). For companies, they can become a convenient and cheap way to raise capital, and for private investors — an alternative to traditional financial instruments.

The first player entered by the Central Bank of Russia into the profile register of information system operators in February last year was Atomize (part of the Interros group). In July 2022, the Atomize platform hosted the debut release of a DFA linked to the cost of Norilsk Nickel palladium. Rosbank was one of the first investors. Further, in October 2022, investors had the opportunity to form a DFA basket for 7 precious metals, including rare rhodium, iridium and ruthenium (Zhuravlev, 2023).

In total, 11 issues of the DFA were held on the Atomize platform in 2022-2023. The total volume amounted to about 1.1 billion rubles (13 million euros). One of the types of DFA on this platform are digital square meter tokens, the issuer of which will be the company "AIRPLANE PLUS DFA" LLC, part of the Airplane group of companies.

Thus, a new type of real estate investment has appeared in Russia. In the first quarter of 2023, citizens will be able to buy tokens for participation in shared-equity construction. Digital tokens, which are primarily an investment instrument, are the first such offer on the Russian real estate market.

The Airplane Group of Companies is the fastest growing public company in Russia by the end of 2021 and one of the largest federal corporations in the field of proptech and development. The following business areas are developing in the perimeter of the group: an online real estate services platform "Airplane Plus", a management company, commercial and rental real estate funds, development of projects in all segments throughout Russia, residential housing, resort real estate and others.

Over the year since the initial public offering on the Moscow Stock Exchange (MOEX: SMLT), the company's capitalization has grown by 400% and exceeded 300 billion rubles. The external valuation of assets reached 423.3 billion rubles, including a land bank of 28.4 million square meters of realizable area and a brand worth 24.6 billion rubles. The Group is among the backbone organizations of the Russian economy, in the TOP 2 companies in terms of current construction in Russia and in 2021 it took the 2nd place in the Moscow region in terms of new square meters output, current construction and sales. It has representative offices in more than 100 cities of Russia and CIS countries and a staff of about 5,000 employees. The company's mission is to create a new quality of life in modern urban neighborhoods and save people the most valuable resource – time (Group of companies Airplane, 2023a).

The issue and sale of tokens that fall under the definition of digital financial assets (DFA) according to the Federal Law "On Digital Financial Assets, Digital Currency" No. 259-FZ dated 31.07.2020, which entered into force not so long ago, is planned to be carried out on the basis of the Atomize platform, which is included by the Bank of Russia in the register of information system operators engaged in release and accounting of DFA.

Transactions related to the sale of newly issued digital assets (DFAs) can only be carried out on the platform where they were issued, in this case it is Atomize. The investor's personal account is also maintained on the same platform.

The purchase of such a token does not give the right to a specific square meter (or a piece of it) in a certain apartment. Such a token represents the issuer's obligation to the token owner. The cost of the token depends on the cost per square meter in the real estate object that the issuer plans to build with the funds raised.

According to Group of companies Airplane (2023), such an investment will be safe.

The funds received by the DFA issuer from investors fall into the escrow account of the developer as payment under the equity participation agreement for the real estate object that is the subject of tokenization. Thus, the funds are protected by the Federal Law "On Participation in the shared construction of apartment buildings and other real estate objects" dated 30.12.2004 N 214-FZ and the developer has no right to use them, as with standard real estate transactions. Settlements in the purchase and sale transactions of the DFA are conducted through a nominal account, and information about the owners of the DFA is recorded in the distributed digital register of the operator of the information

system operating under the supervision of the Central Bank. Financing of construction costs is carried out by banks.

Apartments with the help of tokens are bought at the start of sales. Now, only one project is available for investment – the “Western Quarter”. Potential investors leave a preliminary application for the purchase of digital meters on the website of GC "Airplane" and transfer money to pay for digital meters. This procedure is performed in a few clicks and does not require any special knowledge on the part of investors. A seller will not have to spend time and effort on legal registration and then look for a buyer for investment real estate. The developer will do all this for him. Personal income tax of 13% will be deducted from the income of individual investors automatically. The investor does not need to deal with the calculation and payment of tax.

According to Group of companies Airplane (2023), in order to start investing in real estate, only 50,000 thousand rubles (700 euros) is enough, a very low entry threshold for this kind of investment. Further, the investor will hope to receive income in about 2-3 years – the period when the construction of investment real estate ends. At the same time, the investor can sell his digital meters without waiting for the commissioning of the facility. You can sell digital square meters to a developer or another person.

At the beginning of 2024, it will be possible to donate digital meters and this functionality will be available on the investment platform.

The obligations of the company issuing digital meters are guaranteed by tokenized real estate, which is on the company's balance sheet.

Can a digital meter be stolen? Group of companies Airplane (2023) promises this is impossible. All information about the owners is stored in a distributed registry, which cannot be destroyed or changed, unlike paper documents. The funds from the sale (repayment) of the digital meter are withdrawn from the wallet on the platform only to the owner's account.

According to Nadezhda Korkka, managing partner of the “Metrium” real estate agency, the option with new buildings can work and digital meters will attract a lot of investors — this is a more understandable and predictable asset than cryptocurrency (Lunkova et al., 2023). In the future, many Russian developers will start using the same scheme as the "Airplane". The sale of tokens can support the construction market in conditions of falling

demand for real estate. In particular, this will allow developers to attract money not only from buyers of apartments, but also from investors (Korkka, 2022).

3.4 The future of real estate tokenization

Until now, real estate tokenization initiatives have largely adhered to conventional business models, a cautious approach when embracing new technologies. As both the technology and tokenization's business models evolve, it can serve not only to enhance existing business processes but also to foster novel business prospects. Tokenization has the potential to seamlessly incorporate channels for value generation and harmonize the interests of diverse stakeholders. In the future, we can envision the application of tokenization in employee incentive schemes, lease-to-own agreements, and collaborative workspaces (Hobler et al., 2020).

For a more illustrative example of the development of the future tokenization of real estate, various types of currently existing problematic issues with the most favorable solutions in the future are presented below in “reality – future” mode:

Limited liquidity and market distribution

Reality. Currently, the real estate token market comprises numerous platforms with limited user bases and various token offerings. Acquiring these tokens is straightforward, but selling them poses significant challenges. Furthermore, the tokenization of real estate rights does not guarantee the immediate sale of all tokens. Major investors may not have an interest in tokens, and an influx of small, financially unstable retail investors can potentially devalue the asset. Additionally, this situation can contribute to the inflation of a "financial bubble."

Future. The potential of tokenized real estate assets in shaping the future of the industry and investment prospects is highly promising (Nazarevich, 2023). With ongoing technological advancements and evolving regulatory frameworks, we can expect the extensive adoption of tokenized real estate worldwide. This transition is likely to bring about specialized platforms and marketplaces exclusively designed for trading real estate tokens, ultimately boosting liquidity and diversifying investment opportunities.

Fraudulent activity

Reality. The real estate tokenization market presents risks that blockchain startups tend to downplay. The allure of investment appeal, enhanced liquidity, and potential profitability can be enticing. However, similar to venture investments, property tokenization, until the establishment of unified platforms and a broad consumer base, may also carry the characteristics of a potential source of criminal activity. This risk is associated with the rise and progression of "sectoral crime" within this domain.

Companies will inevitably emerge, with the best-case scenario being those that strive to maintain a positive reputation and the worst involving them in fraudulent schemes related to token misappropriation. This underscores the importance of law enforcement agencies effectively addressing new professional challenges in tandem with the development and enhancement of legislation.

The surge in fraudulent activities can be attributed to three key factors:

- the substantial value of real estate serves as a strong incentive for criminals to engage in unlawful activities.
- the intricacy of real estate transactions provides openings for fraudsters who engage in document forgery, misrepresent the property's condition, conduct multiple sales to different individuals, and pilfer financial information.
- the utilization of the internet further amplifies opportunities for stealing money and personal data. It also enables cybercriminals to operate from anywhere globally with internet access.

Future. The complete journey of real estate can readily undergo digitization and integration into the blockchain. This lays the groundwork for establishing a system where each property is equipped with a digital passport containing comprehensive details, including title documents, historical ownership records, transaction history, lease agreements, loans, service contracts, and even insights into building materials' origin and condition (Tarasenko, 2023).

This data will remain unaltered and secure, leading to enhanced market transparency. It will also lay the foundation for establishing a rating system that monitors the activities of all market participants while ensuring the provision of authentic information about counterparties. Together, these measures will serve to mitigate the risks associated with fraudulent activities.

Excessive bureaucratization

Reality. Real estate transactions involve a substantial amount of paperwork and multiple stakeholders, involving government agencies, insurance companies, real estate agents, banks, notaries, as well as buyers and sellers (or tenants with landlords).

Consequently, a substantial portion of tangible paperwork traverses through the entire sequence of intermediaries who are obligated to register, inspect, validate, and relay these documents. On average, this process consumes anywhere from 1 to 2 months. Remarkably, regardless of the duration spent on document verification, none of these intermediaries offer a guarantee of the transaction's integrity.

Future. Utilizing smart contracts and digitizing documents for inclusion in the blockchain will simplify a complex procedure into a seamless transaction. Participants can access necessary documents online, ensuring their authenticity, and monitor every step of the process. The blockchain guarantees document credibility, while a smart contract ensures precise execution of the transaction terms.

A large amount of intermediaries

Reality. Typically, real estate transactions involve various parties, including:

- buyer and seller, the essential partisipants;
- land cadastre, ensuring property records;
- notaries and lawyers, providing legal expertise;
- realtors and real estate agents, guiding the deal;
- banks and insurers, offering financial security.

However, it's noteworthy that only the seller, buyer, and land registry are truly indispensable. The rest thrive on the intricacies and inefficiencies of the process, delivering intermediary services or guarantees for specific actions, often-inflating costs by 5-10% or more and causing delays (Tarasenko, 2023).

Future. The era of banks, realtors, lawyers, and notaries in real estate transactions may soon fade into obsolescence. The blockchain, with its document authenticity assurance and universal access for all transaction participants, coupled with the automation prowess of smart contracts, is poised to radically change the transfer of ownership and financial transactions.

By focusing on creating of blockchain-based platforms tailored for real estate transactions via smart contracts, both individuals and corporate entities can engage in peer-to-peer dealings, eliminating the need for intermediaries and third-party guarantors.

By way of illustration, consider platforms like Liquid Space, Rentberry, or Airbnb, which enable direct real estate rentals without the need for intermediaries (Tarasenko, 2023). These platforms leverage smart contracts to facilitate transactions, securely lock in deposit payments, and automatically handle monthly rent payments.

High entry barrier for investors

Reality. Traditionally, real estate investments have been accessible mainly to individuals with substantial capital, typically in the thousands of dollars range. This limitation stems from the significant expenses associated with both construction and existing properties, which have the potential for appreciation in value. In most cases, only accredited investors and participants in Real Estate Investment Trusts (REITs) are able to enter the real estate investment arena. In the former scenario, one must possess annual incomes in the hundreds of thousands of dollars or net assets totaling in the millions. In the latter case, investors must contend with elevated commissions and entrust their funds to third-party management entities, introducing additional risks into the equation.

Future. Developers will initiate distinct Security Token Offerings (STOs) with their unique tokens for each upcoming construction project utilizing blockchain technologies, selling them on financial markets. This approach will achieve the following:

- globalize the market reach.
- enhance liquidity for real estate investments.
- broaden the scope of potential investors.
- lower the investment entry threshold.

Anyone from any corner of the world can invest 50, 2,000, or $5,000 in a construction project in Berlin, Barcelona, Dubai, or Singapore without requiring a physical presence in the investment locale, extensive paperwork, lengthy waiting periods, or intermediaries (Tarasenko, 2023). Investors can seamlessly purchase the property token and subsequently sell it as its value grows—similar to how traders handle stocks, gold, or currencies in financial markets.

Searching information

Reality. Typically, investors use a variety of multiple multi-listing platforms to gather information about their target property or to gain insights into the overall market conditions. However, these platforms exhibit several significant drawbacks:

- they typically operate on a subscription basis;
- the decision regarding what information to provide and in what format is dictated by the platform owners;
- there is no mechanism for verifying the accuracy and reliability of the information presented;
- the rate of database updates tends to be sluggish.

Consequently, the data found on such websites tends to be imprecise, one-sided, incomplete, and carries an uncertain level of trustworthiness. Consequently, investors often need to rely on several multi-listing platforms to cross-reference information from various sources in pursuit of the most accurate and dependable insights. This approach diminishes search efficiency and leads to delays in the decision-making process.

Future. The implementation of a decentralized blockchain-based database housing numerous listings opens up the possibility of establishing a platform in which users possess the autonomy to determine the data to be gathered. In this case, the necessity for maintaining costly infrastructure (servers, security measures, extensive support personnel, etc.) is obviated. The system code is subject to scrutiny and data tampering becomes an impossibility. This innovative approach would grant market participants access to more dependable data at a reduced cost, fostering enhanced transparency and trustworthiness in the real estate market.

Financial transactions

Reality. Real estate transactions involving payments are traditionally conducted through one of two methods: cash or bank transfers (Tarasenko, 2023). In the case of cash transactions, there exists a shared risk, as one party may employ counterfeit currency, while bank transfers carry the potential for security concerns such as robbery. Consequently, cash transactions often require multiple phases and involve third parties, typically notaries.

Banking transactions, while less susceptible to risk, tend to be slower, necessitate additional paperwork, and come with associated costs, especially in international operations. Moreover, in the event of complications, rectifying the situation may only be

achievable through legal proceedings. Both options entail an escalation in the transaction cost due to the need to remunerate notaries and/or banks.

Future. With real estate boasting a blockchain-based digital ownership certificate, ownership transfer transactions can seamlessly occur through the application of smart contracts. This standardized procedure typically takes around an hour, contingent on the blockchain's processing speed. Alternatively, in scenarios like construction projects, there exists a sales and purchase approach that involves tokenizing the property and selling all its tokens to a single entity. This method can be swifter and more efficient.

Employing these methods results in substantial timesavings. Without blockchain, financial transactions require 1 to 3 days for domestic bank transfers and up to 5 days for international ones. Furthermore, this approach also translates to cost savings in terms of commissions.

Investors and real estate owners aiming to take advantage of the possibilities offered by real estate tokenization must prioritize seeking guidance from professionals. By jointly navigating these intricacies, stakeholders can tap into the complete potential of tokenized real estate, paving the way for a future where property investment is more accessible and streamlined than ever (Nazarevich, 2023).

Conclusion

The purpose of this work was a detailed study of an innovative way of investing in real estate using blockchain technology, identifying the advantages and disadvantages of tokenization, as well as considering the existing legal regulation and future prospects for the development of this technology.

In Chinese, the word "crisis" is a combination of two hieroglyphs "danger" and "opportunity". Despite the tragedy of the situation, the emergence of blockchain technology is closely related to the catastrophic mortgage crisis of 2008, which revealed a serious problem in the financial system associated with intermediaries in financial transactions.

Just two months after the events on the world market, Satoshi Nakamoto publishes his legendary article about Bitcoin, which opened up unimaginable opportunities for the entire economic system in the future. From that moment, a new era began, foreshadowing the emergence of a completely new investment approach.

Leveraging blockchain technology for tokenization can result in numerous positive outcomes, providing advantages to various business sectors. It can be applicable in all areas where the speed of information transfer with a high degree of its protection is necessary, for example, in healthcare, fake products tracking, intellectual property, charity, and real estate.

In this work, we examined a nature of traditional real estate asset classes and their types. Despite its considerable allure, it is evident that this asset type comes with notable drawbacks, including limited liquidity, a formidable entry barrier, and a protracted transaction process necessitating the involvement of numerous intermediaries. In addition, we looked real estate investments through REITs, REIF and crowdfunding, and examined the possibility of achieving fractionalization through digital tokenization.

Also in the first chapter, we considered the main differences between utility token and security token, NFT and stablecoin, and identified the main players in the tokenization process, such as issuance platforms, compliance providers and regulators, broker-dealers, trading platforms, legal firms and custody.

In the second Chapter, we examined in detail the entire lifecycle of converting a physical asset into a digital one, starting with choosing the conditions for using a security token

and ending with post-support activities of digital assets. Based on this, we can conclude that the tokenization of real estate is a rather complex process and demanding the guidance of proficient experts in real estate, securities, tax, blockchain law, and other relevant fields.

In Chapter 3, we suggested that in an ideal future, tokenization might prevent fraudulent activity, avoid excessive bureaucratization, reduce the number of intermediaries, and reduce barriers to entry for investors, speed up the time of transactions and increase liquidity.

The tokenization of real estate offers numerous benefits such as data transparency, cost efficiency, liquidity, fractionalization, faster settlement and automation, absence of intermediaries, reducing geographical barriers.

Using the example of companies specializing in the field of asset tokenization, it has already been proven that real estate tokenization can work successfully. In this research, three striking examples of investments in tokenized real estate assets were considered - “Hello World” in Baar (Switzerland), Legend Siam Theme Park STO in Pattaya (Thailand) and Group of companies Airplane in Russia. These are very good examples of how tokenization of real estate can work even in conditions of completely unformed legal regulation.

A primary drawback associated with real estate tokenization is the regulatory challenges and the relatively limited understanding among market participants regarding blockchain technology and the tokenization concept. However, those individuals or entities interested in entering the emerging tokenized real estate sector can seize the opportunity to establish themselves as pioneers, contributing to the development of the necessary infrastructure.

Undoubtedly, it becomes evident that blockchain technology can significantly affect on the real estate sector. From a business perspective, tokenization offers the ability to divide any asset into fractions, with the resulting tokenized asset being represented on the blockchain as a digital asset. The concept of fractionalizing assets can enhance accessibility for investors, as digital assets have no inherent limitations regarding their size or who can acquire them.

Consequently, this increased accessibility theoretically transforms into greater liquidity. However, the primary impediment lies in the existing regulatory framework, which

introduces an element of uncertainty. As a result, the full potential can only be realized when these prerequisites are effectively addressed.

Anticipated progress suggests that this could occur around 2025, coinciding with the completion and implementation of scheduled directives, international regulations, recommendations, and regulatory documents.

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