Explorative research on how tokenization can be implemented in real estate funds

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Colophon

Title

Explorative research on how tokenization can be implemented in real estate funds

Master thesis

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Preface

In front of you is the master's thesis: ‘’Explorative research on how tokenization can be implemented in real estate funds''. I wrote this master's thesis to conclude the master's programme in Urban Systems & Real Estate at Eindhoven University of Technology. I can look back with great pleasure on the times of my master's and graduation periods.

During the master's programme, I was able to learn a lot about the built environment and real estate from a very broad to a very in-depth level. For this master's thesis, however, I took a slightly different direction, which suits my interests in innovations and my ambition to constantly progress. It was therefore a huge pleasure for me to learn so much on these developments and new technologies.

I would like to thank my supervisors Stephan and Rianne for their excellent guidance during this process. I certainly understand that due to the novelty and unfamiliarity of this subject for you, this must not always have been easy and that it took a lot of extra effort. However, I always got the support and feedback I needed, for which I thank you.

Furthermore, I would like to thank Layla, my parents, brother, sister and other family members for their unconditional support and guidance throughout this masters and graduation process. In particular, I would like to thank Layla with whom I had the opportunity to spend endless hours together during our graduation projects and in which I had so much support from you.

I would also like to thank FIBREE and Jo in particular. Jo has meant a lot to this research and to me. I was able to learn a lot from him and I am very grateful for that.

Hereby, I would like to proudly offer my master's thesis, in which I hope readers can get inspired and gain new knowledge from it. I hope there is a bright future ahead for blockchain and its applications, but there is still a lot of work to do. I am honoured to have been able to contribute to this.

I wish you much reading pleasure.

Kind regards,

Max Vernooij

Utrecht, 22-11-2022

Samenvatting

De opkomst van een nieuwe technologie, genaamd blockchain, heeft zijn intrede in de vastgoedsector gemaakt. Deze technologie kent verschillende toepassingen, waar tokenizatie er een van is. Tokenizatie wordt omschreven als de representatie van het (gefractioneerde) eigendom in de vorm van een blockchain-based token. Tokenizatie wordt vooralsnog voornamelijk gebruikt bij individuele vastgoedobjecten. Fractionalisatie van individuele vastgoedobjecten kent echter moeilijkheden zoals een beperkte vraag, de markt die blockchaintechnologie moet omarmen en het gebrek aan juiste wet- en regelgeving. Tokenizatie van vastgoed via vastgoedfondsen lijkt een betere oplossing hiervoor. In die markt is men gewend aan fractionalisatie en is de onderliggende structuur en de benodigde wet- en regelgeving ervoor. Daarom wordt dit genoemd als een grote kans en dient er meer aandacht aan besteed te worden. Dit onderzoek heeft tot doel om te vinden wat de samenkomst van vastgoedfondsen en tokenizatie omvat en met dit inzicht, te kijken hoe tokenizatie in vastgoedfondsen geïmplementeerd kan worden. De hoofdvraag is dan ook: ''Op welke manieren kan tokenizatie geïmplementeerd worden in vastgoedfondsen?''.

Om dit te onderzoeken wordt literatuur en empirisch onderzoek uitgevoerd. Het literatuuronderzoek bevat drie onderwerpen: vastgoedfondsen, blockchain en tokenizatie. Het empirische onderzoek bestaat uit interviews, de analyse van de daaruit volgende resultaten, de vertaling van deze resultaten naar informatie hoe tokenizatie geïmplementeerd kan worden in vastgoedfondsen en een voorgestelde manier van implementatie.

In de implementatie van tokenizatie in vastgoedfondsen zijn vier onderwerpen betrokken: vastgoedfondsen, blockchain, tokenizatie en wetgeving. Laatstgenoemde is betrokken nadat bleek dat het voldoen aan de juiste wet- en regelgeving van belang is. Deze onderwerpen hebben bijbehorende aspecten die inzicht geven en helpen bij het maken van keuzes.

De gemaakte keuzes voor de implementatie zijn: een niet-beursgenoteerd, closed-ended fonds in een commanditair vennootschapsvehikel. De uitgifte en verhandeling vindt plaats op een interne beurs. Hierop wordt de uitbetaling op regelmatige basis gedaan in de valuta naar keuze van de belegger. De blockchain betreft een private Ethereum-blockchain met het proof-of-stake consensus mechanisme. De tokens zijn asset-backed security tokens, geconfigureerd op het ERC-20 protocol en worden gewaardeerd op basis van zowel vraag en aanbod, als de onderliggende activa. Om het product compliant te maken, worden KYC- en AML-procedures gedaan op het platform, de tokens geregistreerd door een secretaris en de bron van het kapitaal gegarandeerd door een derde partij. De uitdagingen in de implementatie hebben voornamelijk betrekking op het product laten voldoen aan de geldende wet- en regelgeving, het veranderingsproces van de huidige werkwijzen, onduidelijk- en nieuwigheden en de bottlenecks in de technologie, zo blijkt uit de 16 geïdentificeerde uitdagingen.

Dit onderzoek kent ook beperkingen. Zo zijn er in de loop van het onderzoek aanpassingen gedaan aan de methodologie en beoogde uitkomst. Gedurende het onderzoek is gebleken dat het - voor dit onderzoek - niet relevant en niet mogelijk is om een enkele manier van organisatie te ontwikkelen. Dat komt doordat de marktontwikkeling nog beperkt is, er vele manieren van implementatie mogelijk zijn er beperkte uniformiteit is onder de experts over hoe dit moet worden geïmplementeerd. Zodoende is een manier voorgesteld hoe dit te implementeren en is de benodigde informatie verzameld en gestructureerd zodat eenieder inzicht kan vergaren in hoe dit aan te pakken.

Dit onderzoek draagt bij aan wat de samenkomst van tokenizatie, blockchain en vastgoedfondsen omvat en hoe deze samenkomst gerealiseerd kan worden. De ontwikkeling hiervan verloopt vlot en speelt een grote rol in hoe het geïmplementeerd kan en moet worden. Dit onderzoek is dan ook een momentopname.

Summary

The emergence of a new technology called blockchain made its entrance in the real estate sector. This technology has several applications, one of which is tokenization. Tokenization is described as the representation of (fractionalised) ownership in a blockchain-based token and is, for now, mainly focused on single real estate properties. However, this seems to be a difficult task, given that the demand for fractionalisation of single real estate objects seems limited, this market needs to embrace blockchain and there is not the right legislation and regulation for it. A better approach for this seems to be through real estate funds. In this market, people are familiar using fractionalisation and the underlying structure for fractionalisation and laws and regulations for this are already in place. This is described as a great opportunity and should be given more attention. This research therefore firstly aims to explore what the conjunction between real estate funds and tokenization entails and once this insight is obtained, how tokenization can then be implemented in real estate funds. The main question is therefore: ''In what ways can tokenization be implemented in real estate funds?''.

Literature research and empirical research are conducted to investigate this. The literature research covers three topics: real estate funds, blockchain and tokenization. The empirical research consists of interviews, the analysis from the subsequent results, their translation into information on how tokenization can be implemented in real estate funds and a proposed way of implementation.

Four topics are involved in the implementation of tokenization in real estate funds: real estate funds, blockchain, tokenization and legislation. The latter is added given the importance of achieving compliance in the implementation. These topics have corresponding aspects that create insight into and help in making choices in the implementation.

The choices made in the implementation are; a non-listed, closed-ended fund with a limited partnership vehicle. The issuance and trading of the tokens takes place on an internal exchange. Payouts are done regularly on the internal platform and the currency is at the investor's preference. The blockchain concerns a private Ethereum blockchain with a proof-of-stake consensus mechanism. The tokens are asset-backed, security tokens configured on the ERC-20 protocol and valuated based on both supply and demand and the underlying asset(s). To make the product compliant, KYC- and AML-procedures are done, the tokens are registered with a registrar and the source of funds are guaranteed by a third party. The challenges in the implementation are mainly regarding making the product compliant, change process of current practices, lack of clarity in and novelty of the development and bottlenecks of the technology, as evident from the 16 identified challenges.

This research also has limitations. For instance, adjustments are made to the methodology and intended outcome during the course of the research. During the research, it became clear that – for this research - it is neither relevant nor possible to develop a single way of organisation. This is because market development is still limited, many ways of implementation are possible and there is limited uniformity among experts on how to implement it. As such, a way is proposed on how to implement this and the necessary information is collected and structured so that anyone can gather insights on how to tackle this.

This research contributes to what the conjunction of tokenization, blockchain and real estate funds means and encompasses on the one hand, and how the convergence of these can be realised on the other. Its development is progressing rapidly which plays a major role in how it can and should be implemented. This research is therefore a snapshot in time.

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1. Introduction

1.1 Background and motivation

The rise of blockchain technology and its applications such as tokenization have not skipped the real estate sector (Saari, Vimpari, & Junnila, 2022). Where the real estate sector has several drawbacks for example: illiquidity, high barrier to entry and inefficiencies (FIBREE, 2019). Blockchain can offer the advantages of transparency, reliability and immutability (Swan, 2015; Drescher, 2017; Hileman & Rauchs, 2017) and tokenization can provide liquidity, fast processes and a low barrier to entry (Laurent, Chollet, Burke, & Seers, 2018; Sazandrishvili, 2020; Haddad, 2021). Thus, blockchain and its applications can play an important role in the innovation of business models, (management) processes and change in characteristics (Shahzad, 2020).

Since the publication of bitcoin in 2008 (Nakamoto, 2008), the technology that underpins it – blockchain - has gained notoriety. And as a result, several applications on this technology have been developed since (Dabbagh, Sookhak, & Safa, 2019; Tomov, 2019).

In the world's largest asset class: real estate, worth 326.5 trillion US dollars by 2020 (Tostevin, 2017; Bronckers, Veuger, Appelmans, Cesar, & Brahmbhatt, 2019; Tostevin, 2021) blockchain technology has already entered the sector. One of the first applications of blockchain in real estate are tokenization and smart contracts (Grinyaev, Medvedev, Pravikov, Samarin, & Sherbakov, 2019; Gupta, et al., 2020; Garcia-Teruel R. M., 2020; Matai, Vibho, & Uthra, 2020; Ullah & Al-Turjman, 2021).

In the first publication - an industry report - of FIBREE, blockchain is described as a much-needed solution to the various challenges and problems within the real estate sector (FIBREE, 2019). For example, it can help in sharing data, making the sector more liquid, making processes and registration more efficient and increasing transparency.

As can be observed from the above, there is a new technology that can gradually bring tremendous changes to any sector, including the real estate sector. It is important for sectors and companies to keep up with new developments and the same applies to the real estate sector. Small or big changes can and are being made by the blockchain technology.

Many studies are being and have been done on different aspects of blockchain on real estate. Other studies have for example focused on the combination of real estate and blockchain in land registration (Veuger, 2020; Kaczorowska, 2019; Konashevych O. , 2020), real estate management (Ahmad, A. Alqarni, Ali Almazroi, & Alam, 2021; Dijkstra, 2017) and data sharing (Nijland & Veuger, 2019; Wu, Tie, Yu, Li, & Song). This study focuses specifically on one of the applications of blockchain to real estate: 'Tokenization'. Tokenization is described by Baum (2020) as the process of representation of an asset (or fractional ownership interest) with a blockchain-based token.

According to Baum (2020), it appears that the tokenization of real estate as it is primarily envisaged today - for the fractionalisation of single assets - will be a huge challenge. This is due to lack of demand, blockchain having to be accepted by the market and regulation issues. It appears to have more opportunities in the form of funds. In funds, there is a demand for fractionalisation, the underlying structure is already there for it and the regulations already exist.

It follows that central to this research are, on the one hand, real estate funds and, on the other, the new technology blockchain and its application tokenization. What these can do for each other and what can emerge from their convergence can be explored further.

This research is conducted for the Technical University Eindhoven in cooperation with FIBREE (The Foundation of Blockchain and Real Estate Expertise). FIBREE seeks to promote blockchain technology

within the real estate sector. It is a non-profit organisation with the aim of connecting people and organisations within the intersection of blockchain and real estate (FIBREE, n.d.).

1.2 Problem analysis

Lachance (2016) provides a broad perspective on the concept of blockchain. It is a global online network of ledgers that records all transactions in the world. All these transactions are directly verified or not by the system, that works on the basis of cooperation between all users of the system. This allows the privacy of a person to be protected but is transparent enough to allow an overview for everyone. As a result, it is a system that is not regulated by one person or group, but by all users of the system.

In 1976, the first patent was filed for a system that incorporated the basic idea of a message security exchange that forms a chain to the preceding blocks. This is the first time the term 'blockchain' was mentioned (Kulkarni, 2019). Blockchain offers the possibility to perform applications and transactions in a decentralised manner, i.e., without an intermediary, with the same level of certainty. It has properties such as transparency, robustness, verifiability and security (Greenspan, 2015; Christidis & Devetsikiotis, 2016). For many sectors, blockchain can therefore offer applications that can be disruptive, but also an optimisation of a process, for example.

Blockchain as a development in industries is still in its infancy but has great potential to change sectors profoundly and permanently (Grover, Kar, & Janssen, 2019). According to Mashatan & Roberts (2017), blockchain offers the possibility of establishing the prove of ownership in a digital economy which cannot be copied or changed. This means that, for example, a physical asset such as real estate can be registered, traded and managed through the blockchain (Swan, 2015).

Cartier (2020) has identified six possible applications identified for blockchain on the real estate sector. Firstly, it can remove the middleman from processes by means of smart contracts (Grinyaev, Medvedev, Pravikov, Samarin, & Sherbakov, 2019). The entire transaction process can take place via the blockchain (Huh & Kim, 2020). For financing and leasing, documents can be stored and thus directly checked and verified on the blockchain (Konashevych O. , 2020). Land titles are traditionally not yet digitally documented; the blockchain can also be used for this (Sinha, et al., 2021). Through tokenization of real estate, parts of a real estate object can be purchased by (multiple) different investors (Garcia-Teruel R. M., 2020). Which results in an increase in the liquidity of real estate. And finally, it can be used as a single source of truth of ownership, providing insight into who the owner or owners of the property are (Krupa & Akhil, 2019). Bear in mind that these are only 6 identified applications, that there are more and perhaps even more possible than recognised so far.

Despite the mentioned applications, the development of blockchain in real estate is still in its infancy (Mashatan A. L., 2021). Some companies are already working on it and companies are emerging from the development of new applications (Nowiński & Kozma, 2017).

One of the highlighted applications is tokenization. According to Sazandrishvili (2020), asset tokenization is an application on the blockchain that makes it possible to buy, sell and trade assets in a digital manner. Baum (2020) describes the concept as follows: ''Tokenization is the process of representing (fractional) ownership interest in an asset with a blockchain-based token'' (Baum A., 2020). This can then be understood in two ways: It can either address digital fractional ownership rights or it can address the digital ownership of the entire asset.

As aforementioned, until now the tokenization of real estate has mainly been looked at from the point of view of individual assets, whereby these were fractionalized into tokens representing parts of the ownership (Garcia-Teruel R. M.-M., 2021; Baum, 2020; Wahlin, 2021). This is because real estate is

lumpy and illiquid and to invest in real estate retail investors (individual non-professional investors) will face high entry costs, large capital investments, lack of information, long process time and difficulties in finding the right properties. Therefore, the barrier to entry is higher (Baum, 2020; Chow, 2021). Tokenizing it then offers the possibility of dividing this large asset into smaller parts of digital ownership that are then tradable. It can also take the form as digital property right, which also has advantages (Pang P. , et al., 2020).

Baum (2020) indicates that there is a major challenge before the market will accept the tokenization of individual real estate assets. This is because, on the one hand, there must be demand for fractionalised single assets for which evidence seems limited and poor and, on the other hand, the market needs to embrace blockchain. These are both radical new developments that need to be accepted by the market at the same time. In addition, in many markets it is difficult to achieve fractionalisation because the asset needs to be managed and the right regulation for fractionalisation is required. To facilitate this, an intermediate structure is needed that includes this (Baum A. , 2020).

This intermediate structure is found in funds, in this case real estate funds, where the structure for fractionalisation is already both present and grasped and there is a demand for fractionalisation. Funds are already a fractionalised market in which primary and secondary trading has been done for a long time. Furthermore, funds are already regulated, so this is also likely to be achieved (Baum, 2020; Pang, et al., 2020).

According to Baum (2020), tokenization of real estate funds is a clear opportunity and more attention should be paid to it. This is due to both the underlying organisation of funds that fits perfectly with tokenization and its track record in fractional markets and therefore it should be an easy win to tokenize it. For the further development of tokenization in real estate, it is thus interesting to conduct research into the tokenization of real estate funds. If demand for this is proven in the market, then the market for tokenization of single assets may potentially also follow.

For the different actors/parties in the real estate (investment) system, tokenization (of funds) can solve difficulties or problems and provide benefits. These include making operations more efficient, making information more transparent and various benefits that come with fractionalisation of real estate, such as increasing liquidity and reducing settlement times. These actors include the issuers of the real estate funds, the investors and the real estate intermediaries (Pang P. , et al., 2020). This may potentially help in the adoption of blockchain in the market.

The role of real estate funds in the real estate sector is described as capital providers in real estate investments (Tenneke, et al., 2017). That includes purchases, new construction/development, renovation and the like. This is particularly the case in supply-driven financing, but there is also a shift whereby increasingly demand-driven projects are financed via capital providers. Investment is needed in real estate - especially at the moment of writing - for the further development of housing. The supply of housing lags far behind the demand and this does not seem to change in the near future. The planned supply will even fall short. Due to the lack of investment; sustainability and quality are also lacking in the new supply. Further investments are therefore required from the national government, but also from the market (Mulder, Meuwese, Bakker, & Smit, 2016; Groenemeijer, Gopal, Stuart-Fox, Leeuwen, & Omtzigt, 2021). And institutional funds are increasingly focusing on social investment. Previously, they often invested with a profit motive, but this is changing increasingly due to their social role (Hollanders, Zwan, & Kuiper, 2013).

Thus, it is now interesting to investigate what it involves if real estate funds work together with the tokenization application. This will require an examination of what the three topics; real estate funds, blockchain and tokenization encompass and how these can work together. As these are also

completely different topics which are also new to each other, they should first be examined individually in order to gain knowledge on how tokenization can be implemented in the real estate fund. The accumulated knowledge from this can then be applied to gain more knowledge about it.

No research has yet been done - to the researchers' best knowledge - on tokenization in real estate funds. Which is also evident from Baum's comment, that more attention clearly needs to be paid to it. So due to the novelty of the subject the research will be strongly explorative in nature. Subsequently, it could potentially function as a foundation in the spectrum of tokenization and real estate funds.

1.2.1 Problem statement

Tokenization is one of the various applications of blockchain to the real estate sector. It offers various uses and advantages, but what is currently mainly focused on - the tokenization of individual assets - appears to have little chance of success. A more promising approach is the tokenization of real estate through real estate funds. However, more attention needs to be paid to this. The aspects of the three topics need to be identified and subsequently it should be investigated how the implementation can be undertaken on these aspects. This may then also reveal what the challenges in this are. All this could possibly provide a starting point on how to implement this.

1.3 Research questions

1.3.1 Main research question

The question in this research is how the blockchain application; tokenization can be implemented in real estate funds. It is the first research on what tokenization encompasses in real estate funds. Due to the novelty of this, this will be explored incrementally, by first looking at what blockchain, tokenization and real estate funds include and what the aspects in these are. Subsequently, it will be investigated how the implementation in these aspects can be undertaken based on the literature and interview results.

The aim of the study is to find how blockchain and tokenization can be implemented in real estate funds. To gain insight into how this can be done then, it is interesting to know what the possible choices are that can be made and what are the challenges in the implementation. By investigating the aforementioned, it can subsequently become clear how tokenization could be implemented in real estate funds. All this may lead to a foundation of understanding of the subject, enrichment of scientific information and to insights in the assistance of the implementation of tokenization in real estate funds.

This gives the following main question:

In what ways can tokenization be implemented in real estate funds?

1.3.2 Sub questions

The study is conducted in a stepwise manner, in which the literature research contributes to the insights. This literature research focuses on the three main topics which are: real estate funds, blockchain and tokenization. This obtains and creates an understanding and insight for the empirical research on these topics and collecting the related aspects. This is converted to the first three sub-questions.

Subsequently, from the literature research, the aspects of real estate funds, blockchain and tokenization that play a role in the implementation can be identified. After this, in the empirical research it is relevant to look at what choices can be made and what the challenges are in this implementation in order to gain further insight into the ways in which the implementation can be approached, what is possible in this and what the difficulties are.

From the main research question, the next six sub-questions follow:

I. What are real estate funds?
II. What is blockchain?
III. What is tokenization (of real estate)?
IV. What topics and aspects are involved in the implementation of tokenization in real estate funds?
V. What choices can be made in the implementation of tokenization in real estate funds?
VI. What are the challenges in the implementation of tokenization in real estate funds?

1.4 Academic and managerial/practical relevance

1.4.1 Academic relevance

According to Casino, Dasaklis & Patsakis (2018), many blockchain applications are being deployed, but many issues still need to be addressed. In other words, there is a wide range of applications, but it still lacks concreteness and refinement. This would make the applications both more scalable and more viable. Further research into and within these issues could potentially enhance the future of these applications.

This is - to the researcher's knowledge - the first study to address the issue of tokenization of real estate through funds. At the time of writing, no other research addressing this issue could be found. And - to the researcher's knowledge at the time of writing - no scientific research has yet been done on the basis of tokenizing real estate through real estate funds. This makes it especially interesting and useful and could possibly serve as a basis for further research on this subject.

From the literature, Baum (2020) urges that more attention needs to be paid to this issue. More research needs to be done, as it may offer a more promising approach to tokenizing real estate. He also indicates that for the future of tokenization of individual assets, it is first necessary to implement it through funds. So, more research is first needed into this issue, to then be able to build on it for the further tokenization of real estate.

1.4.2 Managerial/practical relevance

The study offers another possibility of how tokenization of real estate can be applied. According to Baum (2020), this approach is also a more promising approach to the tokenization of real estate. A small number of initiatives are known which focus on real estate tokenization funds, but this research offers possibly more insights for that as well.

For various actors in the real estate (investment) system, tokenizing real estate by means of funds also has implications when these actors are involved. Broadly speaking, it offers them the opportunity to make operations more efficient, to make information more transparent and to enjoy various benefits associated with fractionalisation of real estate, such as increasing liquidity and reducing settlement times (Pang P., et al., 2020).

Especially for the investor it offers a new possibility of investing in real estate (funds). Investing in real estate funds is not new, but for investors who previously could not afford the high costs involved, this offers a new opportunity. For the larger investors it offers, for example, a greater possibility of diversification of their portfolio and faster processing times of orders (higher liquidity) (Pang P., et al., 2020).

1.5 Research design & methodology

1.5.1 Research approach

This research seeks to understand how tokenization can be implemented in real estate funds. There is still little information available on this phenomenon, developments are not far advanced and, to the best of this researcher's knowledge, this is the first research focusing on this subject. This characterises exploratory research, as it attempts to gain an understanding of this phenomenon (Fossey, Harvey, Mcdermott, & Davidson, 2002). Therefore, a qualitative approach is most appropriate for this research.

Due to the novelty of the subject, its limited developments and limited information on tokenization of real estate funds, a literature research will first be conducted for this exploratory research. With this, follow-up research can be done. The literature research examines the three topics - real estate funds, blockchain technology and tokenization - independently. The purpose of this is to gather knowledge, gain an understanding of the topics and collect their various aspects, create further focus on the context and increase the researcher's knowledge of the subject. These aspects and their information are exploited in the empirical research.

The collection of information from the literature research is applied in the first step of empirical research. In this, to gather new information from practice that also directly links to the current state-of-affairs on the latest developments, interviews are conducted. These interviews are conducted with experts from practice who have knowledge of and/or work on tokenization in real estate funds. In this way, this research enriches itself to the latest and broadest information on the subject. Thus, this research can proceed to how (currently) implement tokenization in real estate funds.

The gathered information of real estate funds, blockchain, tokenization and their aspects are processed into interview questions for the interviews. The questions should focus on how, according to the expert, the implementation should be undertaken on the aspects and their reasoning behind it. This gathers information on how the experts view how this can be implemented and what this includes. In addition, other questions may be asked where necessary if this proves necessary during the research based on the information gathered, for the quality of the research. These interview questions are then collected from the experts, after which these interviews are transcribed, coded and analysed.

The information collected then contains a great deal of information and (possibly different) insights from the experts on how to implement tokenization in real estate funds. This information can be utilised by entities wishing to implement tokenization in a real estate fund. Thus, the information will be structured in a comprehensive manner that provides foundation in choices, steps and considerations to be made in this implementation.

The interview questions will also aim to also acquire characteristics and challenges in the implementation of tokenization in real estate funds. In addition, these challenges provide the important insight into what gets in the way in the implementation of tokenization in real estate funds and therefore what needs to be tackled first. The characteristics relate to what (the aspects of) real estate funds, blockchain and tokenization should comply with according to the experts.

The findings from the literature and empirical research are used, on the one hand, to provide insight into what the implementation entails and which choices can be made in this and explanations thereof. On the other hand, these are used to create a proposed way of how to implement tokenization in real estate funds. For this, the challenges and characteristics are also taken into account. Following this, the empirical chapter and its results are discussed.

Finally, the research will be concluded, recommendations for follow-up research will be made and limitations of the research will be discussed.

In the research model, figure 1, the course of the research is presented. The boxes all indicate an activity. These also have a number next to them, indicating the order of the activities.

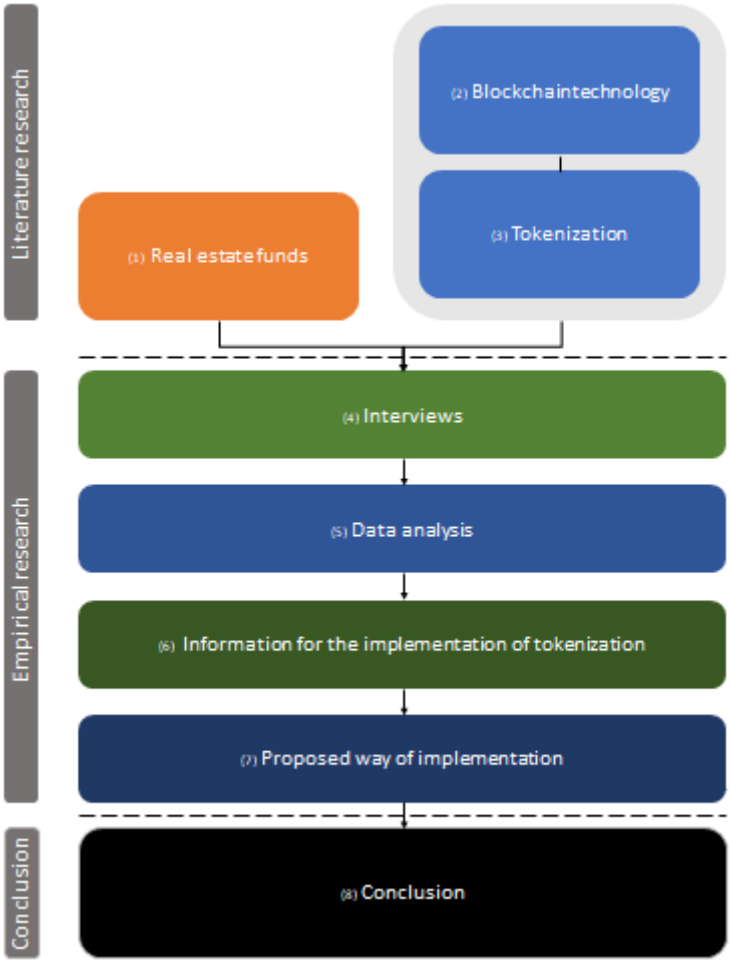

Figure 1: Research model (own illustration)

1.5.2 Research scope

This research is exploratory in nature and it specifically focuses on real estate funds tokenization. The literature cited herein comes from international sources and is collected from digital and international (mainly scientific) sources. The period of this leads back to the moment in time of retrieval. Newer literature might thus be excluded.

In terms of context, this research relates to the Netherlands and the Dutch real estate (investment) market. However, given the international nature of the subject, much of the information collected is also international. An attempt is made to focus on the Netherlands, but a generic outcome is likely.

Regarding blockchain technology and tokenization, the focus in this research is on the link with the real estate sector. The underlying fundamentals of blockchain in terms of programming and the technical side are studied, but within the scope of the study programme. Thus, these data are collected, but to a limited extent included in further results.

1.6 Reading guide

Chapter 2 and 3 comprise the literature research. It discusses in sequence: real estate fund, blockchain and finally tokenization. Blockchain and tokenization is discussed in chapter 3. Of each topic, the basics are discussed first, then relevant aspects are covered and it is finished with a conclusion.

Chapter 4 explains the methodology of the empirical research. It starts with an explanation of the research approach, which is followed by the description of the empirical research, the description of the semi-structured interviews research and this is finally concluded.

Chapter 5 contains the interview results, including the processed and transcribed interview results.

Chapter 6 is about the implementation. In it, the interview results are translated into structured information with further explanation on how tokenization can be implemented in real estate funds. This is followed by a proposed way of implementation. This is followed by the discussion and finally concluded.

The final chapter 7 concludes the research. It answers the sub-questions and hence the main research question, it covers the implications for theory, discusses the limitations and provides recommendations for follow-up research and practice.

2. The real estate fund

This research focuses on how a relatively new application of the blockchain technology; tokenization can be implemented in real estate funds. This chapter is the start of the literature research and includes the first sub-question; ''*What are real estate funds?*''. It examines what real estate funds are and what they entail. The aim is to understand how real estate funds work in order to see how tokenization might eventually be implemented in it.

This chapter firstly discusses the origin and definition of real estate funds, then looks at what a real estate fund does by means of four essential activities, then zooms out on how investment in real estate takes place and what position real estate funds take in this, thereafter looks at different fund structures to make the transition from there to the structures in real estate funds, subsequently it looks at which actors are involved internally and externally, and then at last discusses the main regulations. Note that some information is moved to Appendix I: Additional literature research.

2.1 The basis of real estate funds

History of funds

The very first fund was conceived and established in Amsterdam in 1774 by Abraham van Ketwich. The fund was called 'Eendragt maakt Magt' and offered investors the opportunity to invest in a wide range of (international) bonds. The fund is considered comparable to present day's closed-ended funds (Gemeente Amsterdam Stadsarchief, 2019).

The first open-ended mutual funds date back to 1924, these funds were established by families in Boston, Massachusetts. These initiatives, innovative for their time, were open to investment from outside investors. These funds were not immediately popular at the beginning and were in the minority compared to closed-ended funds (or investment (trust) companies) (Morecroft, 2017).

After the 1929 stock market crash, however, the number of mutual funds grew rapidly as they were considered less subject to abuse and thus a more safe investment. The investment (trust) corporations are even considered to be part of the cause of this crash. This led to the US Revenue Act of 1936, and along with the US Investment Company Act of 1940, mutual funds (or the transition to this) were encouraged (Rutterford, 2009; Morecroft, 2017).

Definition

A fund is defined by Stumpel (2014) as: ''a pooled investment vehicle that collects capital from the investing public and manages this investment from a collective perspective'' (Stumpel, 2014). INREV (2008) explains funds as a structure in which the capital of a minimum of three investors is aggregated and managed as a unified unit with a mutual investment objective. Pozen (2011) adds a remark to this that; ''an investor invests through the fund rather than in the fund'' (Pozen, 2011). They explain that a mutual fund is not an investment in itself, but a (financial) intermediary.

Mutual funds make it possible for both individual investors and institutional investors to pool money to make different investments. A fund is mutual as all returns and expenditures are shared by the investors (Pozen, 2011). Each participant owns a number of units - each of equal value - and depending on the number of units the returns and expenses are shared. The unit value is calculated from the net value of the assets in the fund divided by the number of units outstanding (Ferrari, 2016).

Each fund and its assets are separate from other funds within the issuer or participant. However, a fund may be organised in the form of an umbrella scheme with separate sub-funds focusing on specific asset classes, geographies or with a different management style (Ferrari, 2016).

*A fund is defined as a **financial intermediary** in which capital is collected and invested with a common aim. In the case of real estate funds, investments are obviously made specifically in real estate. It is an **indirect way of investing in real estate** and knows two types of vehicles: listed and non-listed.*

The four essential activities conducted by a fund

Ferrari (2016) identifies the four essential activities that a fund conduct. These activities in general apply to all types of funds; closed-ended, open-ended and unit trusts. Although the latter two may have other specific features.

1. Establishment, organisation and promotion of the fund and administration of the relationship with the participants;
2. Collection of the various financial resources (investments);
3. Custody of the financial instruments, liquidity and keeping track of all movements in a register by a custodial institution;
4. Distribution of the investment units in the fund.

The first activity is that an issuing/executing party will first of all set up and organise the fund. It will then promote it to potential investors and maintain relationships with them. In the second activity, the financial resources of the investors are collected. This may be done by a different party than the one that established the fund (Ferrari, 2016).

The third activity is carried out by a custodian. It stores all financial instruments, liquidity and records all movements. This party carries out the control, acts independently and is separate from the issuing party, which guarantees the operation. The custody institution acts in the interest of the investors (Ferrari, 2016).

As a final activity, a new European Union regulation now allows investment funds to take on distribution activities related to the units. The aim is to improve the distribution network, reduce overall costs for the investor and allow a direct channel, as per regulation (EU) 2019/1156 of the European parliament and of the council of 20 June 2019 on facilitating cross-border distribution of collective investment undertakings (Ferrari, 2016; *pbEU* 2019, L188*)*.

Investing in real estate

Different ways exist to invest in real estate. These are classified into two ways: direct or indirect.

Direct investment

A direct investment in real estate occurs when purchasing all or part of a physical property. This can be for example an apartment, an office building or a factory building. With this ownership come the responsibilities that belong to a property owner. Direct investment requires a (pro) active attitude and may require specific knowledge and experience (Chen, Anderson, & Clarine, 2022).

Indirect investment

Allens Arthur Robinson (2005) explains an indirect investment as; "Indirect investment means a form of investment through the purchase of shares, depositary receipts, bonds, or other securities, or

through a securities investment fund and through other intermediary financial institutions, where the investor does not participate directly in the management of the investment activity". In real estate, this means that a purchase is made of a product that invests in the property on behalf of the purchasing party. Thus, in principle, an investment is made not only in real estate, but also in the management of the real estate and the quality of that management. This means that the investing party is no longer directly involved in his investment and can no longer control and manage it. However, this does enable the investor to achieve higher returns through greater use of variable use of leverage (Stumpel, 2014). For the managing party, there is a fee in return (Pelt, 2015). Indirect investments in real estate are classified into two vehicles: listed vehicles and non-listed vehicles.

Listed vehicles

A listed real estate investment vehicle is traded on a stock market. This makes them accessible to everyone (Stumpel, 2014). The advantages for investors in listed real estate are that they are more liquid, volatile and transparent (Kempen, 2017). The value of the stock is dependent on supply and demand and trading with other investors is called secondary trading (INREV, 2012). These vehicles are also known as REITs (Real Estate Investment Trusts) (Akinsomi, 2016).

Non-listed vehicles

Non-listed real estate investment vehicles are not traded on a stock market. These types of investment vehicles are usually traded within smaller groups and are usually closed to the general public and therefore less well known (Stumpel, 2014). As a result, they also have lower liquidity, volatility and transparency (Kempen, 2017). This also makes the usual investment horizon often longer (5 to 10 years). These products have a high correlation with the real estate market and investors can exert more influence on the management of the investment (compared to listed vehicles).

This form also offers many opportunities to diversify the portfolio, as a wider range of sectors and markets are possible. Moreover, the investments can be done with a similar degree of certainty as other real estate investments (Stumpel, 2014).

2.2 Real estate fund organisation

Real estate pooled vehicle (fund) structures

Stumpel (2014) identifies 4 types of pooled vehicle (fund) structures in real estate: open-ended funds (also known as mutual funds), closed-ended funds and unit investment trusts (UIT) and another form: Unit Trusts (UT). The main difference between these lies in the area of trading, the number and course of shares/units and the trading mechanism.

Open-ended funds

The SEC (n.d.) defines an open-ended fund as a fund that continuously pools money from (many) investors and invests it in (in this case) real estate or real estate-oriented instruments. An open-ended fund is publicly available to anybody wishing to invest in the fund provided that the minimum amount to be invested can be invested (sometimes already available at 25 USD). The investor is able to buy and sell the investment (or a part of it) at any time (on business days) via the issuing company (Bernardt, 2013). Day-to-day trading takes place through them as they cannot purchase shares from other investors on a secondary market (like stock markets or exchanges) and there is no capital limit in this structure (INREV, 2008; SEC, n.d.). For this trading, the trader pays a fee or other costs to the selling company. Open-ended funds are also called mutual funds as the returns and expenses are

shared among the owners/stakeholders and usually these funds have an infinite life span, but they may also be finite.

Pozen (2011) explains an important difference between the closed-ended and open-ended structure is the price setting of the shares. Open-ended funds have an infinite issue of shares, so the number of shares can fluctuate based on capital addition or removal. By investing in an open-ended fund, you buy a stake in a collection of assets. So, the price of a share does not depend on the interaction between supply and demand.

The share price is determined by the value of the assets in the fund minus the debts divided by the number of shares outstanding (which can thus fluctuate). This is therefore calculated by using the Net Asset Value (NAV). And when an X number of shares are purchased, the number of shares will just increase by this X number and will be purchased at the price per share at that particular moment (Pozen, 2011).

The activities of an open-ended fund are outsourced to external parties by the board of directors. The main activity here is in the management company that manages the investments. They are trusted to use their experience for the good of the investors (Pozen, 2011).

Closed-ended funds

Closed-ended funds collect capital by investments and issue shares once at the initial public offering (Pozen, 2011; SEC, n.d.). In a closed-ended fund, the legal status of the formal owner of the fund assets is the investment company and an investor can participate in the fund. The fund closes unlike many open-ended funds and this happens when all available shares are sold (it then has reached the formal capital limit). However, these can still be traded on secondary markets (within the fund), whilst leaving the funds size unchanged. In most cases, closed-ended funds have a finite life span and are non-listed vehicles. This usually results in limited liquidity (of the shares) (INREV, 2012).

The share price is set based on the interaction of supply and demand and for more (called a premium) or less (called a discount) than the NAV. The fund consists of a pool of assets that usually remains unchanged in size, brokered by a party to whom it is outsourced. That also operates for the benefit of the investors just like the open-ended funds (INREV, 2012).

Unit investment trusts (UIT)

Pozen (2011) describes a Unit Investment Trust (UIT) as a portfolio of assets - composed at the outset - that does not change over time at a one-time public offering. The main difference with the previous two structures is that there is no active management by a board of directors. This means that with UITs, no (outsourced) party or person is actively managing the investment/portfolio either.

UITs can be seen as a fixed ‘operation’, with a finite lifespan. The investors can redeem their investment at the NAV-value at that moment in time. They can also sell this investment in an open/secondary market or wait until the end of the UIT's lifetime, at which point the portfolio will be sold (SEC, n.d; Pozen, 2011).

Regarding the trading of shares, UITs can be seen as hybrid versions of open-ended and closed-ended. As a limited number of shares are issued at incorporation, but investors can redeem their shares at any time with the issuer (SEC, n.d; Pozen, 2011).

Furthermore, Pozen (2011) states that UITs are interesting for investors because the portfolio is transparent, as nothing is traded, so it is clear what the ownership is. This makes UITs very cost-efficient because the intermediary costs are very low.

There is also a last - distinct - form of funds: Unit Trusts.

Unit Trusts (UT)

There are also Unit Trusts (UT), this form of pooled investment is often somewhat confusing. This is partly because it is often confused with the aforementioned; Unit Investment Trusts (UIT) but also, the meaning of this form differs per country/region. In some countries, unit trusts are the same as mutual funds (Kagan, Cheng, & Bellucco-Chatham, 2020). A detailed explanation of this form in relation to real estate will be provided in the section; Pooled property vehicles.

Kagan, Cheng, & Bellucco-Chatham (2020) define a Unit Trust as an actively managed unincorporated (no legal personality) mutual investment fund structure in which funds hold assets and distribute profits directly to the individual unit owners instead of investing them back into the fund. The difference between mutual funds and this form is that it is established under a trust deed. A trust deed means that one party (borrower) has a loan outstanding with another party (lender), - which is paid off - and the property is held in trust by a neutral and independent third party until the loan is paid off (Segal, Anderson, & Jackson, 2021). Also, in this form, the investor is the beneficiary of the fund.

Initially, open-ended/mutual funds and unit trusts were the same despite the difference in legal structure. Open-ended funds are separate corporations. Unit trusts are more similar to charities. The structure consists of several units, in which the holders have the rights to the trust assets. These units are created when investments are made and closed when someone sells. So, the price per unit is not determined by supply and demand. This results in a complex mechanism of distribution of units. This in turn can lead to bank run behaviour when there is a lot of capital inflow and outflow. Consequently, UTs have two different degrees of authorisation: authorised and unauthorised unit trusts (Stumpel, 2014).

Authorised UTs are generally structured as open-ended funds, as explained in the previous section. And they are managed by professional asset managers. Unauthorised UT structures serve to benefit (almost) only tax-exempt investors. They may not be traded to the general public, but only to institutional investors or local authorities. For them, it bears the benefits of funds without losing tax-exempt status. Some structures are authorised for sale to specific categories of wealthy individuals or professional investors (Lindberg, 2002).

In this form, characteristics of different structures are mixed, such as that the number of shares is variable (as in open-ended), but the trading and distribution mechanism is closed (as in closed ended) (Lindberg, 2002). To conclude, this form has a slightly different approach than the aforementioned and the legal set-up differs per country/region.

Table 1 below compares some of the important characteristics of the four different fund structures. There may be differences in practice among funds that are classified under a particular structure. The table shows the most common characteristics.

Table 1: Fund structure characteristics, based on Stumpel (2014) and SEC (n.d.)

Characteristics	Open-ended	Closed-ended	UIT (Unit Investment trusts)	Unit trusts (UT)
Number of shares	Unlimited	Fixed	Fixed	Unlimited
Trading	Daily at NAV	Secondary market	Hybrid	Daily at NAV or secondary market
Redeemable	Yes	No	Yes	Yes
Management	Active	Active	None	Active
Board of directors	Yes	Yes	None	Board of trustees
Life span	Infinite	Finite	Finite	Infinite

Pooled property vehicles

For smaller investors for whom it is not possible to put together portfolios of various (single) properties or to work with managers who do it for them, smaller investors can invest in real estate by investing indirectly. They can do this by investing in shares (mainly listed vehicles) or by participating in pooled property vehicles (PPVs) (Baum & Fear, 2001).

Pooled property vehicles really emerged in the early 90s. The main focus here is on Limited Partnerships (LPs) and to a reduced degree on property unit trusts (PUTs). These are explained below. The management of a PPV consists of consultants, fund managers and real estate companies (Baum & Fear, 2001).

Appendix I: Additional literature research elaborates further on how these types of pooled property vehicles can be organised.

Limited partnerships (LP)

A limited partnership allows several investors to jointly invest in one or several real estate properties. The number of partners is (in most cases) limited to 20 and at least one - the general partner (GP) - must have unlimited liability, while the others have limited liability (up to the amount invested). This makes the investment passive for the partners and the vehicle tax transparent (Baum & Fear, 2001). This vehicle is the same as the Dutch; *Commanditaire vennootschap (CV)* (Stumpel, 2014; Bie, 2019). This form belongs to the group of private indirect real estate, i.e. non-listed funds (Gastel, 2010).

The purpose of this form is to achieve a return with a number of participants (limited partners) by investing together in a property portfolio. The vehicle is not a legal entity, so it cannot have any assets in its name. Therefore, a custodian - often a foundation - is appointed that is the legal owner of the property (Bie, 2019). There are two types of partners in LPs: the general partner - who manages the fund and the real estate - and the participating limited partner. If a latter wants to have influence in the management, his status changes and it becomes jointly and severally liable (Gastel, 2010).

Usually, this vehicle has a final life span – typically 6 to 10 years - which is decided in the origin of the partnership. It states that at the end, the portfolio is sold, although it can be extended by agreement between the partners (Gastel, 2010).

Baum & Fear (2001) identify a common management structure for LPs as follows (although it may be more complex in practice). The initiator of the concept establishes the general partner and the GP will act as the lead investor. This may be a special purpose vehicle owned by one or more lead investors. It appoints the operator responsible for certain administrative functions (Baum & Fear, 2001).

In order to obtain the monetary funds, the GP may appoint a promoter. Capital will be contributed by the limited partners and they may develop an advisory board. However, if they actively interfere in the management or in making choices, their limited liability disappears. Investment or asset managers will also be appointed by the GP. That may also involve a property manager (Bie, 2019; Baum & Fear, 2001). A more in-depth explanation of how this is set up, can be found in the section; The set-up and organisation of a real estate fund in Appendix I.

Property Unit Trusts (PUT)

A property unit trust (PUT) is very similar to the previously discussed unit trust (UT). The unit holders are beneficiaries of the trust deed with which they are entitled to potential income. Another important difference between the two is that PUTs do not have a maximum number of participants. A similarity here is that the trustees (managers) act in the interests of the beneficiaries (investors), the difference being essentially the name (Baum & Fear, 2001; Stumpel, 2014; Bie, 2019)

In addition to the previously discussed characteristics, PUTs can be differentiated in five areas: authorised or unauthorised, open-ended or closed-ended, exempt or non-exempt, balanced or specialist and onshore or offshore (Baum & Fear, 2001). These forms are discussed herein, are from the perspective of the United Kingdom. This means that the tax structures may be different for other countries/regions.

Authorised or unauthorised

The main difference between these two forms is the focus group. Authorised PUTs are offered to retail investors, whereas the more usual unauthorised PUTs are offered to institutional investors. For the latter, they may be fully exempt from capital gains tax. This applies to certain parties, and these are often pension funds, charities and suchlike. And investors in these unauthorised PUTs are often professional investors. Further differences between these forms are in the area of taxation (Baum & Fear, 2001). But this will not be discussed in detail here as it is not relevant to this study.

Open-ended or closed-ended

Usually PUTs are open-ended, as also described above. This allows investors to participate by obtaining units. Here the issuer can issue, buy or sell units to/from investors. The manager/publisher offer units that are issued or sold at an 'offer' price, and vice versa they give a 'bid' price at which they buy back. The difference - the spread between bid and offer prices - may reasonably correspond to the trading expenses for the acquisition and sale of a property (Baum & Fear, 2001).

The fund originally consists of the total amount collected by the investors, with which the professional fund manager makes the investments for the best interest of the investors. The units can then be traded with the manager as well as on the secondary market (Baum & Fear, 2001).

Exempt or non-exempt

This refers to the exemption or non-taxation within the vehicle. For example, non-exempt unit trusts are open to all investors (both retail and institutional) and are subject to certain restrictions. The exempt unit trusts are treated as the authorised ones discussed earlier (Baum & Fear, 2001).

Balanced or specialist

The difference between balanced and specialist PUTs lies in diversification. Segal, Anderson, & Jackson (2021) define diversification as: ''Diversification is a risk management strategy that mixes a wide variety of investments within a portfolio'' (Segal, Anderson, & Jackson, 2021). Balanced PUTs have a large variety of objects by type and location. Whereas specialist PUTs are focused on a particular type of property or locations. Also, they are often focused on offshore areas, for an unclear reason (Baum & Fear, 2001).

Onshore or offshore

This refers to the domestic or foreign location of (the real estate objects within) the fund. The difference between the two is the tax regulations. This in turn differs between the investor's perspective/location. In general, offshore vehicles are less regulated and more flexible. Furthermore, they are (depending on the location of the investor) in most cases tax transparent (Baum & Fear, 2001).

The table 2 below summarises the differences between Limited Partnerships and Property Unit Trusts.

Table 2: Differences between Limited Partnerships and Property Unit Trusts, based on Stumpel (2014)

Characteristics	Limited Partnerships (LPs)	Property Unit Trusts (PUTs)
Liability	Unlimited	Unlimited
Legal entity	Letter of Intent (LOI)	Trust deed
Number of participants	Maximum of 20	Unlimited
Governance	General partner	Board of trustees
Lifespan	Finite (usually)	Diverse

*Real estate funds have **four types of pooled vehicle structures**: open-ended funds, closed-ended funds, unit investment trusts and unit trusts. In addition to these structures, an investor can opt for a **pooled property vehicle**. The most common and well-known form is limited partnerships, but property unit trusts are also possible. Both the structures and types have **certain characteristics**.*

The actors and parties involved in a real estate fund

This section deals with the different actors concerning real estate funds. These are, on the one hand, the actors who are directly involved in the fund (internal) and, on the other hand, the actors who are indirectly or auxiliary involved (external). In practice, other actors may be involved, but the ones mentioned are the most prominent.

Intern

Investors

The investor, naturally, is the one who invests in the real estate fund. The investor can invest in the fund only to allocate resources to achieve a certain desired return, or he can also take the initiative to create the fund. The investor eventually receives returns (dividends) and capital growth if the fund manages to achieve profits on its investments. These investors can be private investors or institutional investors. The latter are typically pension funds, insurance companies, banks, large corporates and the like (Pelt, 2015; Gijselaars, 2010; Stumpel, 2014).

It follows from INREV (2022) that the costs associated with investing in (non-listed) funds are currently the biggest challenge to investing in a fund. What these costs entail can be very diverse, but they fall within the scope of investing in the real estate fund. Access to expert management appears to be the main reason for investing in a fund since the beginning of INREV's survey in 2012 (INREV, 2012; INREV, 2022).

Non-executive officers

Investors often do not have much opportunity to influence fund, i.e., the choices and day-to-day performance. As a result, investors would like to somehow achieve this in the fund before investing in it. When the fund is set up, it is determined how this will be organised. This could possibly be the GP or board of trustees, but also so-called; ‘’non-executive officers’’.

INREV (2016) describe their role as: ‘’non-executive directors and investor representatives are accountable to investors in their role as monitors of the performance and compliance of the vehicle’’ (INREV, 2016). Which they do through participating in a non-executive board or a commission. It varies greatly which activities are delegated and what their role is. For example, fulfilling a role as a consultant regarding the investment(s) (Stumpel, 2014).

Fund management (fund manager, investment manager, asset manager & property manager)

In previous sections, several types of managers have already been mentioned, which in the literature tend to fall under the category of fund manager. However, these also include other tasks such as investment manager, asset manager and property manager. The role and/or tasks of the type of manager may differ in practice depending on the type/design of fund structure. The named practices are the most common and are explained in Appendix I: Additional literature research.

The aim of the real estate fund management is to add value to the fund by applying the right strategy at the real estate object level. This management should consist of experts on either a regional market or on a specific type of property (Alstede, 2014).

Fiduciary management

Fiduciary management is mainly used by larger, i.e., institutional, investors. Often, a fiduciary management is a large stand-alone company or part thereof. Their role is to provide expertise in directing and managing the fund, similar to the fund manager. Thus, it is up to them to ensure that those overseeing the managers and consultant have the right expertise to do so, in addition to being in line with the fund's objectives and funds (Nunen, 2011; Stumpel, 2014).

Extern

Regulators (AFM/DNB)

The regulator in the Netherlands is the Authority Financial Markets in English or *Autoriteit Financiële Markten (AFM)* in dutch. The AFM is an independent administrative body with statutory tasks and powers. The AFM supervises the financial markets: savings, investment, insurance, lending, pensions, capital markets, asset management, accountancy and reporting. Their aim is that the markets operate in a clear and fair manner to ensure that the public, the corporate sector and the government have confidence in the financial markets. The task of the AFM is to grant the licences and to carry out ongoing supervision. The DNB *(De Nederlandsche Bank)* supervises compliance with the prudential rules, e.g., minimum capital and leverage (AFM, n.d.; AFM, n.d.). Further explanations are in the section 2.1.3 Main regulations in real estate funds.

Depositary

The task of the depositary is to preserve the assets (real estate objects in the case of a real estate fund) of an investment institution and to perform various supervisory tasks on behalf of the investors. In addition, the depositary also has monitoring tasks, such as checking the distribution of participants, money flows and more (DNB, n.d.).

Accountant

The auditor is responsible for auditing the fund's annual report. The duties of the auditor may overlap with those of the depositary (Pelt, 2015).

Consultants

Further consultants are involved in real estate funds. These include property consultants, external valuers, legal consultants and others (Baum & Fear, 2001; Pelt, 2015)

2.3 Main regulations in real estate funds

This section deals with the main regulations of real estate funds. It provides insight into what real estate funds must comply with within the regulations in the Netherlands and the overlap within the European Union. This is important for the implementation of tokenization in real estate funds.

The regulations described below are the most important regulations applicable to real estate funds and discusses them in outline. Within the framework of this thesis, the various aspects will not be discussed in depth, as this is not directly relevant and where necessary reference can be made later onto various aspects.

According to Bruggeman (2013), fund managers have a lot of freedom within the various laws and regulations within the country in which the fund is registered, which has led to major differences in

structure. The regulations described here relate specifically to Dutch funds. Because these mainly follow from the AIFMD (Alternative Investment Fund Managers Directive) and are harmonised within the European Union, these may overlap with other EU Members.

Investment institutions

The DNB (n.d.) defines investment institutions (investment companies or investment funds) as an initiative that offers the possibility to participate in an asset for collective investment in order to let the participants share in the returns of the investments. European law distinguishes two types of collective investment undertakings:

- Undertakings for collective investment in transferable securities (UCITS *or ICBE in Dutch*); or
- Undertakings for collective investment that do not qualify as UCITS (alternative investment funds or AIFs).

Within the Financial Supervision Act (Wft) (*Wet op het financieel toezicht in Dutch*), two separate regimes for the managers of the different investment vehicles are distinguished (AFM, n.d.):

- A regime for (managers of) undertakings for collective investment in transferable securities (UCITS) based on the UCITS directives; or
- A regime based on the AIFM Directive for managers of alternative investment institutions (i.e., collective investment institutions that do not qualify as UCITS).

In both investment regulations, the AFM is the licensing authority and the DNB advises the AFM on whether the investment institutions comply with the prudential requirements in the Wft (DNB, 2013). It follows from Exporo (n.d.) that all real estate funds, both open-ended and closed-ended, are subject to the AIFMD directives.

AIFMD

The AIFMD (Alternative Investment Fund Managers Directive) is a European directive introduced in 2013 that includes harmonised rules that alternative investment fund managers must comply with. The Directive applies to all managers of (one or more) alternative investment funds or also known as collective investment schemes that are not undertakings for collective investment in transferable securities. Among others, real estate funds fall under this AIFMD supervision (AFM, n.d.). This follows from Directive 2011/61/EU of the European Parliament and of the Council of 8 June 2011 on Alternative Investment Fund Managers (*PbEU* 2011, L174).

The Directive states that a manager may not manage an alternative investment institution or offer units in it to investors without a licence. And a great number of requirements are set for the granting of a licence; these requirements are, for example, in minimum capital, reliability and suitability of the policymakers, manner of conducting business and more. In addition, there are also ongoing requirements for the management, e.g., the periodic ESMA reports in accordance with the AIFMD and the MMF reports (AFM, n.d.). Because this standardisation is EU-wide, it becomes easier for funds to trade internationally (i.e., within the European Union and institutions in certain countries, currently only Jersey, Guernsey and the USA meet the associated requirements). This is possible because once a fund is authorised in one of the member states, it can be offered anywhere in the EU (Exporo, n.d.).

Licensing and registration requirements in the AIFMD regime

In principle, the AIFMD applies to all alternative investment fund managers. The regime to which the alternative investment institution falls depends on the total volume of assets managed by the manager and the type of investor (professional or non-professional). There are 3 regimes within the AIFMD (AFM, n.d.; AFM, 2021):

1. The full authorisation regime; and
2. The registration regime (AIFMD-light); and
3. The retail regime.

Legislation and regulations AIFMD

For the investment institutions within the AIFMD, there are 3 levels of relevant regulations that apply within just the Netherlands or the entire European Union (AFM, n.d.). The first level is on directive an implementation which includes laws and regulations for both Dutch and EU countries. The second is on implementation measures which include four regulations that apply to investment institutions within the EU or seeking to register within the AIFMD (for non-EU Member States). And the third and last level is on three guidelines of the ESMA (European Securities and Markets Authority) (AFM, n.d.)

Further important laws and regulations within the AIFMD are: SFDR (Sustainable Finance Disclosure Regulation), Wwft (Money Laundering and Terrorist Financing (Prevention) Act and the Sw (sanction Law). And recently it has become compulsory to complete a questionnaire on money laundering and terrorist financing prevention and the sanction act for managers of investment institutions (AFM, n.d.).

In addition, there are 10 other national legal and administrative provisions for the purposes of trading requirements and other legal provisions applicable to the alternative investment funds (AFM, 2021). Further details on the aforementioned legislation and regulations of the AIFMD are explained in Appendix I: Additional literature research.

KiFiD

Under the Financial Supervision Act (Wft), financial service providers (i.e., fund managers) are obliged to join a complaints institute recognised by the Minister, which is the Kifid (Financial Services Complaints Institute *or Klachteninstituut Financiële Dienstverlening in Dutch*). The fund manager can join the Kifid if it has a licence from the AFM. A choice can be made whether it wants to be affiliated with the Kifid in a binding or non-binding manner. This makes a distinction as to whether both the consumer and the entrepreneur must abide by a judgment made by the Kifid (Kifid, n.d.; Kifid, n.d.).

From this it can be concluded that for real estate funds in the Netherlands (and within the European Union) it is mainly important to act within the guidelines of the AIFM. Important elements are the license, reporting to the national financial market authorities, reporting and compliance with further laws and regulations. Furthermore, the fund managers can join the Kifid.

2.4 Conclusion

This chapter has investigated an answer to the sub-question: ''What are real estate funds?''. It aims to understand how real estate funds work, in order to gain insight into how this can work together with tokenization, and literature research was carried out for this purpose.

In essence, the answer to this question is that a real estate fund is a (financial) intermediary through which it, as a pooled investment vehicle, raises capital and invests and manages it with a common

investment objective. Here, the revenues and expenses are shared equitably among the outstanding holdings.

This type of real estate investment is classified as indirect investment, which includes listed and non-listed vehicles. Besides that, funds have four types of structures: open-ended, closed-ended, unit investment trusts (UIT) and unit trusts (UT). Real estate funds have two main types of vehicles, limited partnerships (LP) and, to a lesser extent, property unit trusts (PUT), which in turn have their own differentiations.

The main activities that take place over the lifetime of a real estate fund (although these may vary per form of the fund) are: fund establishment, collection of financial resources, custody, distribution of investment units, management and secondary market trading.

It appears that the set-up of limited partnerships and property unit trusts are very similar, with the main difference that the latter can pool an unlimited number of investors. These are often set up as a separate organisation by an umbrella organisation, which also often lends its name to the venture.

The (main) actors within real estate funds can be divided into two categories: internal (directly involved) and external (auxiliary involved). Further regulations for real estate funds are mainly issued by the regulators: DNB and AFM. All forms of real estate funds fall under the AIFMD directive.

As for the aspects identified from this chapter, they are merged with the aspects from the literature research on blockchain and tokenization from the next chapter to come up with interview questions in the empirical research. The aspects of real estate funds identified in this chapter are: the five main activities, real estate fund type, property fund structure and pooled property vehicles.

In the next chapter, the literature research will continue. The studied topics are: blockchain and tokenization. In which blockchain is the technology underlying tokenization. Simultaneously, tokenization is an application of blockchain technology.

3.0 Blockchain technology and tokenization

3.1 Blockchain technology

The previous chapter discussed one of the three main topics that this research revolves around: real estate funds. This clarified what real estate funds entail and how these operate. Now, the shift can be made to the technological part of this literature research.

This chapter focuses on the other topics: blockchain technology and tokenization. This paragraph is centred on blockchain technology. It examines the sub-question: ''What is blockchain technology?''. The technology underpins tokenization and performs the primary role in its functioning.

It attempts to explain - in a chronologically comprehensible manner - what blockchain is, how it works, what its usefulness is and what it entails and what the state of affairs is in real estate. For this purpose it first discusses what the technology is and subsequently the key elements in it, then the blockchain types and what distinctions can be made, next various consensus mechanisms are discussed, then what smart contracts entail is explained, this is followed by how the technology works now that many terms are explained, and finally it is shortly discussed what the technology encompasses in real estate. Note that some information is moved to Appendix I: Additional literature research.

3.1.1 The basis of blockchain technology

What is blockchain technology

The introduction of this thesis has already mentioned where blockchain comes from. Briefly, it follows from the first patent from 1976 for a system that incorporated the basic idea of a message security exchange that forms a chain of the previous blocks (Kulkarni, 2019) and the Bitcoin white paper from 2008 (Nakamoto, 2008). The author of the Bitcoin white paper, Nakamoto, proposed a decentralised peer-to-peer (P2P) network called Blockchain. Hileman and Rauchs (2017) describe blockchain as a type of database that is replicated over a P2P network, which - as there are also other types of distributed databases without central database managers - is different. In this regard, blockchain is a technology based on distributed ledger technology (a shared database). The functioning of a distributed system compared to a centralised or decentralised can be seen in figure 2.

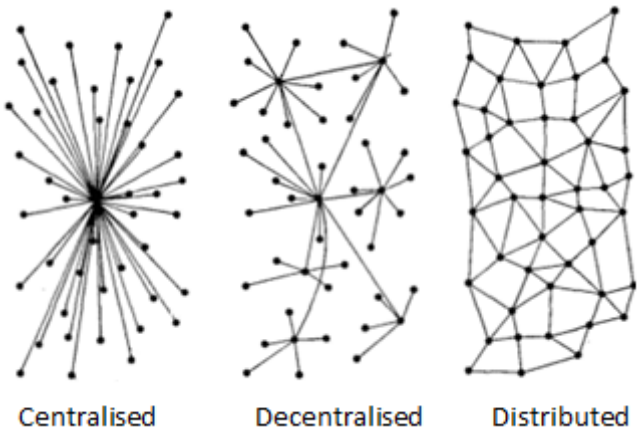

Figure 2: Comparison centralised, decentralised and distributed (Baran, 1964)

Simply put, it is a protocol in which value information is digitised and mutually approved by all participants (P2P). It can guarantee the authenticity of transactions (exchanges) preventing double payments, enable transparent transactions and ensuring traceability making counterfeiting (almost)

impossible and provide stable protection for the ecosystem against possible attacks by malicious users, allowing it to function without a central authority (NRI, 2016). The blockchain shared database works by capturing and combining transactions in a decentralised, secure ledger system that creates a chain of chronological data over which no single party has the control. Its value lies in tracking and authenticating transactions in real-time without the required intervention of a third party (JLL, 2018). The decentralisation aspect may differ between approach, as will be explained later.

As mentioned, blockchain has become known mainly since the emergence of Bitcoin. Bitcoin is a digital currency that works through a peer-to-peer network using a cryptographic protocol whose underlying technology is blockchain. It uses a blockchain as a transaction repository to record all bitcoin transactions from one party to another (P2P), thus allowing it to operate independently of a third party (a financial institution) and is shared among all participants of its network (Nakamoto, 2008). However, the potential of this technology goes beyond this digital currency according to Swan (2015). The principle of blockchain - and what makes it different from other distributed ledger technologies (DLTs) - is that it is designed to achieve a consistent and reliable agreement on who owns what over a course of events between different participants who may have different motives and goals. To put it simply: the participants in a blockchain network reach agreement on the state of the shared database (i.e., the changes made to it by the transactions) by means of a consensus mechanism that establishes that each participant's view of the shared database is the same as that of all the other participants. Thus, as explained, there is no need to trust the integrity of other network participants or administrators. The consensus mechanism in combination with the specific data structure also eliminates the 'double-spending' problem (transferring the same digital file several times) in a blockchain (Hileman & Rauchs, 2017; Zheng, Xie, Dai, Chen, & Wang, 2017; Wouda & Opdenakker, 2019).

Since the emergence and prominence of blockchain, many developments have already taken place. Swan (2015) identifies three generations: blockchain 1.0, 2.0 and 3.0. Blockchain 1.0 revolves around the currency, the deployment of different cryptocurrencies in use, such as their transfer, digital payment systems and transfers. 2.0 is about contracts, all economic, market and financial applications that go beyond simple cash transactions. Such as stocks, bonds, mortgages, loans, titles and smart contracts. The last generation: 3.0 are blockchain applications that go beyond currency, market, financial or markets, but in the areas of government, health(care), science, culture and more. At the time of writing, there is no new scientific or institutional literature on new generations succeeding these three.

In brief, Blockchain can be defined as a system in which ***information is digitised and approved by all participants in the network****. This is stored in a* ***decentralised secure ledger system*** *over which no one has control. A chain of information is created that is linked and thus cannot be changed because the chain would not be correct and consequently would not be approved by the participants. This creates a system that is transparent, can guarantee the authenticity of transactions and ensures traceability. This allows it to operate* ***without the intervention of a third party****.*

Key elements

Hileman and Rauchs (2017), Tasca & Thanabalasingham (2017) and Tapscott & Tapscott (2018) identify five key elements a blockchain (generally) has: cryptography, peer-to-peer network, consensus mechanism, ledger and validity rules. The elements belong to the perspective of the bitcoin blockchain.

Cryptography: Cryptography makes it possible, without the intervention of an intermediary and in an open distributed system, to securely identify the owner and his property and to ensure that only that owner has access to his property. Blockchain uses asymmetric cryptography and is a method of encrypting and decrypting data by means of a mathematical algorithm. In blockchain technology cryptography is used in several ways, e.g., by hash functions, public- and private encryption keys and digital signatures (van Tilborg & Jajodia, 2011; Drescher, 2017). This is further explained in the subsection: Asymmetric cryptography.

Peer-to-peer (P2P) network: A secured network without the involvement of a third party to ensure the trust. The power is distributed over the network without a (central) point of control (i.e., a centralized party owning the server and with the authority) (Nakamoto, 2008; Hileman & Rauchs, 2017).

Consensus mechanism: According to Zhang (2020), a good consensus mechanism plays an important role in the stable operation of the blockchain. It is used to solve the consistency problem (distrust between the networks in a decentralised network) of distributed systems. The consensus mechanism is protected by the consensus algorithm, by negotiating through the protocols to reach a consensus and consequently reach consistency. Hileman and Rauchs (2017) describe it as: ‘’an algorithm that determines the ordering of transactions in a hostile environment’’ (i.e., assuming not every participant is honest) (Hileman & Rauchs, 2017). Thus, it allows the system to function properly without the need of any intermediaries. Forms of these consensus mechanisms include: proof-of-work (PoW), proof-of-stake (PoS) and proof-of-authority (PoA). This is further explained in the subsection; Consensus mechanisms.

Ledger: Similar to what was explained earlier, Peters & Panayi (2016) explain a blockchain in its crudest form as a ledger that is a ‘’database in which transactions are recorded chronologically by a network of computers’’ (Peters & Panayi, 2016). The ledger consists of a record of all data transactions that have ever taken place and continues to grow as more and more transactions are added chronologically. This ledger thus consists of a list of transactions as cryptographically linked "blocks", with a ‘chain’ of these blocks consisting of the accepted history of the transactions (using a cryptographic signature called a "hash" - which will be explained in the subsection; Hashing, hence the term: ‘blockchain’. A blockchain database is distributed over all the participants (nodes) in the network and is permanently maintained, with all nodes having validated the data, thus ensuring transparency and trust in the network (Peters & Panayi, 2016).

Validity rules: These are the common set of rules established upon (the participants in) the network. These rules can include what consensus mechanism is used, in what way the ledger gets updated, what transactions are considered valid, etcetera. The validity or validation rules are related to the (operationalization) of the consensus mechanism (Hileman & Rauchs, 2017).

Blockchain types

There may be differences in the structure of a blockchain. This section follows from Peters & Panayi (2016), Hileman & Rauchs (2017) & Wust & Gervais (2018). First of all, there are three main types of permissions that can be set when configuring a blockchain network; read, write and/or commit:

- *Read*: who has access to the ledger and who can see the transactions;
- *Write*: who can make transactions and share them with the network; and
- *Commit*: who can update the state of the ledger.

The types of blockchains can be characterized as permissionless, permissioned or both. The distinction between permissionless or permissioned blockchain is as follows:

- *Permissionless*: a blockchain where anyone can participate as a reader, writer and committer. There is no authorization who manages the membership. This means that any peer can at least read the content;
- *Permissioned*: a blockchain where only a limited group of readers and writers are authorised. A central authority decides which peers and assigns rights to peers; or
- *Both: the* blockchain contains properties of both permissionless and permissioned to a certain extent as set by the developer.

Furthermore, there are four types of blockchain structures:

- *Public*: the blockchain is readable and available for anyone to submit transactions;
- *Private*: the permission (read, write and commit) is restricted to a single entity;
- *Consortium:* similar to private, but the blockchain is controlled by a group rather than a single entity; and
- *Hybrid:* These blockchains are controlled by a single entity but have processes or a certain level of oversight in which validations are done that are performed by the public blockchain.

In figure 3 below, the blockchain types are shown by permission type and structure.

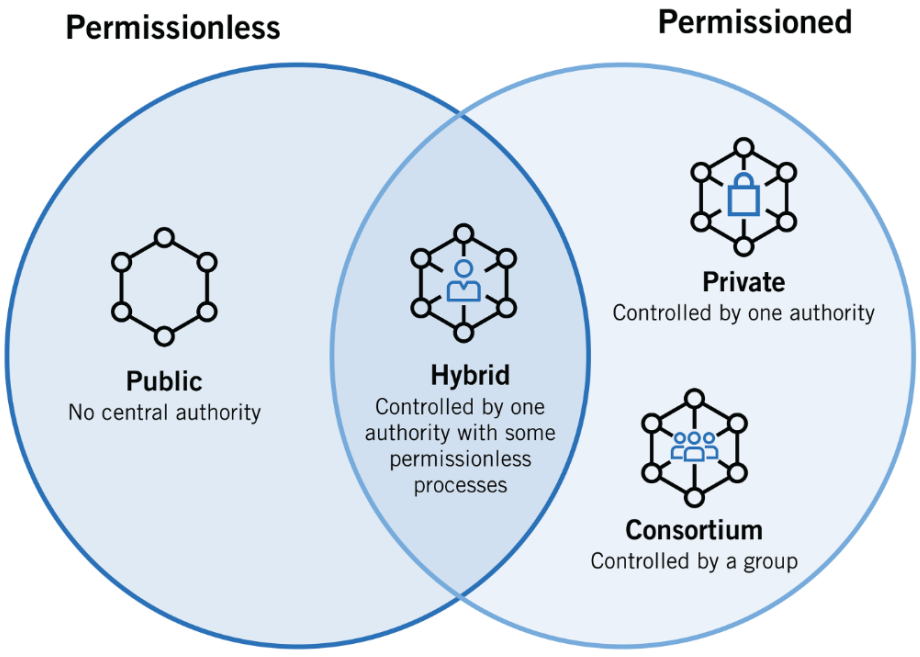

Figure 3: Types of blockchains on permission and structure (Wang, 2021)

Consensus mechanisms

Bains (2022) identified several consensus mechanisms distinguished among public and private blockchains in a large and growing variety of consensus mechanisms. So, note that there are more than mentioned here and more are created at the time of writing. In public blockchains the most common identified consensus mechanisms are: Proof-of-Work (PoW), Proof-of-Stake (PoS) and Delegated Proof-of-Stake (DPoS).

These mechanisms work well in networks in which the participants do not or cannot rely on each other, i.e., public or permissionless networks. For private blockchains Bains (2022) identified four consensus mechanisms: Practical and Istanbul Byzantine Fault Tolerance (pBFT/iBFT), Federated Byzantine Fault Tolerance (fBFT), DiemBFT and Proof-of-Elapsed-Time (PoET) (Bains, 2022). The complete explanation of these consensus mechanisms can be found in Appendix I: Additional literature research. Another important aspect of blockchains are smart contracts, this is explained in the next subsection.

Smart contracts

Smart contracts are simply computer programmes which can automatically execute something, such as a payment. This execution takes place when it is triggered by a certain event, which responds to pre-set parameters/conditions of this event. It thus makes it possible to automate a large number of (business) processes between different entities. An example of this is that a payment is made when the ownership of an asset is transferred from the original owner to the new owner (Peters & Panayi, 2016; Hileman & Rauchs, 2017).

When these smart contracts are applied to a blockchain, the added value is that they are guaranteed by system rules and that the outcome is verifiable and controllable by all participants in the network (Hileman & Rauchs, 2017). And given that contract partners cannot always rely on or trust each other, it makes it possible to execute without the trust of a third party if they would like to work without a third party, because the parties can rely on an (established) protocol (Hileman & Rauchs, 2017).

In real estate, smart contracts can reduce risk and speed up processes according to Mohanta, Panda & Jena (2018). The principle allows documents to be verified, validated and signed digitally and automatically, manual actions can disappear and processes can proceed according to predefined conditions (Mohanta, Panda, & Jena, 2018).

Blockchain types*: the difference in these types is mainly characterised by the degree of permission. This means to what extent the blockchain is structured as central, decentral or a hybrid of these.*

Consensus mechanism*: the consensus mechanism ensures that the participants in a blockchain reach agreement on the state of the shared database. This means that for consensus to be achieved, this state must be the same with everyone.*

Smart contract*: smart contracts allow processes to be automated based on predefined parameters. When these parameters are triggered by a certain event, the process is initiated.*

3.1.2 How blockchain technology works

In order to get a more comprehensive picture of how the technology works, four facets (technologies and processes) that take place on the blockchain are explained in a concise and understandable way explained in this section. These are: hashing, asymmetric cryptography, digital signature and signature verification and transacting on the blockchain.

Hashing

With hashing, it is possible in a distributed peer-to-peer system with a lot of transactional data to identify each unique data by its digital 'fingerprint' in a quick and easy way. This works by means of 'hash functions', a complicated algorithm. The hash function translates an input - every possible form of data with all possible lengths - into a series of fixed-length alphanumeric characters. The output of this is called the 'hash value', which in turn is based on the given input (NRI, 2016; Drescher, 2017).

Each hash function will provide the same output for the same input, for example, the input; ''Hello!'' provides the following unique sequence of characters: '334D016F755CD6DC58C53A86E183882F8EC14F52FB05345887C8A5EDD42C87B7' with the hash function; Secure Hash Algortihm-256 (SHA-256). Hence, a change to the input will always produce a different output with the same hash function. Also, the input cannot be traced back from the output, as it works as a one-way function. It is therefore impossible to retrieve the original data based on the hash value (NRI, 2016; Drescher, 2017). This process is illustrated in figure 4.

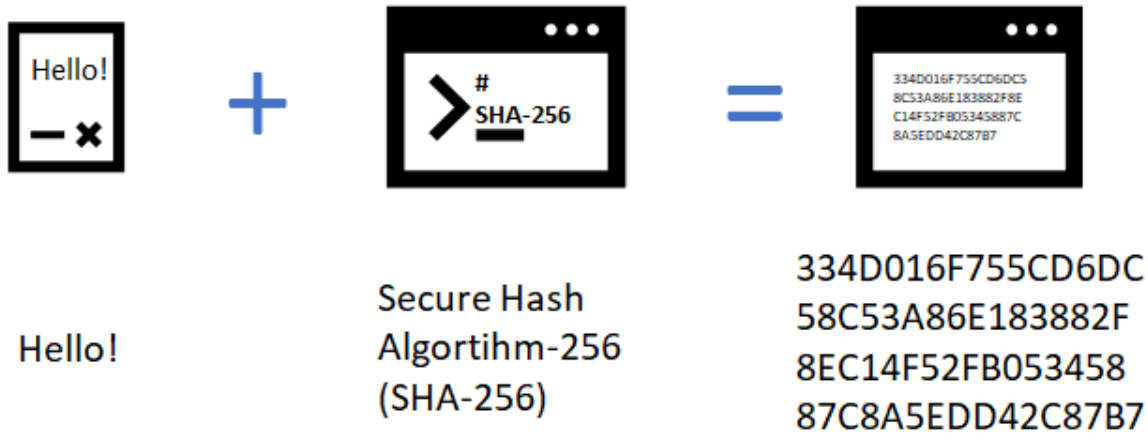

Figure 4: Hashing process (own illustration)

In the blockchain, the blocks are connected sequentially using hashes. If block 'I' is hashed, then this hash is placed in the header of the next block; block 'i+1'. This makes it impossible to modify or delete data in a previous block, because no consensus can be reached in the validation as the data does not correspond to the next block(s) (Spielman, 2016; Drescher, 2017). In a simplified manner this is displayed in figure 5.

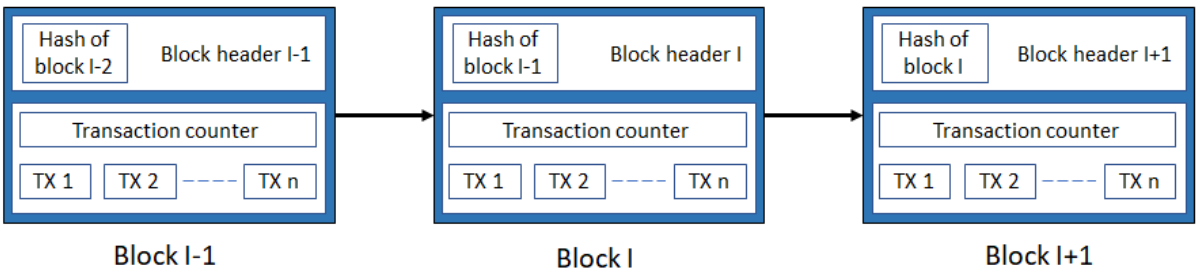

Figure 5: Simplified example of blockchain which consists of a continuous, own illustration based on Zheng Z. , Xie, Dai, Chen, & Wang (2018)

Asymmetric cryptography

Following on from the earlier explanation of cryptography, this section looks at how this works. In blockchain asymmetric cryptography is used for identification and signing. This technology is a continuation of symmetric cryptography in which users send an encrypted message that can be decrypted with a key. The problem here is that if someone else gets hold of this key, the information will be available to them (NRI, 2016).

Asymmetric cryptography solves this problem by giving each participant two keys: a public and a private key. The public key is accessible to everyone and is generated from the private key. The private

key should be kept to a person (the owner) and is used to access data that is only for that person or to execute certain operations. It should therefore be kept securely. The pair of keys are related and can only be used together (Rivest, Shamir, & Adleman, 1978; NRI, 2016; Drescher, 2017). To give a similar example: the debit or credit card that many people use. Here, the account number may be known to anyone, but the PIN-code must only be known to the user.

In practice, this works as follows: a sender sends a message to the recipient. The sender sends it to the public key of the receiver, thus encrypting the sent document. Only the recipient can now read this message, because with the private key it can be decrypted (Rivest, Shamir, & Adleman, 1978; NRI, 2016; Drescher, 2017; Seuren, 2018). An explanation of this and the difference between symmetric and asymmetric cryptography is shown in figure 6 below.

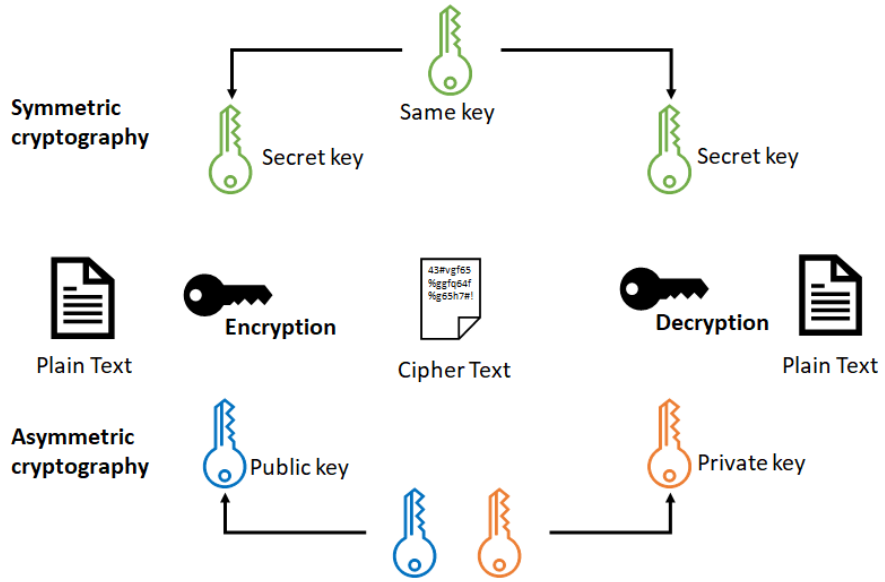

Figure 6: Explanation of symmetric and asymmetric cryptography, own illustration based on Jallouli (2017)

Digital signature and signature verification

Digital signatures are used to authorise transactions on the blockchain. This ensures that only the lawful owner can transfer his property to others. In the technique of digital signatures, keys (private and public) and hash functions are combined. Simplified, the process involves hashing what is shared (for example, a document) and then encrypting it with the private key. The receiver can then verify it with the public key (NRI, 2016; Drescher, 2017).

It serves the purpose of identifying the account, recording which specific data the owner corresponds to in the transaction and approving its execution. And for the receiver, it provides three elements: the signature confirms that the sender is actually the legitimate sender because only that entity has the private key, the sender cannot deny that they did not send it because the sender is the only one with access to the key and finally, the sent message is not changed between sending and receiving because this is not possible due to the hashing (NRI, 2016; Drescher, 2017; Zheng Z. , Xie, Dai, Chen, & Wang, 2017).

Transaction process on the blockchain

From the above information, a clearer picture of blockchain technology, what it encompasses and how it works has emerged. This, together with further literature, provides insight into what the transaction

process on a blockchain looks like in an abstract manner. Notice, that a transaction can be any form of data transfer and therefore does not have to be a transaction in the form of value. This process follows the following steps (PWC, 2016; Hileman & Rauchs, 2017; Hayes, Brown, & Kvilhaug, 2022):

1. An entity makes a request for a transaction, which includes information from the recipient and a digital signature;

2. The transaction data is sent to all participants/nodes in the relevant blockchain. Here the block is created;

3. The nodes validate whether the transaction complies with the predefined validation rules (validation process). This is shared with all nodes in the ledger, who can now see and verify it;

4. If the transaction is approved, the new block is added to the chain to the previous block;

5. The transaction is complete: a new block is added to the existing chain and since it is validated and hashed it is now immutable and auditable.

How blockchain technology works can be briefly explained using three aspects. Through ***hashing****, all transactional data are given a unique digital fingerprint. Using* ***asymmetric cryptography****, data can be securely shared and accessed, with only the designated person being able to access it.* ***Digital signatures and signature verification*** *make it possible to authorise transactions on the blockchain. As a result, only the rightful owner can transfer their property.*

3.1.3 Blockchain in real estate

The ‘’FIBREE Industry Report Blockchain Real Estate 2021’’ provides an overview of the current state of development of blockchain in the real estate sector (FIBREE, 2021). FIBREE is also involved as a consultative expert in this research.

In brief, it shows that mainly Europe and North America are strongly represented in products centred around blockchain and real estate. Over the years 2019 to 2021, this number has seen a decline in 2020 and further growth in 2021. Further detailed information of this can be found in Appendix I: Additional literature research.

3.1.4 Conclusion

This paragraph answered the second sub-question: ''What is blockchain technology?''. The purpose of this was to gain a comprehensive understanding of what the technology entails in order to, on the one hand, understand what it entails as an underlying technology to tokenization and, on the other hand, to reflect certain aspects in the conjunction of real estate funds and tokenization. For this purpose, literature research was executed.

Blockchain can be described as a distributed database in which value information is digitised and approved jointly by all participants in the network. Due to the strength of the protocol, it can operate without the control of a single party. This is partly due to its distributed nature (from the peer-to-peer network and the consensus mechanism), that it can guarantee the authenticity of transactions, enable traceable and transparent transactions (which are stored on a chronological and secure ledger) and the security the network provides.

These are based on five core elements, (asymmetric) cryptography, the peer-to-peer (P2P) network, the consensus mechanism, the ledger and the validity rules. These elements make the basis of blockchain technology (possible). The recording of transactions works through hashing, asymmetric cryptography, digital signature (verification). All of these elements enable the transaction process (exchanges) to take place.

In order to make processes itself and processes on the blockchain easier, smart contracts can be applied. These programmes run at certain pre-set inputs, from which a desired output follows. On a blockchain the advantage is that the output is controllable and verifiable and guaranteed by the system rules.

Blockchain is the principle of the technology, but there are differences between how a blockchain can be set up and structured. Three important aspects are the degree of permission that a user has, the choice between permission, permissionless or both and the four types of blockchain structures. There is also a choice as to which consensus mechanism to use, which also depends on the type of blockchain structure that is opted for.

The aspects discussed herein will either directly or together with aspects from the other literature research on real estate funds and tokenization emerge to interview questions in the first round of interviews.

Now that an understanding is established, insight are obtained and it is clear what blockchain technology is, includes and works, the focus can shift to tokenization. Blockchain technology is concerned with how this works and therefore principles and terminology is similar.

3.2 Tokenization

In the introduction, the meaning of the term "Tokenization" has already been briefly mentioned. This research focuses on the tokenization of real estate funds, for which this paragraph serves to further explore what this application of blockchain technology encompasses in order to obtain a comprehensive understanding of it. This answers the sub-question: ''What is tokenization?''. This follows from the previous paragraph where the foundation of tokenization: blockchain technology was investigated and explained.

This is also explained in a chronologically comprehensible manner. First of all, it discusses what tokenization essentially is, how it works, what the main types of tokens and standards are, what the regulations and state of affairs in tokenization of real estate is, what the life cycle of a tokenized security looks like and finally what the advantages and challenges of tokenization (in real estate) are.

3.2.1 The basis of tokenization

What is tokenization

There is no unambiguous definition of the term 'tokenization' in the various sources. For example, Baum (2020) describes it as: ‘’the process of the representation of an asset (or fractional ownership interest) with a blockchain-based token’’ (Baum A., 2020). Sazandrishvili (2020) describes it as ‘’a method that converts rights to an asset into digital tokens that can be bought, sold and traded on blockchains’’ (Sazandrishvili, 2020). Laurent, Chollet, Burke, & Seers (2018) describe tokenization of assets as: ‘’The process of issuing blockchain tokens (specifically security tokens) that digitally represent tradable assets’’ (Laurent, Chollet, Burke, & Seers, 2018). From this, it can be deduced that tokenization is a process or method that digitises assets (and their ancillary elements) into tokens,

which represent this (or fractions of it) on the blockchain, whereupon it can be transacted. An important difference to be distinguished here is the nature of the asset: as it can be on-chain (i.e., it is a digital asset) - examples of this are bonds or equities - or it can be an existing asset and thus the token is a digital representation of an existing off-chain asset (i.e., it is a physical object) (Hileman & Rauchs, 2017).

Furthermore, tokens should not be confused with coins. The difference between the two lies in the method of creation. Coins are created through the previously explained consensus mechanism. The nodes that do the executing of the consensus mechanism are rewarded with coins, which in turn have a certain value. An example of this is Bitcoin. Tokens are created by the users themselves, through the method discussed above. The consensus mechanism also plays an important role, namely by maintaining the ledger in which the tokens are stored. The similarity between the two is that the mechanism of ownership is via the user's private key (Konashevych, 2020).

Tokenization also makes it possible to fractionalise (real) assets. For example, a real estate object can be divided into several parts of ownership. Investing in or selling these parts can be done via tokenization, thanks to the advantages offered by blockchain, which among others, are security, liquidity and immutability (Sazandrishvili, 2020).

How tokenization works

An example of this is when an investor wants to invest in real estate, and for example that person wants to invest in smaller amounts, accumulate (gradually invest more) or diversify. The investor can buy tokens that are affordable to them, invest in parts on a regular basis or buy tokens in different objects. Vice versa, a seller can also sell a part of his real estate object by tokenization.

Suppose a seller wants to get an amount of 10.000 euro out of his real estate object of 200.000 euro. That person can then tokenize his object and an amount of tokens he wants to get the 10.000 euro. This number of tokens is completely up to him to decide, the value per token would logically follow from the value of the object divided by the number of tokens. Normally this would be difficult because there are no possibilities to do so. As fractionalisation would be very difficult because of the underlying processes, administration (time), higher costs and so on (Sazandrishvili, 2020).

The process underlying how to tokenize the asset can differ somewhat. This has to do with the judicial and legal aspects that differ per country/region, but also with how the issuing party itself wants to approach this. Furthermore, it differs per type and nature of the asset (Gupta, et al., 2020). Gupta et al. (2020) state that this process briefly consists of: the registration of the entities, the creation of a special purpose vehicle and then the tokenization.

When the underlying is tokenized, it can be "offered". This is done by means of a Security Token Offering (STO). This is the issuance of tokens that are backed by the asset and is intended to raise the intended funding. In the STO, investors can invest for the first time. In the secondary market these tokens can be traded again (Gupta, et al., 2020). Initially, this was done on the blockchain for the issuance of virtual assets - such as coins - in so-called Initial Coin Offerings (ICOs) and the two are often confused with each other or used in each other's place. Furthermore, the ICOs are very similar to Initial Public Offerings (IPOs) in which companies raise funds, this is the first share sale on the stock exchange. And similar to ICOs are Initial Exchange Offerings (IEOs) in which the coin is issued directly on an exchange (Pang P., et al., 2020).

Tokenization can be briefly explained as a ***process or method*** *in which assets (and its ancillary elements) are digitised into* ***tokens which represents the ownership****, after which it can be traded. A key feature here is that ownership can be* ***fragmented****. These assets can be both* ***digital assets*** *(e.g., a bond) and* ***physical assets*** *(e.g., a real estate object).*

Type of tokens

There are different types of tokens that differ in their purpose and functioning. The Swiss Financial Markets Supervisory Authority (FINMA) identifies three types of tokens, but states that there is no generally recognised classification of tokens (FINMA, 2018). These are the main types, but there are also other types that fall under 'other' in this classification. It should also be mentioned that not all types of tokens are concerned by tokenization. Tokenization includes that which - as explained earlier - digitises an asset into a token and stores and transacts it on the blockchain. The definition of a token moves along two lines: on the one hand, it addresses the function of the token and, on the other, it covers what it represents (Freni, Ferro, & Moncada, 2022).

- Payment tokens;
- Utility tokens;
- Security tokens; and
- Other.

Payment tokens: Payment tokens are the same as the previously mentioned coins or cryptocurrencies. Their purpose is to serve as unit of account, store of value or medium of exchange. They are similar to fiduciary or fiat money (Sockin & Xiong, 2020).

Utility tokens: The purpose of utility tokens is to provide the owner of the token with certain access or benefits (Sockin & Xiong, 2020). Landau & Genis (2019) describe these tokens as a right of use for future services. This can be manifested in many ways, such as membership or a service provision (Sockin & Xiong, 2020).

Security tokens: A security token is a digital representation of an asset. For example, a share in a company, ownership of (part of) a real estate object or participation in an investment fund. This makes it comparable to a traditional security, with which the owner has ownership rights (Gupta, et al., 2020).

Golda, Kane and Sierra-Pambley (2021) distinguish security tokens into three categories:

- Equity token: similar to traditional equities. It represents (fractional) ownership and gives the owner profit and voting rights;
- Debt token: represents a loan that is guaranteed by a smart contract; and
- Asset token: represents ownership of an asset.

Other: Other types of tokens that are identified are: non-fungible tokens (NFTs), Exchange tokens, DeFi (decentralized finance) tokens, stablecoins, asset-backed tokens and privacy tokens (Oliveira, Zavolokina, Bauer, & Schwabe, 2018). The former is a type whose popularity has increased significantly since 2020. These Non-fungible tokens (NFTs) are - as the name suggests - non-fungible, which means that each token is unique and indivisible and represents a specific asset. Examples of use cases are identity or authenticity checks via the tokens (Bao & Roubaud, 2022).

There are also hybrid versions of the different tokens that carry certain properties (to varying degrees) of the combined token types (FINMA, 2018; Sockin & Xiong, 2020). And note that there may also be overlap between the types.

Token standards

Token standards or protocols are the rules that enable the development of tokens on different blockchains. This is necessary to be able to work with smart contracts in good harmony. These also have standards, which are rules that the smart contract must comply with in order to be utilised on the underlying blockchain network. They must meet certain requirements in order to enable basic functions such as the creation of tokens and the processing of transactions. These standards make communication on the blockchain efficient and facilitate interoperability (Antonopoulos & Wood, 2019).

The token standards are a component of the smart contract standards and often contain instructions and rules on how, for example, applications such as wallets can recognise and interact with the tokens. Developers in the blockchain community are constantly discussing and creating new standards. This is done in the programming language 'Solidity', which is mainly used on the Ethereum blockchain. These standards are named in the form of ERC-[Digit], which stands for 'Ethereum Requested for Comments'. The ERC-20 was the first and is considered the basis of token standards to which many have been added (Antonopoulos & Wood, 2019; Di Angelo & Salzer, 2020).

3.2.2 Regulations in real estate tokenization

In this section, the state of regulations on tokens is discussed, both in general and in relation to real estate. It also covers what is currently important in that context of regulations in real estate and in general.

At the time of writing, the European Parliament is working on new rules for crypto-assets, including tokens. The reason for this is that they are neither guaranteed nor issued by a central bank or public authority at this moment. Which results in risks for customer protection and financial stability and could lead to market manipulation and financial crime. The draft regulation distinguishes three different crypto assets: asset-referenced tokens (stable coins), e-money tokens and general crypto assets (European Parliament, 2022).

For tokenization a problem lies in the decentralisation and the regulation around it. Securities are normally subject to the jurisdiction of a particular country or region, which means that when they are issued and traded on the secondary market, these regulations apply. Despite the decentralisation, this also applies to this and the country/region boundary element can cause difficulties. This also results in a reduction of the benefits that follow from decentralisation. What is needed is compliant methods in which tokens can be issued and traded with ideally an international scope, although the latter will be very difficult, certainly for now. Creating clarity in the regulations and clear guidance from regulators is what is needed now for the development to progress. So, it appears that a framework is required. This will also make it possible to avoid scams (Laurent, Chollet, Burke, & Seers, 2018).

Konashevich (2020) also indicates the importance of the role of government. They should set standards within cross-blockchain infrastructure and security. This will allow users to choose which and how to use a blockchain or to opt for the use of blockchain technology in the first place. This will result in better quality, security and further development of the technology.

This shows that it is necessary for governments to establish frameworks and standards, from which a more harmonious and constant development will take place that can also be more easily issued and traded internationally. Several countries, such as Malta and Switzerland, are already working on this (Laurent, Chollet, Burke, & Seers, 2018). In the following, two other, and important frameworks are discussed: from the Securities and Exchange Commission (SEC; United States) and from the European Parliament. As the international element is thus important, both are covered instead of just the European, on which the emphasis lies given the nature of the research is focused on the Netherlands.

The Securities and exchange commission has regulatory authority over the issuance and trading of all tokens that have the characteristics of an investment contract (Gupta, et al., 2020). A security is an investment contract under the Securities Act of 1933 and Securities Exchange of 1934 (U.S. Congress., 1934; U.S. Securities and Exchange Commission, 1934). During the U.S. District Court for the Eastern District of New York on 11 September 2018, it was ruled that a digital token can be considered a security by means of the Howey Test (Gupta, et al., 2020).

The Howey Test is used to determine whether there is an investment contract, which applies when there is: ''an investment of money in a common enterprise with a reasonable expectation of profits to be derived for the efforts of others'' (U.S. Securities and Exchange Commission, 2019). This corresponds to the framework, where the (three same) criteria have been established to determine whether an investment contract exists (U.S. Securities and Exchange Commission, 2019).

Similarly, from the Financial Conduct Authority (FCA) in the United Kingdom, security tokens fall under the regulatory parameters (Financial Conduct Authority, 2019). This means that the smart contracts must be set up in such a way that they are legally binding (Gupta, et al., 2020).

For the tokens, the SEC will therefore look at whether they are perceived as representative of traditional security. This means that it will be very similar to how things have always been done (Golda, Kane, & Sierra-Pambley, 2021).

Following on from the above, the European Parliament is working on new rules for all crypto assets. The draft EU regulation contains a uniform legal framework for crypto assets, protecting customers from market manipulation and financial crime, and an EU taxonomy for sustainable mining activities by 2025 to reduce their carbon footprint. This follows from the Proposal for a regulation of the European Parliament and of the council on Markets in Crypto-assets, and amending Directive (EU) 2019/1937 on Markets in Crypto-assets, and amending Directive (EU) 2019/1937 (*pbEU,* 2020). The aim is to increase customer confidence and support the development of digital services and alternative payment instruments (European Parliament, 2022).

Some of the key provisions adopted for the release and trading of the crypto assets relate to transparency, disclosure and authorisation and supervision of the transactions. In addition, the legal framework supports market integrity and financial stability by regulating the public offering of the crypto assets. This leads to better informed consumers regarding risks, costs and fees. The regulation also contains measures against money laundering, terrorist financing and other criminal activities (European Parliament, 2022).

The introduction of the regulation is seen as enabling an innovation-friendly crypto regulatory environment that can set the standard globally. The next step is to negotiate with European authorities to produce the final draft (European Parliament, 2022).

In both cases, it can be seen that efforts are being made or will be made to work with certain standards in which the new developments can take place. Also in both cases, the aim is to support further development.

For the creation of an investment vehicle, Gupta et al. (2020) proposes a 'Special Purpose Vehicle'. This is a company with its own assets, liabilities and legal status and can be created by an organisation. This vehicle serves to undertake certain business purpose or activities (Gupta, et al., 2020).

The reason for choosing this vehicle is that the rights and the like of assets are usually very difficult to tokenize due to a lack of legal and technical frameworks (Uzsoki, 2019). So, the assets, liabilities, legal status and the like are accommodated in this vehicle from which this vehicle can be tokenized (Gupta, et al., 2020).

Implications for regulators and third parties

Distributed networks of ledgers, such as blockchain, allow regulators to monitor, supervise and audit issuance, trading and agreements in real time, greatly enhancing current regulatory systems. Furthermore, off-chain assets still require third parties. The technology itself cannot see whether the data entered is correct and accurate. The same goes for the tokens being fully and correctly backed up by the assets they represent. Third parties need to check and manage this. Strict rules and safeguards need to be put in place to ensure this (Hileman & Rauchs, 2017).

3.2.3 The lifecycle of a tokenized security

This section is summarised from the article: ''Real Estate Tokenization'' by Pang et al (2020).

The tokens in the form of a share in a real estate investment (direct or indirect) are in the form of a security. This follows from the fact that the security is backed by the real estate. This process therefore also applies to tokenized participations in real estate funds (Pang et al., 2020). Pang et al. (2020) identifies the lifecycle of a tokenized security. This consists of five activities in four phases. The four phases comprise: tokenization, primary distribution, post-tokenization management and secondary trading. Under the tokenization phase fall the activities deal structuring and digitisation, under the subsequent phases fall investor management, corporate action management and secondary market trading respectively (figure 7). This section discusses what the phases entail, what activities are involved and what the implications of blockchain, smart contracts and tokenization are within them.

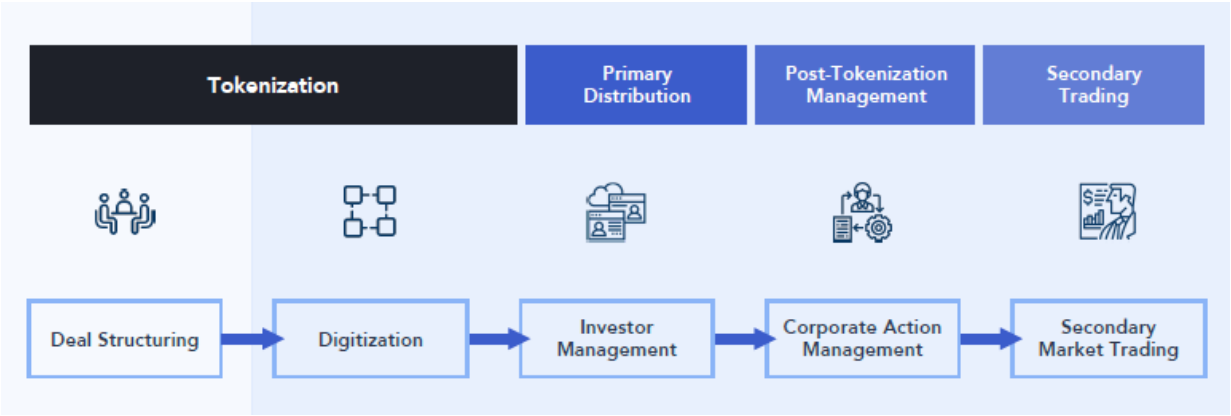

Figure 7: Lifecycle of a tokenized (Pang, et al., 2020)

Deal structuring

Deal structuring is an important part of any securities offering and involves important decisions about the terms and conditions of the security (token). These include the rights and obligations, the form in which payment will be made, how tax will be levied and other implications for the investor and issuer. In terms of governance, tokenized securities are very similar to traditional securities. For example, it is similar to the current regulatory framework, creation, ownership and transfer. At the same time, there are also the same governance and regulatory underpinnings such as investor KYC (Know Your Customer) procedures, accounting, investment due diligence and legal ownership. It follows from Clifford Chance (2020) that in the Netherlands the same regulatory framework applies to security tokens (offerings) as to traditional securities.

The level of valuation of the token can be determined by various factors and should be addressed in the deal structuring. As a core, the value is based on the valuation of the property and the ability to generate cash flow, but due to the tokenization of the security, other factors influence it. The reduced transaction and administrative costs and the increased liquidity can also increase the value of the security token.

Digitization

In this phase, the securities - traditionally kept in paper or document form - are put on the blockchain, encoded in smart contracts and issued. Two core elements of tokenization are blockchain technology and smart contracts. The former allows for certainty and security in processes where data cannot be altered by another person in a digital form (ROM) which is stored on the blockchain as a complete record of ownership. The difference with the current fractional ownership is in the efficiency of the management of the data because it can be updated almost instantly and is safe from manipulation by others, such as hackers.

By means of the smart contracts, processes can - as explained earlier - be executed digitally on the basis of terms set by the developer and the issuer. At this stage, these processes can include KYC, AML (anti-money laundering), due diligence compliance protocols, distributing dividends and holding shareholder votes. As such, smart contracts also play a crucial role in facilitating near-instant settlement of transactions and obtaining liquidity.

Primary distribution

In the primary distribution, tokens are issued to the investors in exchange for the investment and this is recorded on the blockchain. The form of the asset from which the securities are tokenized differs, for example, it can be directly through a separate property or indirectly through a real estate fund.

Post-tokenization management

This phase contains the corporate action management processes, i.e., the activities carried out by the issuer over the lifetime of the security tokens. Examples are shareholder voting and dividend distribution. In many cases, these activities can be performed by the smart contracts.

Secondary trading

In this phase, the investor can trade his security token with another investor on an exchange or over-the-counter. The current problem of illiquidity in real estate is probably the result of the high financial threshold to entry, long lock-up periods (investors cannot liquidate their investment) and long transaction processes. With tokenization, this is solved by fractionalisation, fast settlement and transfer of the securities and flexibility and adaptability in the portfolio.

In real estate funds, tokenization of the participations can help to achieve operational efficiency, increase liquidity and the benefits of fractionalisation. This is especially applicable to private real estate funds with long lock-up periods and high minimum investments that create a high threshold.

In a limited partnership structure, the general partner (GP) can keep part of its ownership for management reasons and tokenize another part, thus freeing more capital for other purposes. While the limited partners can obtain more flexibility and liquidity if, for example, they want to change the composition of their portfolio. As an investor in a fund can be locked in for a long time and facilitating a takeover costs a lot of time and effort. The process of transferring tokens of the general partner and limited partners is shown in figure 8. At the same time, for the fund manager it offers the advantages of lower costs and workload associated with arranging the transfers of the participations as opposed to the current way of working.

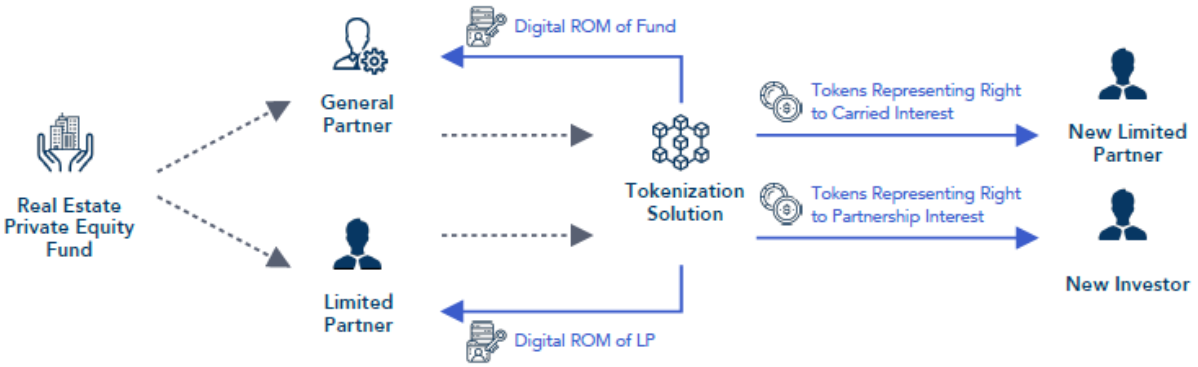

Figure 8: Process of transferring tokenized participations in a private real estate fund (Pang P. , et al., 2020)

3.2.4 Benefits and challenges of blockchain and tokenization (in real estate)

Swan (2015) explains that the potential benefits of blockchain extend beyond the economic. It can also offer benefits in political, humanitarian, social, scientific, health care, manufacturing and other areas. These advantages exist over traditional databases and transaction systems. However, this new technology also creates challenges. The benefits and challenges discussed in this section are identified from different sources (Swan, 2015; Drescher, 2017; Hileman & Rauchs, 2017; Wust & Gervais, 2018; Hoven, 2018; Seuren, 2018; Wouda H. , 2019; Ali, Jaradat, Kulakli, & Abuhalimeh, 2021). Note that there may be differences between benefits and implicit sectors, interests, needs etc. and that these may differ per entity and that there are more and other underlying to the mentioned. Furthermore, the named benefits and challenges relate to blockchain, tokenization and, in many cases, both.

Benefits

Reliability

The information on a blockchain can be seen as very reliable due to two elements: the hashing principle and the distributed ledger. Using the hashing principle, it can be ensured that the information blocks formed are practically immutable. In addition, they are recorded with timestamps and digital signatures. The distributed ledgers also ensure that there is no point of failure. Because of the distribution of the ledgers, no change can be made by just one or a few nodes without the proper documentation and then it is not validated by the consensus mechanism (Drescher, 2017; Hileman & Rauchs, 2017; ven, 2018).

Greater liquidity

By tokenizing the assets, they can be made available to a wider public, on the one hand due to the lower entry barrier created by fractionalisation and on the other hand due to internationalisation, whereby investors can invest more easily across borders. As the tokenized assets can be offered on a secondary market. At the same time, it removes the difficult and time-consuming aspect often inherent in certain assets, such as real estate or art (Hughes, Carlson, & Stafford, 2018; JLL, 2018; Laurent, Chollet, Burke, & Seers, 2018; Gupta, et al., 2020; Sazandrishvili, 2020; Cryptopedia, 2021; Haddad, 2021).

Automation of transaction

The working mechanism in blockchains can replace manual operations if this is possible. This is possible because of the 'single source of truth' with which all information is encrypted and stored. In the process, transactions are either validated by the system or not. In addition, with the introduction of smart contracts, it is possible for parties to reach an agreement automatically (Mohanta, Panda, & Jena, 2018). The latter also applies to the transaction process of tokens, in which transactions can be executed in real-time. From the replacement of manual operations (of the transaction process), it requires fewer or no intermediaries, which results in faster transactions, but also in lower costs related to the process (Laurent, Chollet, Burke, & Seers, 2018; Mohanta, Panda, & Jena, 2018; Gupta, et al., 2020; Sazandrishvili, 2020; Cryptopedia, 2021; Haddad, 2021). In real estate, smart contracts can make it possible to automate agreements and their processes and to accelerate and smoothen pre-lease due diligence. Because by recording identities, they can be verified more quickly (JLL, 2018; Hughes, Carlson, & Stafford, 2018).

Transparency

Because the tokens are recorded on the blockchain, the entire ownership record, along with, for example, the owner's rights and legal responsibilities are publicly visible and available and cannot be altered with. This ensures that it is clear who one is doing business with, everyone's rights and responsibilities, previous owners and suchlike. The degree of transparency - besides the recording of ownership - depends on the characteristics established for each project and blockchain type. The characteristics can be defined in the future by means of legislation and regulations (Laurent, Chollet, Burke, & Seers, 2018; Gupta, et al., 2020; Sazandrishvili, 2020; Cryptopedia, 2021; Haddad, 2021).

Trust

In purchase and sale transactions, entities are often new to each other, which may create a lack of mutual trust and concerns about integrity, for example. Trust in inter-entity trade can be increased by established digital identities and record keeping systems. Moreover, this can be done without an intermediary (Deloitte, 2017).

Disintermediation

This advantage relies on no longer needing intermediaries or third parties. Where traditional processes required human assistance or the use of additional technology, blockchain allows the system to function properly without this. This means that the dependency, costs and suchlike of this intermediary are eliminated (Swan, 2015; Hileman & Rauchs, 2017)

Incorporated in these benefits are others such as: immutability, greater accessibility, global access, less/no need for intermediaries, faster transactions and fractionalisation. And other value propositions where these benefits can be useful in real estate are land titles (property recording) and a common database (shared collection of real estate information) (Deloitte, 2017; JLL, 2018; Hughes, Carlson, & Stafford, 2018).

Challenges

Regulation

Swan (2015) indicates that government regulations are one of the most important factors and risks in the future and formation of blockchain technology. The European commission is working on a legal and regulatory framework for blockchain (applications) (European Commission, n.d.). It is also working on a strategy for the further development of blockchain technology, with which it wants to become the leader in blockchain technology (European Commission, n.d.). In addition, there are also difficulties in terms of responsibility, as blockchain operates in a peer-to-peer network and no one is responsible in advance for ensuring that transactions are settled and secure. In terms of tokenization, it mainly concerns the legal and regulatory recognition of the tokens and the necessary guidelines for it. However, it should be mentioned that there is more to this and that this issue is still very extensive and complex (Laurent, Chollet, Burke, & Seers, 2018).

Compliance

A first compliance challenge is at the transaction level, where the parties to the transaction need to be verified. The same applies to transactions on an international level, as discussed earlier. MiFID (Markets in Financial Instruments Directive), AML (anti-money laundering) and KYC (Know-your-customer) also play a crucial role. These should be observed and ideally be embedded in a framework or overarching approach. From there, automation and processing for further tax raising could follow. The ideal situation would be a smooth-running, connected and mostly automated way of working (Laurent, Chollet, Burke, & Seers, 2018).

Further points concern what the tokens represent. Examples are when the underlying asset is stolen or when costs have to be covered among many owners. There are many questions on how to solve this. Secondly, there are also concerns related to risks of hacking (Laurent, Chollet, Burke, & Seers, 2018).

Security

It is often thought that blockchain cannot be hacked, but that is a myth (Hileman & Rauchs, 2017). There is a high degree of security due to the increased intrinsic reliability, cryptography and distributed ledgers, but there are still challenges in the area of security. These challenges are mainly in two areas: private keys and 51% attacks. Private keys serve as keys to encrypt data and to create digital signatures by encrypting the hash of a document. Which should only be known to the owner, as the term 'private key' already says. This creates a weakness as it can be stolen by a social approach. A 51% attack means that someone with more than 51% of the computing power takes charge of the blockchain and do damage to it. Certain consensus mechanisms are particularly vulnerable to this. Other security challenges include hacks in exchanges or quantum computing (Laurent, Chollet, Burke, & Seers, 2018; Sazandrishvili, 2020).

Business partners

Companies or other initiatives that want to apply tokenization need the right technicians, financial partners, legal advisors and others with expertise in blockchain, tokenization and smart contracts. Due to the growth in demand for implementation, the supply of experts is lagging behind (Sazandrishvili, 2020).

Liquidity issue

The increased liquidity that arises, as described under benefits, is only sustained by sufficient demand. It is also difficult to estimate what the trading volume of tokenized assets will be until traditional investors start to adopt them (Haddad, 2021).

Privacy

Due to the high degree of transparency and traceability involved, a user's privacy is diminished. Because others can see the transaction data and follow them, it becomes possible to follow a user, which leads to a loss of privacy. This makes transparency and privacy conflicting considerations (Yli-Huumo, Ko, Choi, Park, & Smolander, 2016). In essence, however, accounts are anonymous.

Standardisation

The novelty of the technology also creates a lack of standardisation. This is due, on the one hand, to the differences in blockchain applications and solutions and their own layout and structures and, on the other hand, to the difficult transition to other processes and systems. The former is due to the rapid development of the technology and the developments taking place side by side, which makes it difficult to connect. The second lies in the connection of the current way of working in organisations and processes that are not compatible with the blockchain (Hileman & Rauchs, 2017).

Processing speed

Transaction processing requires intensive communication and processing to reach consensus and disseminate information. This often results in a slow transaction processing speed. This in turn prevents large-scale implementation (Hileman & Rauchs, 2017). However, there are many developments taking place to speed up this process.

3.2.5 Conclusion

This second paragraph of this chapter answers the sub-question: ''What is tokenization?''. Herein, it is investigated what this application of blockchain technology includes in order to combine it with real estate funds in the next stage.

Tokenization is a process or method for digitising the ownership of assets, after which they exist in the form of a token on a blockchain on which they can be traded or exchanged. This also makes it possible to fractionalise it. The asset can be either a physical asset or a digital asset and should also not be confused with coins that are created on the blockchain through the consensus mechanism.

The operation of the tokens is mainly in the easy trading or exchange of them on the blockchain. As a result, it can also be done from here in fractional shares, which in turn has advantages. The issuance of the asset-backed tokens is done through Security Token Offerings (STOs) and serves to raise the desired funding.

Tokens also differ in type, there are three main types of tokens: payment, utility and security tokens. There are also other and hybrid versions of tokens. The type depends on the function and what it represents.

The lifecycle of a tokenized security runs through five main activities in four phases. These activities consist of: deal structuring, digitisation, investor management, corporate action management and secondary market trading respectively. Through this process, the deal and paperwork are arranged, the token is created and issued, everything is continuously managed with the investors and the fund and its underlying, and secondary market trading proceeds.

Due to the novelty, there is still a major challenge in the area of regulations. Usually, the token will fall under the regulations of securities which in turn facilitates this. However, there is still a difficulty due to the decentralisation. It appears that compliant methods in the form of frameworks, guidance, standards and clarity in the regulations are required for this. The Securities and Exchange Commission and the European Parliament are already working on this.

In addition, third parties are still needed to regulate, monitor and audit, but also for the off-chain assets and their input, management and control.

Tokenization and blockchain have a number of benefits: reliability, transparency, traceability, automation (of transactions), increase in liquidity, intermediation, immutability, greater accessibility, global access, less/no need for intermediaries, faster transactions and fractionalisation. However, there are also challenges in terms of regulations, compliance, cybersecurity, standardisations, processing speed, privacy, sustainability, business partners, privacy and uncertainty of adoption.

The technology has several value propositions in real estate, namely: smarter, more efficient and transparent operations and processes, increased liquidity, the recording and exchange of land titles can experience the benefits of blockchain, information of real estate objects can be shared in a common database and the trust between parties can increase. There is also an increase in the number of products (companies or projects that are involved in the real estate market).

The aspects identified from this chapter are merged with those from the literature research on real estate funds from the previous chapter to create the interview questions in the empirical research. The aspects of blockchain identified in this chapter are: which blockchain, blockchain type, consensus mechanisms and smart contracts. Of tokenization, these are: token configuration, token type, payout design, token issuance and trading, regulations and legislation.

The conclusion of this chapter also marks the end of the literature research. It has created a large and broad understanding and insight on what real estate funds, blockchain technology and tokenization are. Also, aspects on real estate funds, blockchain and tokenization are identified that contribute to the understanding on what the subject encompasses in order to use them in the empirical research. Other gathered information plays an important role in its eventual implementation and realisation.

4. Method empirical research

The previous chapters have discussed the three topics that are central to this study. Each topic is explained in terms of what it is, how it works, the most important aspects and of blockchain and tokenization also what the benefits and challenges are. This chapter covers the methodology of the empirical research of this research. It explains the research approach, how the successive chapters of the empirical research will be conducted and describes what the interviews entail. It discusses how the interviews are structured, what their purpose is, how they are conducted, how the validity is ensured, what underlies the interviews, what the interview questions are, what the interview population is and how the collected data is analysed. The research approach and course are shown in figure 9 with this specific research part highlighted.

4.1 Research approach

To conduct this research there is the possibility between quantitative and qualitative research. In quantitative research the focus is on quantifiable data which can be used for statistical analysis. This can be used for interpretation for a broader population or area (Baarda, et al., 2013). This research focuses on a subject of which there is little information, no research has been done yet and there are no or few examples in practice.

This research aims to get more insight in how to implement tokenization in real estate funds. By looking at how the different aspects of real estate funds, blockchain and tokenization can be implemented. It also looks at what choices and challenges are in this and present a proposed way it can be implemented. In the preceding chapters, the basis and the different aspects of the topics have become clear. The empirical research is intended to clarify how to implement these aspects, what the choices and challenges are and how it can possibly be implemented. For these reasons, a qualitative approach is chosen for this research. This way, information is gathered in the appropriate manner within the spectrum of the subject.

In qualitative research, a distinction is made between three types of research: descriptive, testing and exploratory. Exploratory research is used for subjects on which little or no research or knowledge is available (Baarda, et al., 2013). This approach lends itself well to this research because (as mentioned before) there is no known scientific research focusing on this subject and there is little knowledge on the subject.

In exploratory research, Baarda et al. (2013) distinguishes three (most common) ways of data collection: the use of existing documents, interviews and observations. Observations are used to analyse behaviour and existing documents are (often) used to collect information from events that occurred in the past. The former is not applicable and the latter is not possible as this information is not available. Also, most of the available information has already been processed in the literature research.

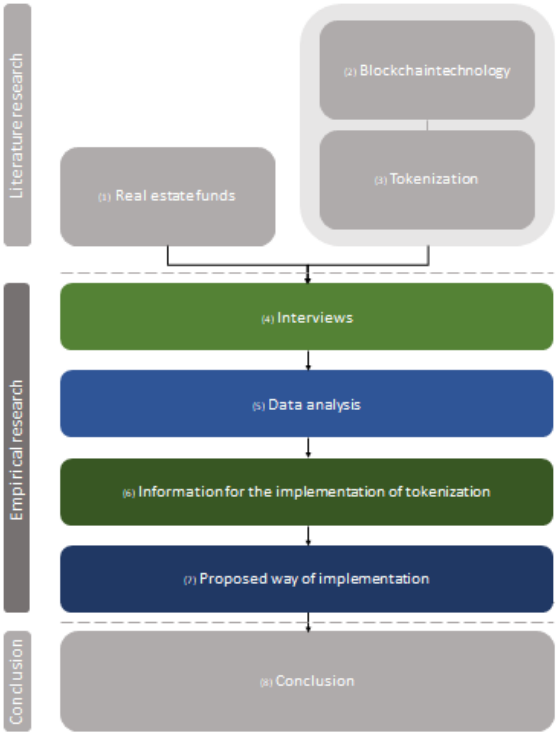

Figure 9: Research model with empirical research highlighted (own illustration)

In order to answer the research question, the knowledge and experience of experts is needed, which is why interviews are the most appropriate method of data collection. Due to the novelty of the subject, not many people are suitable for the interviews. Therefore, these are conducted with individuals. In this way, knowledge, opinions, attitudes and experiences of the individuals on the subject can be collected.

4.2 Empirical research description

By means of the interviews, data is collected to gain insight into where, why and how aspects of blockchain and tokenization can be implemented in real estate funds. This is done by checking the collected information from the literature research for completeness and correctness where necessary, by asking where (in the course of) real estate funds, tokenization can be useful and how this can be done. With semi-structured interviews, the main questions are fixed, but there is room for further exploration. This allows the interviewer to ask further questions, which fits within the exploratory nature.

For the purpose of the interviews and the required saturation, it follows from Dworkin (2012) that for the sample size in number of interviews, on the one hand, 5 to 50 interviews are necessary and on the other hand, that interviews are necessary until saturation is reached. This is adhered to in this research.

Data validity and reliability

To ensure that the measured data from the interviews produce the intended results, validity is an important indicator in this. The focus is thus on whether the intended outcomes are measured correctly. Also, the reliability of the results - the collected results may or may not be correct because the interview questions are correctly communicated to the interviewee and also understood - is an important indicator of measurement validity. Essentially, the objective of establishing validity and reliability in research is to ensure that the data are robust, reproducible and the results are accurate (Mohajan, 2017).

The research objective of the interviews in this empirical part of the study is to gather information on how tokenization can be implemented in real estate funds. These interviews are prepared using different aspects of real estate funds, blockchain and tokenization which follow from the literature research. There is coherence among the questions but - if relevant - questions may be independent of the rest. For the sake of internal validity, the interviews are conducted in the same way for all interviewees. However, given that these are semi-structured interviews, additional questions are added during the interviews if relevant. These questions may differ for each interviewee.

Furthermore, for the reliability, the interviews are structured so that more information is available in the interview if an interviewee does not have (full) knowledge on a question. The interviews are conducted via an online environment and all questions, besides being cited, can also be read by the interviewee on their own screen where it is presented to them via a presentation. This ensures that the questions are clear and communicated completely. The interviewee is also given time (to their needs) to read this. This extra information is available in some questions and otherwise the interviewer can always answer all the interviewee's questions. The latter is told prior to the interview. Also, the interview questions are based solely on an extensive literature research. The literature research consists of only the three topics and their aspects, thereby optimising the internal validity.

For the purpose of external validity, the interviewees are selected on their expertise, knowledge and experience with the subject. Also, during recruitment, they are asked to what extent they have expertise, knowledge and experience with the subject and are selected accordingly.

4.3 Semi-structured interview research description

As mentioned, the first round of interviews with the experts serves to gain insight into how the combination between real estate funds and tokenization can be implemented. For this purpose, questions are asked on real estate funds, blockchain and tokenization and their aspects and in a concluding section (see also table 4). These questions are based on the literature research and include control questions on certain aspects derived from literature, questions on the aspects of real estate funds, blockchain and tokenization, how the experts think this should be implemented and on the interaction between the three topics and aspects. In the final section, concluding questions are asked on what and how the expert sees the outcome and consequences of it.

In the interviews, follow-up questions are asked in addition to the established interview questions if it is relevant to get more information from the expert's answer. In addition, it is checked whether the interviewee has understood the question once the question is asked. Additional explanations can be given if necessary.

An agenda and a presentation are prepared for the interviews. The agenda helps the interviewer to discuss everything and to keep a good structure in the interview. It consists of the full course of the interview. That means that there are several points to be discussed in the introduction - explaining the purpose of the research, the interviews and the general - but it also contains the interview questions and some wrap-up remarks.

The presentation serves for the interview questions. As the interview takes place via an online meeting method, the questions are sometimes complex and lengthy and in some cases may require additional information, it can be helpful for the interviewee if the questions are easy to read and understand. This is presented per question per slide so that after the question is presented, the interviewee can read it again and go through it thoroughly before answering it. Additional information is not yet included; only if the interviewee asks for further explanation the next slide can be accessed, which contains the question together with additional information. This additional information follows directly from the literature research and is not suggestive in any way.

The validity of the results from the interview questions is strengthened by this method because the questions are communicated to the interviewee in their entirety and there can be no question of any interference. The latter could be possible because it is done through an online method and the question is lengthy and/or complex. This ensures that what is intended to be measured, is measured with more certainty.

After the interviews are conducted and simultaneously recorded using the online meeting method, this is transcribed. Verbatim transcription is chosen here because all the information that is mentioned, is or can be important but speaking mistakes or stuttering and suchlike are irrelevant. The transcript per interview contains the processed conversation, who is being interviewed, when it took place and who said what.

The interview guide lays the foundation for the interviews. Table 3 below shows how the interview proceeds, what is discussed in each section and what the purpose of it is and why it is relevant what is discussed. The interview questions follow from the interview guide and on the basis of the literature research. For each topic, open qualitative interview questions are asked that cover the purpose of that topic in order to fulfil its relevance.

Table 3: Interview guide (own source)

Topic	Description	Relevance
Introduction	Name, interviewee, description of job, description of company, general introduction	Resume about the subject and the purpose of the research and interview. Also, the context of the expert and the interview is shaped.
Real estate funds	This topic aims to gain insight into how to shape the real estate funds and what it involves when tokenization is implemented. It also includes control questions on ascertainable information from the literature.	It can be determined what aspects the real estate funds should have in the implementation. In addition, it is possible to find out what this implies. Furthermore, it can be confirmed whether certain information from the literature is correct.
Blockchain	This topic aims to find out how to set up the blockchain and what is important in it.	In setting up a blockchain (system), various choices and considerations have to be made. These are covered and discussed in this topic.
Tokenization	This topic includes how to arrange tokenization of the real estate fund. It examines the regulations and how to arrange these, as well as how to set up certain aspects and processes.	This section makes clear how to handle the application of tokenization in real estate funds and the changes it entails in different areas.
Concluding section	In this last section, concluding questions are asked about the implementation and its consequences.	It can provide a comprehensive insight into the central issue and gives the interviewee the space to share unmentioned information.

The interview questions are listed in table 4 below. The questions asked are constructive and chronological. This means that nothing is ever mentioned that has not already been discussed in a previous question, and that information that is discussed can be included in subsequent questions.

Table 4: Interview guide with open questions (own source)

Topic	Open questions
Introduction	Interview is opened and interviewer and interviewee introduce themselves to each other, subject and purpose of the research and this round of interviews is discussed.
Real estate funds	○ What adjustments would you make to the following five main activities/phases in a real estate fund: establishment, fund raising, continuous management, post-tokenization management and secondary (market) trading? If so, what and why? ○ In which of these phases would tokenization add most value and why there? ○ In which real estate fund type; listed or non-listed would tokenization be more useful and why? ○ Which property fund structure would you use for tokenization: open-ended, closed-ended, Unit Investment Trust or Unit trust, and why?

	○ Which pooled property vehicle do you think best suits the tokenization of real estate funds: limited partnerships (LP) or property unit trusts (PUT), and why?
Blockchain	○ Which blockchain would you build it on and why? ○ Would you choose a decentralised (public), centralised (private) or hybrid approach, and why? ○ Which consensus mechanism would you choose, and why? ○ What would be the role of smart contracts in the whole process and how? ○ What is the added value of blockchain in the whole process and why?
Tokenization	○ How would you configure the token and why so? ○ And which token type would you choose and why? ○ How would you design the payout and why so? ○ How can the tokens be issued and traded and why so? ○ What is needed in terms of legislative and regulatory requirements to stimulate the development and why? ○ What is the added value of tokenization in the entire process and how?
Concluding section	○ How do you envision tokenization in real estate funds to be organised? ○ What are the critical success factors herein? ○ What would be the impact of this on the real estate industry?

Interview population

The interviews are focused on experts. They have knowledge and expertise on real estate funds, blockchain and tokenization. This is necessary to be able to answer the questions and the synergy between them. Most of these people have a background in real estate and from there have become interested in blockchain and tokenization. In addition, the interview population - due to the international nature of the subject - also consists of an international pool.

These people are invited to assist in the research through the interviews. Table 5 below lists the interviewees with the interview number, company they work for, the focus of the company and their respective roles. This gives an insight in who the interviews are conducted with and what their expertise is. The name of interviewees and the corresponding companies of some are omitted at their request.

Table 5: List of interviewees (own source)

#	Interviewee name	Company name	Company focus	Function/role in company
1	Makram Hani	Arms & McGregor Blocksquare FIBREE	Real estate agency Tokenization solutions Real estate and blockchain NGO	CEO COO Executive board member
2	Jo Bronckers	FIBREE	Real estate and blockchain NGO	Vice president
3	Colin Nimsz	Scalingfunds	Capital raising solutions	Chief Strategy Officer & General Counsel
4	Frans Voskuil	Blyver	Fintech real estate platform	CEO

5	Anonymous interviewee *(#5)*	Max Crowdfund	Blockchain real estate platform	-
6	Alex Pham Phd	Realbox	Blockchain real estate platform	CEO

Data analysis

To analyse the interviews, these are transcribed and coded as mentioned. Coding takes place by selecting relevant fragments from the interview text and then processing these using open coding, axial coding and selective coding respectively. By doing so, structure is brought to the collected data. This is included in Appendix III: Transcribed interviews and interview coding.

An overview of this can be seen in table 6. In this coding scheme, all data is presented in a sufficient and structured manner. Completeness and reliability of the data is important before the data is analysed (Bryman, 2012). Coding took place by processing text fragments in a spreadsheet. These text fragments are classified by axial coding. The aspects follow from the axial coding and are grouped by the topics. The extent to which each interviewee has dealt with this aspect is indicated. Table 6 shows that all aspects are covered by the interviewees and all are therefore included in the analysis.

The six interviews resulted in 285 text fragments. The coded text fragments are selected on the basis that they are directly related to the implementation of tokenization in real estate funds. Other issues that do not directly apply to the implementation but might be interesting findings in the spectrum of blockchain and tokenization with real estate funds or the real estate sector are included in a separate subsection. The unprocessed text fragments from the interviews are not related to this or are duplicates of the processed text fragment.

The goal in the selection of text fragments is to gather information on those different aspects and how tokenization can be implemented in them. Furthermore, text fragments are selected that are relevant in the implementation of tokenization in real estate funds. These are, for example, named important characteristics or challenges, but can also take other forms.

If there are other aspects or information of great importance, the selection may also include this. This strongly depends on what is relevant and important in the implementation.

Table 6 below shows that all topics and aspects are covered by the interviews.

Table 6: Coding scheme (own source)

Topic	Aspect	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6
Real estate fund	Real estate fund type	Yes	Yes	Partly	Partly	Yes	Yes
	Real estate fund structure	Yes	Partly	Yes	Yes	Yes	Yes
	Pooled property vehicle	Partly	Partly	Yes	Yes	Yes	Yes
	Real estate fund organisation	Yes	Yes	Yes	Yes	Yes	Yes
	Payout approach	Yes	Yes	Yes	Yes	Yes	Yes
	Currency approach	Yes	Yes	Yes	Yes	Yes	Yes
	Issuance & trading	Yes	Yes	No	Partly	Yes	Yes
	New business model	Partly	Yes	Yes	Yes	No	Yes
Blockchain	Blockchain type	Yes	Yes	Yes	Yes	Yes	Yes
	Blockchain effect	Yes	Yes	Yes	Yes	Yes	Yes
Legislation	Legislative and regulatory needs	Yes	Yes	Yes	Yes	Yes	Yes
	Compliance organisation	No	Yes	Yes	No	Yes	Yes
Tokenization	Tokenization setup	Yes	Yes	Yes	Yes	Yes	Yes
	Token configuration	Yes	Yes	Yes	Yes	Yes	Yes
Other	Standardisation	Yes	No	No	No	Yes	Yes
	Unchanged way of working	Yes	Yes	Yes	Yes	Yes	Yes
	Success factor	Yes	Yes	Yes	Yes	Yes	Yes
	Real estate influence	Yes	No	No	Yes	No	Yes

4.4 Conclusion

This chapter contains the explanation on the methodology on the subsequent chapter, namely the empirical research. In outline, it contains explanations on this research approach, empirical research description and the description on the semi-structured interviews. In the former, it is explained why empirical research is conducted and why interviews are chosen herein. With interviews, information can be gathered on how tokenization can be implemented in real estate funds. Semi-structured interviews make it possible to ask some fixed questions but allow for further exploration and information gathering where necessary. This may be necessary as this is exploratory research and there is little information available on the subject. The interviews contained 19 fixed questions and are conducted with 6 experts who have knowledge of tokenization and blockchain, as well as real estate funds. After conducting the interviews, they are transcribed, coded and analysed.

5. Results

In this chapter, the results of the interviews are discussed. This follows from the transcription, coding and analysis of the interviews. These outcomes lead to the structured information and the proposed way of implementation in the next part/chapter of the empirical research.

5.1 Interview results

The interviews are structured on real estate funds, blockchain and tokenization. The aim is to obtain from this how tokenization (and hence blockchain) can be implemented in real estate funds. The interview results show that in this, complying with legislation is a very important matter. Thereof, legislation will be included as a topic of its own in the following of this research to emphasise its importance in the implementation and to present it in a comprehensive manner. This makes the topics in the remainder of the research: real estate funds, blockchain, tokenization and legislation respectively. By means of these four topics and their corresponding aspects, the interview results are discussed.

In addition, four things emerge from the interviews that do not directly apply to implementation but are possibly interesting findings in the spectrum of blockchain and tokenization with real estate funds or the real estate sector. These things are: standardisation, unchanged way of working, success factor and real estate influence respectively. This is elaborated upon in the subsection: 5.1.1 Other.

The purpose of the interviews is to gain insight into how aspects of blockchain and tokenization can be implemented in real estate funds. The three main topics – as identified before the literature research: real estate funds, blockchain and tokenization - are discussed in the interviews in order to see how tokenization can be implemented. What is discussed may relate directly to the topic under discussion but may also be in connection with another topic. This follows from what was said in the interviews.

Real estate fund

From the literature research, a number of aspects followed on how to set up the real estate fund. The aim from the interviews was to retrace what can be the (best) choice to make in that regard and why. It also allowed for checking whether the findings were correct and/or complete. From the interviews - also originating from questions on other topics - eight aspects followed on how to set up the real estate fund and why in that way.

Real estate fund type

When asked which type of real estate fund would be best to use, most agreed that for non-listed funds the impact was the highest. As they can then be traded on the secondary market and listed on exchanges, it results in more efficiency in the administration and back-end of the fund and the benefits of being listed can also apply to these non-listed. However, it had to be said that these funds would then become (partly) listed and would therefore have to comply with the applicable legislation and regulations. Interviewee 3 also indicated that most funds were dark pool managed and wanted to stay that way, because the actual pricing of the fund would then constantly change, which is exactly what they did not want.

Two others say listed funds are the better choice. Interviewee 1 indicated that they could offer more compliance, and thereby be more efficient and cheaper. In addition, the bureaucracy can be reduced. However, he does indicate that the impact of tokenization on these funds is lower than on non-listed ones. Interviewee 4 indicates that listed funds are better suited to the purpose of his project and that he therefore chooses them.

Interviewee 5 indicated that regulatory constraints still make it impossible to achieve this regardless of whether the funds are listed or non-listed. A listed fund is tradable, so that is important to take into account in terms of legislation and regulations.

Real estate fund structure

Interviewee 2 and 3 indicate that the fund structure is not hugely relevant. It is more of a preference choice and has to fit in with how someone wants to set up the fund and chooses the structure that fits in with that. The latter also indicates that there is not much difference in the structures. Interviewee 6 indicated that a tokenized real estate fund would need a new structure and would not directly fall under one of the four mentioned. However, he does indicate that Unit Trusts are the most similar to what he envisions, because the units represent fractional indirect ownership of the underlying asset, they are traded on secondary markets and the target group, retail investors, are the same.

Open-ended funds are the most opportune, as they allow the portfolio to be updated with entries and exits and reduce risks according to interviewee 1 and 4 respectively. Interviewee 3, however, indicated that open-ended real estate funds do not function well and often behave like a closed-ended or hybrid form and that he therefore does not prefer this and opts for closed-ended funds. Interviewee 1 endorsed this by saying that studies show that closed-ended is the better structure in real estate. Interviewee 6 indicates that tokenization should be able to provide more transferability and fungibility to closed-end real estate funds.

Interviewee 1 indicates that unit investment trusts (UIT) offer several advantages, such as that they allow for different 'behaviours' and that this is useful given that the laws and regulations are different in different jurisdictions. Interviewee 3 indicates that there are many Unit trusts (UT), but a problem with these is that they differ quite a bit by jurisdiction and are not as easily traded as closed-ended ones. Interviewee 4, however, would choose unit trusts because they allow for many owners.

Pooled property vehicle

When asked which pooled property vehicle is the best suit and why, interviewee 6 indicated that this depends on the location of the fund and its assets. This plays along with the presence of a regulatory framework. If there is one, it should be chosen in which it fits, but if it is not, as is the case in many places, then one should be chosen that fits best in that case. Interviewee 2 also indicates that different ones should be possible.

Interviewee 1 points to limited partnerships as the best choice because it limits liability and it restricts or limits the management of the fund to specific individuals that can be increased or decreased over time and allows the flexibility to develop structures accordingly. Interviewee 3 indicates choosing for a corporate approach, but a limited partnership as a second choice. A property unit trust is not very widespread, he states. A limited partnership, however, is less useful according to interviewee 2 because it can only have 20 participants. Unless a clever construction can be devised to circumvent this.

Interviewee 2 further indicates that the agreement should be digital to facilitate negotiability, because if a deed has to be arranged via the civil-law notary, this becomes very difficult. A letter-of-intent seems easier to digitise.

Real estate fund organisation

Interviewee 1 indicates that tokenization in the establishment is of most added value. He says it can be adapted to make it simpler, smoother and more efficient. Interviewee 5 and 6 endorse this, by

digitising it, the establishment can save a lot of time, but it still takes a lot of effort compliance-wise. Interviewee 2 indicates that the establishment is crucial to the success of the fund. If mistakes are made here, they cannot be reversed and you can be out of the game. This is where the foundation is laid for the legal and technical structure. Organising compliance across different jurisdictions also plays a major role here, according to interviewee 6.

Interviewee 1 and 6 say that fundraising can be greatly improved through tokenization because the threshold for joining is lower and it can be organised through more channels. However, fundraising costs a lot of effort and money because it takes a lot of time for each investor to explain the fund structure, documentation and the like, which is the bottleneck, according to interviewee 5. Interviewee 6 states that for fundraising in real estate funds, more efficient ways need to be found.

Continuous management can be greatly improved with the help of blockchain or digitisation through automation according to interviewee 3 and 5. For example, administration, registration, dividend distribution and sending newsletters can all be improved with the help of automation. Interviewee 2 mentions it as the phase in the real estate fund where tokenization and blockchain are of most added value. It makes it possible to transfer small amounts at high frequency with very low administrative costs.

Interviewee 1 and 3 mention secondary market trading as one of the phases where tokenization is of enormous added value in real estate funds. The latter indicates that this would mainly be for private funds, but according to him this would be different from what most people think. Interviewee 2 mentions its importance for liquidity. Without secondary market trading, there is still no increase in liquidity.

Regarding legislative and regulatory in the fund organisation, interviewee 2 said that the legal structure is even more important than the underlying technical structure. It must be compliant by design. Interviewee 5 states that this is not even possible without the right eligibility requirements such as KYC and AML. Only white-listed wallet trading is possible. According to interviewee 2, being compliant is very important and complex. He mentions, for instance, where you are going to offer the tokens, which legislation and regulations you must be compliant with, where the organisation is based, where the real estate is located and what does that mean for your compliancy.

According to interviewee 6, one way to organise a fund is to keep it with the same infrastructure and be tokenized as this would be a good way to start. Interviewee 1 also mentions this. It is an interim phase in which the existing is tokenized. Interviewee 2 indicates that it is important that the structure is properly explained to the investors and that this is clear. For example, what their risk is, degree of influence and how it is managed.

Interviewee 2 emphasises the importance of manageability, liability and reputation. He says that it is all technologically possible, but that the risk is that something is set up that cannot be done and therefore ruins your reputation.

> *''If you make a mistake, you are out of the market''*

Apart from that, according to interviewee 5, as a fund founder you are accountable for who you pay dividends to. He also asks the question why you should use tokenization instead of just a database. Because the decentralised nature of many blockchains does not account for that.

Payout approach

The interviewees gave different ways of approaching the payout. Interviewee 1 and 6 indicate that one way is by paying dividends in a native token. Another way would be for the payer to buy up outstanding tokens and not issue them again. In this way, the value of the tokens can increase, which can offer tax advantages because no direct return is made and this does not have to be declared. However, an indirect result is that all holders of those tokens benefit. Interviewee 4 indicates that the holders in his project are paid out in more ownership of the same fund. Interviewee 2 states that possible investors would also like to have their wallets filled with direct returns. This could be in fiat money, cryptocurrencies or other currencies.

Interviewee 1 also mentioned the advantage of automated periodic payments for the payout. However, interviewee 5 mentioned that if the payment is automated, this could cause problems if the tenant does not pay and the payment would be made immediately. He therefore indicates that it would be better to do this on an ad hoc basis.

According to interviewee 2 and 4, a compound interest effect can also occur through the payment. In this way, more capital can be generated.

Currency approach

Also concerning which currency to use, the approaches and opinions differ. Interviewee 1 uses a native token for part of the payouts, as mentioned. Interviewee 6 mentions that besides this, payments and payouts can also be done via stable coins. Interviewee 3 mentioned that until there is a digital central bank currency, he would use fiat. Decentralised currencies such as bitcoin and Ethereum are not usable according to him because of the high transaction costs which can be as high as 1%. He indicates that nobody in the real estate sector would ever work with these currencies because of the high costs. The central bank digital currency could be used for this purpose because it makes it possible to do automated distributions. Without this, one always has to refer back to the banks by means of the old transfer methods, which is a pain point according to him. He also mentions that the trust in the transfers is very important.

Issuance & trading

Interviewee 1 and 2 indicated that this could be done through brokers or trading platforms. The former indicated that they make it possible to do this and have the knowledge, but also that they comply with the correct regulations. He thinks that this is a first phase and that it will take place later via peer-to-peer. The latter mentions that it will be done through a reputable exchange that the real estate fund can join. The latter can then determine who will be its partner for the tokenization. Interviewee 5 also states that in the future this will take place via exchanges, but at a national level.

In the project of interviewee 4, the approach is different. He indicates that the tokens are not tradable on an open market but can be sold back to the fund only.

Interviewee 6 explains that for his project, the utility tokens can be purchased via crypto platforms and the security/asset-backed tokens can be purchased and traded via their own exchange. This makes the latter easier to control, according to him. In addition, he mentions that for real estate funds it is easier in terms of regulations and restrictions and it is cheaper to issue the funds on own blockchain exchanges.

New business model

Interviewee 1, 2, 3 and 6 all mentioned the possibility of lowering the minimum investment threshold and thereby attracting new groups of investors. Where previously the threshold to invest was very high for real estate funds, tokenization or digitisation and the benefits that come with it could make this easier and cheaper. This has the effect that more funding capital can be acquired and, through increased demand, the value can rise according to interviewee 2. The latter could therefore cause the value of the asset and the tradable token to become disconnected, according to interviewee 4.

> *''And also using blockchain technology and tokenization, we can reach to a larger audience around the world instead of a small pool of investors, as we are doing at the moment.''*

Blockchain

The literature research shows how a blockchain can be set up, i.e., what aspects it consists of, and what choices can be made. This was presented to the experts in order to collect their views on how to design the blockchain and why in that manner. The reasoning behind that approach could then also be deduced from it. This results in two different outcomes on blockchain: blockchain type and blockchain effect. The first concerns which blockchain type to choose and why, what choices to make on certain aspects and how to set it up and why. The blockchain effect is about what the result and usefulness is of using a blockchain (in this way).

Blockchain type

When asked which blockchain the experts would choose to build, interviewee 1, 2, 3 and 4 chose the Ethereum blockchain. They each said they would choose this because it has been tested sufficiently, is distributed and is the most widely used, and therefore solid. Interviewee 2, 3 and 6 also mentioned the importance of the size of the blockchain. This is important because it increases the trust, provides the security it needs and the safety that goes with it for the size and number of transactions that would take place. Interviewee 2 also mentions that Ethereum is used most frequently for tokenization and is also focused on smart contracts. Interviewee 1 did mention a disadvantage of Ethereum, namely that it involves high (gas) fees for transactions.

Interviewee 5 and 6 opted for other blockchains, Ignis and Binance respectively. The first mentioned chooses Ignis because it allows the development of non-tradable tokens. The latter chooses Binance because the blockchain has a big user base, offers a lot of support for development and it can handle large transaction volumes. The disadvantage is high (gas) fees. He also states that they are still orienting on which blockchain to build and that they can still switch from one to another. Interviewee 3 also mentions that this is possible, saying that he has seen the most successful projects that moved their register from one blockchain to another.

For the choice of which consensus mechanism to use, interviewees 1 and 2 choose the proof-of-stake consensus mechanism. The former chooses this because it can evaluate transactions better, more efficiently and faster than the previous proof-of-work mechanism. The latter chooses this because it is the better choice for economic and environmental reasons. Interviewee 5 also opts for proof-of-stake instead of proof-of-work because the latter is too expensive and proof-of-stake can achieve a much faster transaction speed. However, he indicates that this is only if there is eventually a blockchain technology because he indicates that the usefulness of the technology is currently low. He also mentions that it will then have to be a centralised consensus mechanism, because someone has to allow something. Especially for governmental projects. Interviewee 4 states that for a public consensus mechanism, the energy consumption and the complexity for the participants to understand it are

important. Interviewee 3 says that the consensus mechanism is not important in this scenario because, as mentioned earlier, he has seen projects that moved the register from one blockchain to another.

Regarding the role of smart contracts, interviewee 6 indicates that it drastically reduces costs in many activities. Especially compared to traditional or manual processes and contracts, this can make a difference. Interviewees 3 and 4 indicate the same, the administration and manual tasks can be reduced or replaced. A second factor is that the smart contracts cannot be changed and that they cannot be altered with in the interim by a scammer or project owner, according to interviewee 6. In summary, smart contracts are characterised by transparency, reliability and operational efficiency according to him. Interviewee 1 mentions three things in which smart contracts can play a role here: replacing central banks with smart contracts with certain triggers, to function for protocols and to function for agreement management in real estate funds.

Interviewee 2 states that a strong blockchain is important to ensure that the smart contracts do not make the wrong decisions or are manipulated. Interviewee 4 looks into the possibility of incorporating the token and its representation into the pool of assets by means of a smart contract, i.e., by automating it.

What approach to take regarding centralised, decentralised or hybrid is divided among the interviewees. Interviewee 1 indicates that for now he would choose a central blockchain. However, with the right protocols and methods, a hybrid or decentralised approach will be possible in the future. Interviewee 6 states the same; currently centralised but in the future possibly decentralised or hybrid. For interviewee 4's project, he is using a hybrid blockchain that allows it to work transparently but guarantees privacy. It also centrally manages tradability.

Interviewee 2 says that a centralised or hybrid blockchain is too much in its own system and does not capture the power of the technology. He says that blockchain is decentralised, where no one can influence the result which the blockchain calculates. For example, interviewee 3 says that if a blockchain is centralised, it does not matter whether it works through blockchain or another database technology because it is then essentially regulated by a central authority. Interviewee 5 adds to this by stating that a central blockchain is very expensive to develop. But centralisation is necessary to prevent money laundering and 'dirty' money, he states.

Interviewee 5 emphasises that a(nother) database technology offers advantages and is easier to organise compared to a blockchain. Firstly, he says that a database is cheaper and faster. In addition, it does not matter if someone were to break in, because the property is registered elsewhere. Also, someone could lose their login details and for that it needs to be centrally organised. Automation through digitalisation, he says, is the advantage of bringing together real estate funds and a database technology; it makes processes easier and faster. Regulatory problems are the reason not to use tokenization, he says. He says that real estate fund tokenization is not possible unless they are tradable on a platform where everyone has done KYC and tradability is limited. But even then, he questions, why not choose a database over centralised blockchain given its aforementioned advantages. For his project, he uses blockchain for transparency. There, the tokens are non-tradable and they only work with white-listed wallets because that is a regulatory requirement.

> *''One of the requirements of the European regulations will be that it is a restricted tradable token, so only tradable to and from whitelisted wallets. Back to the aforementioned: ''why not a database?'' Because those people have to create an account anyway, they have to do KYC. And a database is many times faster than blockchain technology, many times cheaper than blockchain technology.''*

Interviewee 3 explains that in his project it only operates in the background. It works more as an internal procedure in the fund management and has little to do with the investor management. It is also not even mentioned. So, the token is also more internal and not something that is 'passed around'. The shares are registered. They are registry-based issuances that the registrar controls. And even though it may be said that it is distributed, it is not because the shareholder registries are not something that is passed around.

Blockchain effect

Interviewee 1 indicates that blockchain technology can have various effects in cooperation with real estate funds. First, it can provide transparency and the ability to monitor and track transactions and time batched transactions and management of the fund can be done very efficiently and at low cost. Interviewee 2 adds that administrative costs can be drastically reduced and secondary trading can become much easier and faster. The administration can also be reduced enormously.

> *''It makes it possible to run registries that are trustworthy outside of the registrar and the party issuing the registry. It allows programmes to be built into the registry to digitise manual tasks that are currently happening and therefore gain efficiency.''*

So, it allows to gain efficiency, transparency, trust and security if done right. If it is not done right, all those things fail, according to interviewee 3. Transparency and efficiency is also what interviewee 6 mentions as an effect of applying blockchain technology. That trust is also what interviewee 4 emphasises; people may gain more confidence to invest because of the transparency that follows. It would also make it possible to connect different data in real estate, he states.

Tokenization can also have different effects on real estate funds, according to the experts. According to interviewee 1, this is in terms of efficiency, lower costs, lower time utilisation, much faster processing to liquidity. Interviewee 6 agrees with this and also mentions the larger investor pool that can be made possible by this. According to interviewee 3, the added value lies in running the registry and the distribution and secondary trading. And secondarily, it can be a little bit helpful in sort of the post management.

Interviewee 5 sees the added value mainly in automation for real estate funds. According to him, many real estate funds work in an old-fashioned way with a lot of manual operations and administration. He indicates that this can all be standardised and automated.

> *''There are many real estate funds that still do everything the old-fashioned way. So, the issuing the documents, getting approval, collecting money, keeping Excel spreadsheets of what they have to pay out, administrative staff on it. That can all be automated and standardised.''*

Legislation

The interviews reveal the important emphasis on legislations and regulations. Therefore, this is placed in its own section. This is because it is determinant in what is allowed (at the moment) and from that how it should be implemented. From the interviews, the legislative and regulatory needs and the organisation of compliance follow, in addition to what is processed in those specific sections, such as for real estate funds for instance. The first is about what the experts see as necessary in the field of legislation and regulation to make the developments possible and to stimulate it further. The second is about how to (currently) implement it in order to meet current compliance.

Legislative and regulatory needs

Interviewee 1 mentions that legislators and regulators want things to settle before they act on them. Interviewee 4 indicates that they have to work proactively because otherwise there is a risk of being outrun by others and becoming dependent on them or having to go along with technologies they have developed. He also stresses the danger of new unregulated system(s) of taking over (a part of) the regulated monetary system.

The regulators' and legislators' understanding of the technology and what it encompasses is mentioned by interviewee 1, 5 and 6. They all mentioned the importance of further development at the legislative and regulatory level.

> *"What is needed in terms of requirements is a good understanding of the opportunities behind the technology, but also of the challenges."*

Interviewee 3 describes that the administrators must start using additional technology openly and actively. That is probably the number one blocking factor. And he says the solution to that is to have less 'noise' in the industry because it confuses them a lot. A lot of new terms are used and that can be avoided by not using those for things that they already know very well and use for a long time, this makes it less complicated. Interviewee 4 also indicates that the attitude of regulators should turn towards wanting to develop with, instead of only assessing.

Interviewee 2 and 4 also indicated that harmonisation of legislation and regulation is also very necessary. A kind of global standard would help, according to the latter. According to interviewee 6, a number of countries are reasonably open to trading tokens, but much still needs to be done.

The recognition of and adaptation in legislation of digital assets is something that interviewees 2 and 6 stress. It must be made clear how this is to be done and how it is to be dealt with. Interviewee 6 also mentioned the need for regulatory and legislative frameworks and clearness for compliancy, secondary trading and taxation.

Compliance organisation

The experts give different insights on how it (currently) works in terms of compliancy for tokenization in real estate funds. Interviewee 2 emphasises the importance of legal compliance. A lot has to be aligned in order to achieve this, he says. Interviewee 3 adds that in order to do this, the current eligibility requirements for trading the tokens must be met: AML and KYC and are carried out by third party transfer agents. Interviewees 5 and 6 also indicated that working in regulatory compliance fashion and KYC is and will be required.

Interviewee 5 also indicated that he expects European legislation to require that the trading of tokens be restricted and only from and to whitelisted wallets. He also states what the reason would be for using blockchain instead of another database, as discussed earlier. It must also be possible to fully guarantee the source of the funds. This is also linked to his comment that the biggest problem of blockchain technology is the fact that it is decentralised. He adds that it must be centralised, otherwise it will be impossible to retrieve the login data. With regard to the source of funds, interviewee 6 adds that there are also issues concerning (international) money laundering.

The experts also mention various issues for the tokenization of real estate fund products. Interviewee 2 indicated that legislation is the bottleneck for speeding the product to market. Interviewee 3 indicates that there is already a legal setup for the distribution of shares at national or European level

(via ESMA passporting regime) or via a non-European methodology. It concerns registration-based issuance.

Tokenization

The tokenization aspect of this can be addressed in various ways, as is apparent from the literature research. Again, the experts were asked what their view on this was and why. It also appears that legislation and regulations play an important role in this. Which was incorporated in the previous part on legislation. The interviews show how to set up tokenization - which can also be understood as 'tokenomics' - and how to configure the token.

Tokenization setup

The interviewees mentioned different insights into the valuation aspect of the token. Interviewee 2 indicates that this is a choice to make in the establishment and that it is certainly important. This can be done by linking the value one-to-one to the asset value of the property, or as a free market in which the value can then fluctuate. It must be determined how the valuation takes place and how accurate it is. He indicates that this could be done quarterly or periodically and extrapolated at the time of the transaction, or through a fully automated model that provides a valuation for a transaction at any time. If the value is decoupled from the real estate, there can be a potential for value creation, he says. For example, if there is more demand than supply. Interviewee 4 also indicates that the value of the token can be linked to the value of the property and thus fluctuate with that value. Interviewee 1 says he would like to see the token have a cumulative aspect of investment, so that the fund can increase not only in dollar value but also in unit value or count. Also, he would want the token to have an infinite point of return.

Interviewee 1 also mentions the issue that if the equity or security is only tokenized, an incorrect correlation arises between it and the underlying asset in the valuation due to tranches of costs that arise. The solution is to also tokenize the underlying. Moreover, he says that it is important to store reserves in connection with the fact that real estate is a cyclical market and that in less economically prosperous times reserves must be kept in order to allow growth to take place organically.

Interviewee 6 explains that in his project, the value of the token follows the value of the real estate because it is a kind of stable coin that does not fluctuate drastically in the short term. So, this token is similar to a security token and is one of the two tokens in his project. The other is a utility token, or as he calls it; a governance token, that allows users to make transactions in their ecosystem. In this project, the security tokens are also kept on the own exchange.

Interviewee 5 indicates that tokenization is still very difficult from a regulatory perspective. The token must not be tradable on an open market, otherwise it is a freely tradable financial instrument. It should be a restricted tradable instrument, according to him. The trade has to be approved by someone, because it should not fall into the wrong hands. As a fund, you have to know to whom it is being sold. He also says that the financial authorities will not even consider a fund with freely tradable instruments. He himself uses non-tradable tokens in his project, which are used for the benefit of transparency so that one can see that they are not being sold twice. These tokens can still be changed to tradable tokens if the regulations ever allow it, he says.

Interviewee 3 indicates that the meaning of a token is different from what people say or think it is, saying that the word is meaningless. For one thing, he says, it is something that takes place more in the background, in the back end. On the other hand, the token is not the representation of the share. If you break it down into legal form and put it in front of judges and lawyers, it consists of the same

theory that was available prior to this technology. He explains that they are registrar-based issuances that are controlled by the registrar and even though it is said that they are distributed it is not the case because the shareholder registries is not something that is passed around.

Token configuration

The interviewees were asked how they set up the token technically and why. Interviewee 2 indicates that the token type depends on how you want to structure your product. This can be done, for example, with an NFT if you want to specify each token or with an ERC-20 if you want to divide a fund into equal parts. Interviewee 4 said that in his project the ERC-20 protocol is used. This is because it is the most tested, stable and proven. Interviewee 6 also uses this protocol. He uses it because it can handle large volumes of transactions and because they get a lot of support from the technology for it. Interviewee 3 indicated that a 1440 protocol was used in his project. It is important that the token type is heavily used, i.e., is used in large transaction volumes, otherwise it is difficult to trust that there is no flaw in it. Furthermore, it must be simple, well understood and tested. Interviewee 1 further indicated that he considers it important that the dynamics of the tokens are very clear from the issuance.

However, interviewee 3 indicates that they are not very different and it does not matter so much which is used as it cannot be sent to unknown third-party wallets anyway because it has to be registered. And the protocol does not matter that much because a system on which a third party would run does not have to be connected to it. And by not allowing it to be sent to a third party, you probably only make it easier for yourself.

> *''Because you're not going to be sending these things out to unknown third-party wallets that have to understand the protocols anyways ... If you do, it doesn't really matter so much because then you're going to be able to adjust it via the registry anyways. And if you don't allow them to go out to there, it probably just makes your life easier.''*

5.1.1 Other

As mentioned, there are four things that do not directly apply to the implementation of tokenization in real estate funds or are in another shape already mentioned elsewhere in the results. These are discussed in this subsection. These things are: standardisation, unchanged way of working, success factor and real estate influence.

Standardisation

Interviewee 1 mentioned the need for standardisation in both operations and management and regulations. According to him, the latter can result in less frustration and more clarity for users. Interviewee 5 is already working on standardisation in his project; they have standardisation in the documentation. That way, a document can be filled and handed in immediately.

Unchanged way of working

The interviewees also mentioned a number of points where nothing needed to be changed and work could be done with or as it is now. Interviewee 1 indicated that the deployment of the funds can stay a level with what it is now and the methods and rules that we have today can still be followed. Interviewee 3 and 5 also mention that activities in the fund remain the same. The first one indicates that the management, with for example the issue of dividends, investor management should always be done. The latter indicates that a real estate fund has restrictions and these remain, and also that an offer document must always be submitted. Interviewee 2 concurs with this. He said that both listed

and non-listed funds will have to continue to meet certain compliancy requirements and need permits from a regulator.

Interviewee 3 and 4 stated that they can operate within the current laws and regulations. The latter indicates that his project has been working with blockchain for three years. Interviewee 3 says he can launch his project within the existing structure, but mentions the risk of legislation and regulations changing, which could have a negative impact on his project.

Interviewee 1 also mentions that tokens can work like shares work now. For example, stock splits can also be done for tokens.

Success factor

Each interviewee have mentioned several success factors. These are discussed below for each interviewee.

Interviewee 1 first mentions people's adoption of the idea of tokenization. He also mentions service and risk management. With the latter he mentions the problem of the novelty of this. Because usually people work with previous experiences and experiments, this is difficult because it is not there yet, he explains.

Interviewee 2 also mentions risk management, but then more about liability. He adds to that with reputation. If you can set up something that turns out it doesn't work later on, it can ruin your reputation.

Interviewee 3 explains that technology can provide smoother operations and new opportunities, but if you present it as a forefront and have to explain it, it is a risk. And he explains that real estate is a sector where small risks are a big deal so it probably won't scale because of that.

Interviewee 4 names four points: comprehensibility, transparency, convenience and validation. The latter refers to the fact that the information on the blockchain must be correct, otherwise it could mean a loss of trust.

Interviewee 5 explains that it is all technologically possible, but that two things are extremely important. These are: trading from and to whitelisted wallets and regulatory approval. He explains that the regulations must move with this and allow it. Because, as he points out, nobody in the crypto world is interested in centralised financial instruments.

The success factors of interviewee 6 were mentioned earlier. These are: the issues concerning AML need to be resolved and the education concerning understanding how the technology and such works.

Real estate influence

The asset class real estate will evolve over time and this is the future according to interviewee 1. The characteristics of the asset class will change and that is something that will have to be understood and accepted.

Interviewee 2 explains that it might be more than an alternative to and what might increase the market for investing and real estate. Interviewee 4 indicates that it can make the real estate market healthier and more transparent. People with the wrong intentions have their playing field reduced by a kind of enforced transparency.

Interviewee 6 calls it one of the biggest disruptions in real estate in the last 100 years. He explains that the real estate sector has long been a playing field for a small group of people with a lot of wealth,

creating a lot of disparity. For instance, younger people and retail investors cannot anticipate in this market due to the inefficiencies of the existing structure. On the one hand, it can result in greater efficiency in the market and, on the other, it can lower the threshold for investment and make it fairer, quicker and more accessible for investors and homebuyers to invest in and buy property.

5.2 Conclusion

The interviews conducted are with six experts who have knowledge and expertise of real estate funds, blockchain and tokenization. The interviews featured sections on real estate funds, blockchain and tokenization and a concluding section. Subsequently, the interviews gave rise to four topics with corresponding aspects. Of which the results are processed accordingly. Following the three topics of the literature research, legislation has been added as a topic. The interviews have shown the importance of legislation and therefore, in order to emphasise this and reflect it properly, it has been included as its own topic. Real estate funds, blockchain, tokenization, legislation and especially their aspects represent what needs to be undertaken and is important in the implementation of tokenization in/of real estate funds. The results contain varied insights from the different interviewees. This is concluded below by topic and lastly in its entirety.

There is also a subsection 'other' which contains things that are not directly applicable to the implementation of tokenization in real estate funds, but relate to tokenization, blockchain, real estate funds and the real estate sector.

The first topic, real estate funds, contains aspects that follow from questions on the real estate funds, but also from other topics where these are eventually (mainly) applicable to real estate funds. The interviewees are divided on which property fund type to choose; the results give insight into what it would imply to choose one or the other. On the real estate fund structure, various advantages or reasons are given as to why one should choose a certain structure, but it is also indicated that it is only a preference choice and that for tokenization another property fund structure might be needed. For the pooled property vehicle, reasons are also given for opting for certain ones, whereby it is also specifically mentioned that regulatory implications and implications by digitalisation in it are important.

In the section on real estate fund organisation, the interviewees' insights into the various phases of the real estate fund, as it was presented, are given. But it also includes further implications for how to organise the real estate fund in combination with tokenization and what is important there. Different (contradictory) insights are given on how to arrange the payout and what currency to use for this. The interviewees have different views on how the issuing and trading should take place, for example, this can be done through exchanges, which in turn can be managed in-house or by an external party. Or these cannot be issued at all, as this strongly depends on whether the token is tradable. As a final result, it is implied what kind of result tokenization or digitalisation can have on real estate funds.

Furthermore, the interviews reveal that tokenization and real estate funds can operate in two ways. It can be referred to as; ‘’tokenization of the real estate fund’’ when tokenization, blockchain and the real estate fund cooperate in its entirety. When tokenization takes place in a fund and/or its processes, it can be referred to as; ‘’tokenization in the real estate fund’’.

The Ethereum blockchain is the most chosen blockchain, as it is widely distributed, widely tested and most widely used. Other named blockchains are Ignis and Binance. Different reasons, advantages and disadvantages of the named blockchains are given. This also applies to the consensus mechanisms, whereby further individual insights are also given. The interviewees also explained the role of smart contracts, in which the main characteristics are transparency, reliability and operational efficiency.

According to the interviewees, the approach to a centralised, decentralised or hybrid blockchain is likely to shift (in that order) over time. For example, it would be better to work with a central blockchain now and to shift to a hybrid or decentralised approach in the future. However, according to one interviewee, the power of the technology is not through a centralised approach but through the decentralised.

Other interviewees also mentioned critical points regarding blockchain and tokenization. One interviewee questioned the usefulness of blockchain in relation to database technology, claiming the latter to be cheaper, faster and without the risk of hacking or loss of login data. Furthermore, tokenization is not possible due to regulatory issues, unless it meets regulatory compliance and tradability is therefore limited. Again, this interviewee raises the question of opting for blockchain. Blockchain and tokenization is currently only useful for transparency and possible as non-tradable tokens, according to him. Another interviewee emphasises that tokenization takes place more in the background and serves for automation and digital operability. The shares (tokens) are namely registry-based and cannot be transferred between people for compliance reasons.

The use of blockchain can have several effects. It can generate transparency, trust, security and efficiency, and provide the ability to monitor and track transactions and time batched transactions, fund management and administration can be done very efficiently and at low cost, secondary trading can become much easier and faster.

The interviews revealed the importance of legislation and regulation on this subject. One of the aspects deals with what is needed in the legislative and regulatory field. In addition, the importance of complying with legal compliance was mentioned, because without it, it is simply not possible. This includes regulatory legal compliance, current legal setup and potential future European legislation.

In terms of tokenization, two aspects emerged from the interviews: tokenization setup and token configuration. In regards to the former, it turned out that the valuation of the tokens is an important aspect. This can also be handled in different ways. Other aspects that are mentioned are the tradability, type of token and the connection of the token to the real estate or not. The interviewees gave various insights into this. Another notes that it is something that happens in the background and is nothing new in legislative terms. For the token configuration, it appears that there is quite a lot of flexibility in it. It was also indicated that for the token type it is important that it is heavily used, simple, well understood and tested, and has large transaction volumes to ensure trust in it.

Other things that are not directly applicable to the implementation of tokenization in real estate funds are placed in the subsection "other". Standardisation is one of them and includes the need, usefulness and discusses its application. Unchanged way of working includes where and how to work with current methods and within current laws and regulations. All interviewees also indicated various success factors that are required within a project, legislation or society to make it a success. Influences on the real estate sector are also mentioned. It is seen as a major disruption to the sector and makes the market healthier, fairer and the threshold for entry lower, but it can also provide greater efficiency.

In conclusion, it is observed that there is no uniform perspective on the tokenization in/of real estate funds and the interviewees' approach to it. It also appears that there are many different possible approaches to it. However, the results do contain many insights into how to tackle different aspects, what implications it has, what is important, what the advantages and disadvantages are, etcetera. It also becomes clear that the market is not mature yet and that there is no marketed or launched product that uses tokenization on/within a real estate fund (yet). It should be noted that this applies to the time of writing, as much is related to the development of this.

In addition, it appears that the tokens and the blockchain are difficult or impossible to organise in a entirely decentralised manner. This is because it must be clear who owns the shares, i.e., the tokens, they must be registered, which restricts their tradability, and compliance requirements must be met. In this regard, an interviewee questioned why a blockchain should be chosen instead of a database technology that offers advantages over a blockchain.

6. Implementation

The previous chapter dealt with the interviews. These interviews consisted of questions that followed from the literature research on real estate funds, blockchain and tokenization. It contains the results that emerged from these interviews and provides insights on how to implement tokenization in real estate funds. An important observation to mention in this, is the importance of legislation and therefore this is added to real estate funds, blockchain and tokenization as a topic. These results serve for the processing in this chapter and it continues with the last part of the empirical research. It discusses the structured information collection and the proposed way of implementation.

This chapter first explains how the results from the interviews lead to the structured information for the implementation. This is followed by an explanation of what it entails, how it works and what can be done with it. Subsequently, how tokenization can be implemented in the proposed way of implementation of tokenization in/of real estate funds is discussed. Finally, the discussion and conclusion of the chapter are covered.

6.1 Transition from interview results to the structured information for the implementation

This section explains why and how the structured information is drawn from the outcomes of the interviews and why in that way. First, it explains in summary what emerged from the interviews that influenced the conception of the structured information and its relevance. Then, the content is explained and what the rationale behind it is.

The (structured) information is relevant for several reasons apparent from the interviews. First, it appears that there are many different ways to implement tokenization in real estate funds. Choices need to be made in the implementation as is evident from the literature research and the experts gave different answers in the interviews to the questions, with corresponding substantiation, on how they would approach it. This, in turn, shows that it possible in the implementation to choose between many options. In addition, there is no uniform perspective from the experts. This would therefore make it incorrect to set up a way of implementation and state that it is the only possible way.

Implementation also faces another challenge in that it is very difficult in terms of legislation and regulations. This is mainly because the shares (i.e., tokens in this context) must be registered. Free tradability, which is a prominent characteristic of decentralised blockchains, is therefore not possible. This makes it necessary to look at what is currently possible.

Following on from this, other possibilities besides blockchain and tokenization could also be looked at. Other database technologies, automation in processes and digitalisation in general are considerations mentioned in the interviews.

Hence, it can be concluded that the market is not yet mature and information, knowledge, progress and experience are still lacking in many areas. Thus, at the moment, tokenization in real estate funds needs to be implemented step by step. This therefore makes the collected information necessary for anyone wishing to implement tokenization in their real estate fund. There are many choices to be made and for different reasons. The structured information helps with that. With all required information structured in one place, well-considered choices can be made to work step-by-step towards tokenization in/of real estate funds. It can thus be considered as the basis for the implementation.

Content of the structured information for the implementation

The results of the interviews lead to many insights on how to do things, what implications this has, what is important and what are the advantages and disadvantages on how to implement tokenization in/of real estate funds. This followed from the coding of the transcribed interviews. Additionally, in the semi-structured interviews, room is left for the interviewees to answer the questions as they wished and for the interviewer to ask further questions. This led to a large collection of further insights.

The information is structured so that on real estate funds, blockchain, tokenization, legislation and their aspects insight can be gained into:

- What has to be dealt with;
- How it needs to be tackled;
- What implications that has;
- What is important in it;
- What has to be taken into account and/or;
- What has to be observed; and
- What the advantages and disadvantages are;

In the setup or processing of blockchain in and tokenization in/of real estate funds.

For the implementation of tokenization in/of real estate funds, this basis should be taken into account. It explains what is needed and the necessary explanations for the implementation are provided.

6.2 Explanation on how to use the structured information

The structured information contains insights on what is important, what are advantages or disadvantages, how to approach something and what implications it has on the different aspects. The stated information concerns how to implement tokenization in/of real estate funds. To create more structure and overview in the information, labels are added that refer to the tokenization in/of real estate funds as mentioned:

- Applicable: this is directly applicable;
- Choice: a choice needs to be made;
- Desirable: this is desirable to promote development;
- Insight: this is an (existing) aspect on which new insights are created in this respect; and
- Effect: a possible effect arises or this is a possible effect of the application on the discussed matter.

For an entity that wants to implement tokenization and blockchain in or of the real estate fund, this information can be used as a foundation to make choices and can be used to gain more insight in this.

The structured information is in Appendix IV: Structured information for the implementation of tokenization in/of real estate funds. This contains all the collected information with explanations on tokenization, blockchain, real estate funds and legislation.

Table 7 below shows the overview of the topics, aspects and associated labels of the structured information. To create more overview in this, the headings in it have the same format as in the structured information.

Table 7: Overview of topics and aspects and corresponding labels of the structured information (own source)

Topic	Aspect	Choices, insights, effects, applicable or desirable	Label
Real estate fund			
	Real estate fund type		
		Non-listed *or* Listed	Choice
	Real estate fund structure		
		Choice of preference	Insight
		Unit trusts *or* Open-ended structure *or* Closed-ended structure *or* Unit investment trust *or* Unit trust	Choice
	Pooled property vehicle		
		Location & regulatory framework	Insight
		Limited partnership *or* Property unit trust	Choice
	Real estate fund organisation		
		Establishment	Insight
		Fund raising	Insight
		Continuous management	Insight
		Secondary market trading	Insight
		Legislation & regulation in the fund	Applicable
	Payout approach		
		Native token *or* more ownership *or* buying outstanding tokens	Choice
		Compound interest	Choice
		Automated *or* ad hoc	Choice
	Currency approach		
		Native token *or* stablecoins *or* fiat *or* CBDC *or* decentral coins	Choice
	Issuance & trading		
		Internal *or* external exchange *or* internal exchange	Choice
Blockchain			
	Blockchain		
		Blockchain requirements	Insight
		Blockchain effect	Effect
		Tokenization effect	Effect
		Role of smart contracts	Insight
		Ethereum *or* Binance *or* Ignis	Choice
		Consensus mechanism	Choice
		Centralised *or* decentralised *or* hybrid	Choice
		Blockchain *or* database technology	Choice
Tokenization			
	Tokenization setup		
		Valuation of token	Choice
		Token type	Choice
		Regulation	Insight
	Token configuration		
		Token protocol	Choice & insight
		Token relativity	Insight
		Registration of tokens	Applicable
Legislation			
	Legislative and regulatory needs		
		Proactive approach of legislators	Desirable
		Harmonisation	Desirable
	Compliance organisation		
		Complying with the legal requirements	Applicable
		Centralisation	Applicable

6.3 Proposed way of implementation of tokenization in/of real estate funds

In this last part, the most important characteristics and challenges of real estate funds, blockchain, tokenization and legislation are collected. In this, it is examined what a starting point might be and what solutions are needed to include the important characteristics and it takes the challenges into account. Also based on this and the literature and interview results, choices are made on how to implement tokenization and blockchain in the real estate funds. At last, the effects of this are discussed.

Based on the preceding information of the literature and empirical research, this results in a proposed way of how tokenization can be implemented in real estate funds. In which choices are made on (the aspects of) real estate funds, blockchain, tokenization and legislation. These mostly correspond to the aspects labelled as ''choice'' in table 7. The explanations given below follow the same order as the mentioned topics.

Important characteristics and challenges

For the real estate fund, it is important that it complies with laws and regulations and consequently can be approved by the financial authorities. It must be taken into account that this can vary per jurisdiction, for example on the location of the investor or the fund. Further, it is up to the originator to decide how to set up their product, provided that it is compliant.

The blockchain must be large, i.e., widely distributed and in transaction volume, and that it has been tested extensively. And it cannot achieve free marketability as this would not be compliant.

For tokenization, the tokens cannot be freely tradable. The tradability is therefore highly restricted, which makes being compliant an important aspect here as well. This is because tokens need to be registered. In terms of configuration, it is important that the token protocol is simple, stable, well understood and tested to ensure trust. In whatever way this takes shape.

As it involves the trading of financial instruments, the trading must be compliant with legal requirements. Before trading can take place, it must be approved by the financial authorities.

It can be observed that complying with laws and regulations is crucial. On a technical level and for the real estate fund, choices need to be made in how to set this up and how to make it compliant.

Besides compliancy, there are other challenges in the implementation and set-up of the real estate fund in combination with blockchain and tokenization. For instance, it is hugely important that the product is set up properly from the start, otherwise it may cause issues at a later stage. It is also mentioned, for instance, that if a mistake is made, you are out of the market. In addition, the reputation of the project and its developers is very important and does no good if the market's perspective on it turns.

Also, the real estate sector is by itself a highly risk-averse sector, where they want to mitigate all risks. With the entry of a new technology, which can be seen as bringing new and potentially more risks, it might be difficult for this to be embraced.

Similarly, the market, real estate sector and people in general need to become familiar with what the technology is, how it works, what it encompasses and such. This way, more understanding can be created and one can see what it can offer.

In the implementation, many choices can be made and there are many choices to be made, all of which again have certain implications and at the same time have to be combined with other choices made. This makes the chance of making mistakes high, where it also has to match the market and its needs

and at the same time must be compliant. Also, there are still many unknowns in these areas. In addition, the target group of a product like this is still unknown. In which a distinction can also be made in how the product is set up and which target group fits in with it.

The development in both technical, legislative and market terms is going extremely fast. This can make it difficult for a project to keep up with the latest developments in these areas.

Starting point

The setup of the real estate fund, blockchain and tokenization is up to how the originator wants to set it up but must be compliant. This must include that the shares/tokens must be registered and cannot be freely traded. The real estate fund must also know with whom it is trading and what the source of funds is. Working within the currently developed frameworks can offer a solution for this. Furthermore, for the real estate fund choices must be made as these are mentioned.

The blockchain cannot be used for freely tradable tokens, must be registered with a registrar and must only be able to function as a trading platform to and from whitelisted wallets, and consequently must therefore be centrally organised to achieve this. It is also important that this is in principal solid to obtain the necessary trust (for the investors). The blockchain must be set up in such a way that it encapsulates all this.

Because the tokens/shares are not freely tradable, tokenization would operate more in the background in order to achieve the desired effects. The automation will provide for this.

A consideration can also be made to choose another database technology that contains automation, as this should be easier, faster and cheaper than a (central) blockchain. This also overcomes the registration (of shares) and hacking issues, as everything is registered in the first place. Also is there no problem if someone loses their log-in data, as this can be recovered.

In order to be compliant, regulatory requirements for trading, i.e., AML (Anti Money Laundering) and KYC (Know your customer) must also be met.

Since laws and regulations change, the achievement of these requirements may also change in the future. However, this gives a starting point on how to achieve this based on the important characteristics and challenges.

The choices made

Real estate fund

For the real estate fund type, it appears the impact is greatest for non-listed funds. These can then be traded on secondary markets, which can bring efficiency in administration and back-end of the fund and other advantages of listed funds. However, it should be taken into account that the fund will become (partially) listed and implications such as associated laws and regulations will arise. The non-listed structure is chosen because it is - believed to be - the better structure in real estate, these often function better than the other structures and is a common structure (especially for non-listed funds). It should then provide more transferability and fungibility. For the pooled property vehicle, the limited partnership is chosen. With this form, liability is limited and it restricts the management of the fund to specific individuals that can be changed and thus allows flexibility to develop different approaches over time. Two things that need to be tackled in this are the limited number (20) of participants and the agreement that needs to be digitally facilitated. Smart contracts can be helpful here.

Trading and issuance of the tokens (i.e., shares) is done on an internal exchange. On this, processes can be more easily controlled and done, it is easier to reconcile this with regulations, restrictions and

other associated laws and regulations, and it is often also common for (non-listed) funds to do this on their own platform. Payout is done by means of a periodic payout with a currency of the investor's choice. This periodic payment is processed using smart contracts, which can solve cash flow problems (e.g., in case of vacancy or non-payment of rent) and facilitates an efficient process. It is common on similar (investment) platforms that the currency in the payout can be chosen by the investor. This can then be fiat, stablecoins, cryptos, a native token or a central bank digital currency, for example. The latter may also later become the replacement for fiat.

Blockchain

The chosen blockchain is the Ethereum blockchain given that it matches the required characteristics named by the experts. Namely, it includes the required size, is widely tested distributed and widely used and is therefore solid. This consequently includes the proof-of-stake consensus mechanism. This ensures good transaction evaluation, speed and efficiency but is also better for the environment than proof-of-work. As Ethereum recently switched to the proof-of-stake consensus mechanism.

For the purpose of tradability of tokens, which cannot be freely traded, the blockchain needs to be centrally organised. Hence, it is necessary to comply with laws and regulations. Which is also necessary for the platform on which issuance and trading take place. A private Ethereum blockchain can be set up for this purpose.

Tokenization

For the valuation of the tokens, it is chosen to allow it to fluctuate based on supply and demand. This is also common practice at present. The token type becomes a security token which is backed by the asset(s). The valuation in this case fluctuates with the value of the real estate or fund on the one hand and the market on the other. It is therefore similar to securities, making it easier to comply with laws and regulations. The tokens are also bound to the platform and therefore not freely tradable.

The liquidity of non-listed vehicles and closed-ended funds can increase as a result of tokenization. It therefore makes sense for the timing of valuation to take place regularly, e.g. daily or through an automated model that facilitates direct trading.

For the token protocol, the ERC-20 protocol is chosen because it is simple, widely used and tested, it is stable, it can handle many transactions and is thus proven to be a strong protocol. Also, it allows ownership in the fund to be divided into equal parts.

Legislation

To achieve this and get concrete what is important in terms of legislation, a number of things need to be organised or taken into account. First of all, regulatory requirements need to be met by the users on the platform. These requirements are Know-your-customer (KYC) and Anti-Money Laundering (AML) and must be carried out by a third party. Also, the tokens/shares must be registered by a (third party) registrar. Furthermore, it is expected that within European regulations, only trading to and from whitelisted wallets will be possible, so this must be organised in advance. Furthermore, the source of funds must be guaranteed, so this must be incorporated in the processes. Lastly, via the ESMA passporting regime, the distribution of shares can be regulated at national or European level. Ultimately, it is of utmost importance that the product is compliant and approved by the (authoritative) financial authority.

Possible effects

Applying tokenization and blockchain in the way described above can cause several effects. For instance, there can be a (large) increase in liquidity as a result for non-listed, closed-ended real estate funds. This is due to both secondary trading but also by creating a larger investor pool. This secondary trading can also be applied to a part of the fund (later) or at some point in the lifetime of the fund. The larger investor pool can be created by lowering the barrier to investment due to lower entry prices and lower costs. The lower threshold consequently creates more democracy in real estate investment. The lower costs arise from automation in and digitalisation of the real estate fund. This covers, for example, processes that take place digitally and might be automated.

Other effects - by blockchain (or other database technology) and tokenization - can be transparency, trust, lower costs, lower time utilisation and security. The former can give investors more confidence to invest and the monitoring of investments can be transparent. Furthermore, it allows for more efficiency, lower costs, smoother processes in the management of the real estate fund.

6.4 Discussion

The new technology blockchain has made its entry into the real estate spectrum and particularly within real estate investment. An application of this technology, called tokenization, is currently mainly focused at (single) property object level. However, it appears that this can be done more effectively through real estate funds. This is due to on the one hand, the limited demand for fractionalisation of single real estate properties, acceptance of blockchain by the market and regulatory issues. On the other hand, real estate funds offer a market with demand for fractionalisation, an underlying structure for fractionalisation and regulations for this already exist (Baum, 2020). In existing literature, however, there is limited attention to and knowledge of the coherence of real estate funds, blockchain and tokenization, let alone how to realise the conjunction of it. The aim in this study is to investigate how tokenization can be implemented in real estate funds.

Regarding fractionalisation, it appears that (real estate) funds are already regulated for this, the structure is in place and fractionalisation is common here (Baum, 2020; Pang, et al., 2020). However, if this is brought in conjunction with tokenization, other aspects come into play. Two interplaying elements of tokenization are namely decentralisation and free tradability (Laurent, Chollet, Burke, & Seers, 2018). As this current research shows that this poses the problem for real estate funds; the shares (tokens) need to be registered, which thwarts decentralisation and thus free tradability is not possible. This does not mean that tokenization is not possible, as it can be achieved if the right regulatory requirements are met which also means it must work through a private (centralised) blockchain and tradability is restricted (Laurent, Chollet, Burke, & Seers, 2018). But decentralisation and free tradability are thus hampered. This therefore restricts the secondary trading of tokens as it is intended.

The activities in a real estate fund where tokenization is implemented are: establishment of the fund, fund raising, continuous management, corporate action management and distribution of investments/secondary market trading (Ferrari, 2016; Pang et al., 2020). These phases are used in the interview questions. From the interviews it appears that these phases are also common in a real estate fund where tokenization is implemented or for projects where this is going to happen, these phases are taken into account. However, it is mentioned that there may be differences in these phases depending on the fund set-up and consequently they may differ accordingly.

The literature research identifies the problem regarding decentralisation and the regulations related to it (Laurent, Chollet, Burke, & Seers, 2018). For this, (international) governments are designated to provide solutions. Standardisation and frameworks are mentioned as starting points (Konashevich,

2020). This is endorsed by the interviews, standardisation and frameworks are required to know how something can and should be developed.

Tokenization is defined as a process or method in which assets are digitised into tokens that represents that asset from which it can be traded internationally (Laurent, Chollet, Burke, & Seers, 2018; Baum, 2020; Sazandrishvili, 2020). This is done on the blockchain in which the information is digitised and approved within a decentralised system which is governed by all participants in the network (Hileman and Rauchs, 2017; Kulkarni, 2019). Contradicting to this is that in a compliant application, tokenization takes place in the background and trading takes place on a private system. In this, the blockchain cannot be decentralised either.

The benefits identified in the literature research relate to the effects that arise from the implementation. Thus, the identified benefits: greater liquidity, reliability in investing, automation, transparancy and trust (Swan, 2015; Drescher, 2017; Hileman & Rauchs, 2017; Seuren, 2018), are also reflected in the effect that follows from the proposed way of implementation. Moreover, effects that subsequently follow are in this: larger investor pool, lower threshold and costs, more democracy in real estate investment and smoother processes. However, as a result of the implementation in the centralised way, operating without intermediation is eliminated.

The findings from the empirical research indicate that the challenges in the areas of regulation, compliance, security, standardisation and processing speed are in line with those identified from the literature (Swan, 2015; Yli-Huumo, Ko, Choi, Park, & Smolander, 2016; Hileman & Rauchs, 2017; Laurent, Chollet, Burke, & Seers, 2018; Sazandrishvili, 2020; Haddad, 2021). Shares should be registered and trading should be compliant, which is also mentioned by Laurent, Chollet, Burke, & Seers (2018). For users, the risk of security issues is already known (Laurent, Chollet, Burke, & Seers, 2018; Sazandrishvili, 2020), for instance, losing or stealing and then retrieving this data appears to be a major problem. Konashevich (2020) mentioned the problem of standardisation, the experts identified the creation of standardisation as a challenge but also as an opportunity to further accelerate development if they are created. The challenge regarding processing speed is mainly focused on the slowness and the consequently difficult adoption of the technology (Hileman & Rauchs, 2017). The experts complement this with challenges regarding sustainability and the consensus mechanism which are related to this processing.

Whereas other challenges, namely issues concerning business partners, liquidity and privacy are not mentioned by the experts. Most striking is that the liquidity issue is not perceived by the experts and, on the contrary, only its benefit is recognised. From the interviews, more challenges can be observed regarding the real estate fund, namely that the fund has to be set up properly, the reputation is related to this, mistakes cannot be made but the chances of this are high, the real estate sector is risk-averse, the market needs to embrace blockchain technology and at the same time a lot is still unknown and the development is going fast.

A blockchain generally has five key elements, one of which is that it is a peer-to-peer network (Nakamoto, 2008; Hileman & Rauchs, 2017). The choices made in the proposed way of implementation exclude this. In this, a private blockchain is chosen, with the aim of making the product compliant. After all, the peer-to-peer element is what causes a problem regarding compliancy. From the interviews, it follows that this can have different implications on what that means for the target audience, the attractiveness of the product and, consequently, who considers the product attractive.

The structured information presented in the current research contributes to both the development of blockchain and tokenization (in the field of real estate) and the development of digitisation in real estate funds. The structured information, accumulated insights and proposed way of implementation

give guidance and insight on how to implement tokenization in real estate funds and what this includes. Furthermore, it has become clear what the conjunction of blockchain, tokenization and real estate funds implies. It is expected that this can be a foundation for this subject and contribute to further research within this development.

6.5 Conclusion

The first part of the empirical research includes the interviews and their outcomes. That is the basis for the last part of the empirical research. With these results, the information is collected and structured that can be used as a foundation in the implementation of tokenization in/of real estate funds. It offers many insights into real estate funds, blockchain, tokenization, legislation and their aspects that are important in this respect. The structured information is set up in this way as there is little to no uniformity in how to implement tokenization in/of real estate funds from the results of the expert interviews. Besides, a developer is free in the choices they make in how they want to set up the product. In this, there are many choices to be made.

The biggest challenge in implementing tokenization in real estate funds is getting the developed product compliant. This is mainly due to the originally decentralised nature of blockchain and its trading in this case. The tokens cannot be freely tradable within current laws and regulations. This is because the shares (i.e., tokens) must be registered. This involves the trading of financial instruments so it must be compliant with legal requirements and approved by the financial authorities.

Furthermore, it is very important that the product is properly set-up from the start. Otherwise, this can cause issues at a later stage. Also, the reputation of both the product and its developers is very important. Another factor is that many choices can be made, must be made, have different implications and must be combined with other choices at the same time. In this, it also has to match the needs of the market and must be compliant. This makes the whole development very difficult and the likelihood of errors high, especially given that much is still unknown. This also applies to the target group, which is still unknown and may also differ per product set-up.

In addition, the real estate sector is inherently very risk averse and wants to avoid all risks. The entrance of this new technology with all the associated things that can go wrong and the risks it entails will not be embraced easily. For that, it is therefore important that the real estate sector, the market and people in general learn more, become familiar with and know how the technology works.

Also, the development on both technical, legislative and market terms is going extremely fast. This makes it very difficult for both a project to keep up, but also for the embracement.

Finally, a proposal is made as to how the implementation can be undertaken. In this, choices on the aspects of real estate funds, blockchain, tokenization and legislation are made. This is based on the literature and interview results. Herein, key characteristics and challenges are taken into account. This results in one way to implement tokenization and blockchain in real estate funds. However, it must be borne in mind that this is one way to approach this.

The impact for the real estate fund type is greatest for non-listed funds. This is partly because they can (partly) be traded on the secondary market and partly because of efficiency and automation. A closed-ended structure is chosen, as this often works better than the other structures and is seen as the better structure in real estate. A limited partnership vehicle is chosen because it limits the liability and allows flexibility to have different approaches in the fund over time. A disadvantage in this is that this vehicle can only have 20 participants, to which a solution needs to be devised as tokenization - and the subsequent fractionalisation - often involves many owners.

The trading and issuance of the shares/tokens is done on an internal exchange. On this in-house platform, processes and operations can be better controlled and it is easier to comply with laws and regulations than with external parties or via peer-to-peer trading and issuance. Also, this is often common for (non-listed) funds. On these, payout of the income to be granted takes place periodically where the investor can choose the currency. By paying out in different types of currencies, it can suit any type of investor. Smart contracts play an important role here to facilitate an efficient process.

The Ethereum blockchain is chosen, which meets the required characteristics. It has the required size, has been tested a lot, is highly distributed, used and thus solid. Moreover, the experts reached consensus that this is the blockchain of choice. However, a private Ethereum blockchain is chosen because the tokens cannot be freely traded and the product must be compliant. Which is easier to organise on a private blockchain and platform. With that, it operates on an internal exchange. The characteristic of the Ethereum blockchain being highly distributed therefore does not apply in this case. In it, the proof-of-stake consensus mechanism is applied. Possibly in the future - if laws and regulations change - the blockchain can become decentralised. And as mentioned before, the blockchain can be switched in a later moment.

Tokens are valued based on supply and demand and are revalued on a regular basis. In this, the tokens are asset-backed, so the valuation is on the one hand on the value of the real estate and on the other hand on supply and demand. This makes them similar to securities and easier for compliance. The ERC-20 protocol is chosen because it is simple, widely used, tested and therefore stable, but also able to handle many transactions.

Furthermore, in terms of legislation, regulatory requirements (KYC and AML) need to be met. Also, the tokens must be registered by a registrar. Furthermore, trading can only take place between whitelisted wallets and the source of funds must be guaranteed.

In this proposed way of implementation, the resulting potential effects are also described. In summary, the overall effects are: more liquidity, lower threshold to invest, new and larger investor pool and more democracy in real estate investment. The blockchain results in more transparency, lower time utilisation, more security and creates more confidence to invest for the investor. For the management of the real estate fund, it also provides smoother processes, automation, lower costs and more efficiency.

This concludes the empirical research. A large number of insights are gathered on what the conjunction of blockchain, tokenization and real estate funds means and includes. Ultimately, all this came together to create a proposed way of how this implementation can be undertaken.

7. Conclusion, limitations and recommendations

This final chapter of this research deals with the conclusion, implications for theory, recommendations and limitations. In the former, the main and sub-questions are answered, next are the implications for theory, followed by the limitations and lastly the recommendations for follow-up research and practice are discussed.

7.1 Conclusion

Based on answering the sub-questions, the answer to the main question of this research is formulated. The main question - as also stated in chapter 1 - is:

In what ways can tokenization be implemented in real estate funds?

SQ1: What are real estate funds?

A real estate fund is a form of real estate investment that is classified as an indirect investment. As an intermediary, a real estate fund raises, invests and manages capital with a common investment objective. Real estate funds have four types of structures and two distinguished types of vehicles. The life cycle of a real estate fund has six phases: fund establishment, collection of capital, custody, issuance of investment units, fund management and secondary trading.

The founder is flexible in how they want to set up the fund. This is the case both in general and in the context of tokenization in conjunction with real estate funds. The founder can set up the (real estate) fund to suit their needs and wishes for the fund. In this respect, however, it is important to comply with the applicable laws and regulations.

SQ2: What is blockchain?

Blockchain technology can be described as a protocol in which information is stored digitally and mutually approved by all participants in a system which can function without a central authority. The information is stored as a chain in a shared database. The technology is characterised as reliable and transparent, it allows for automation and increase of liquidity and makes it possible to operate without a central body.

This is based on five core elements; asymmetric cryptography, the peer-to-peer (P2P) network, the consensus mechanism, the ledger and the validity rules that enable the foundation of blockchain technology. And through hashing, asymmetric cryptography, digital signature, it is possible to do transactions. Also, smart contracts are used to make processes easy. This characterises the principle of the technology, moreover, the developer has several choices that can be made in how the person wants to set it up and structure it. Choices can be made on type of centralisation of the blockchain, degree of permission, four types of blockchain structuring and which consensus mechanism to choose. The results from the interviews support this. The blockchain can be set up how one wants. However, it should be taken into account that the choices made here will influence the subsequent effects, benefits, challenges and the value propositions in real estate. Moreover, it appears that this set-up and structure can be modified later and the blockchain can be switched to another. This makes it possible for the developer to change the approach of his project over time, so that it continues to meet their wishes.

SQ3: What is tokenization (of real estate)?

The term tokenization refers to the process or method in which the ownership of an asset, which can be a physical or digital asset, is digitised. After this, this ownership exists on the blockchain in the form of a token and can be traded. In real estate, this means that ownership in a real estate object or a real

estate fund then takes the form of a token. This digitisation also makes it easy to fractionalise the ownership and hence allow trading in that form. It can also provide more liquidity, automation in transactions, creates transparency, lowers threshold for entry, allows international access, is immutable and transferring is possible without the need for an intermediary.

Tokenization also has aspects on which a developer needs to make choices. This is to be done on the token type, how to issue and trade, how to perform the payout and how to configure the token. Also, because of its novelty, it has a big challenge in legislation and regulation. Because of its (often) decentralised nature, getting tokenization compliant is a challenge in the implementation of tokenization in real estate funds. However, there are several developments in this area, with both the Securities and Exchange Commission and the European Parliament are working on this matter.

SQ4: What topics and aspects are involved in the implementation of tokenization in real estate funds?

Four topics are involved in the implementation of tokenization in real estate funds: real estate funds, blockchain, tokenization and legislation. The first three are the starting point for the literature research. The latter is involved because of the importance of being compliant with legislation and regulations in the implementation.

This includes 12 aspects. Real estate funds include: real estate fund type, real estate fund structure, pooled property vehicle, real estate fund organisation, payout approach, currency approach and issuance & trading. Blockchain only includes one aspect: 'blockchain'. Tokenization includes: tokenization setup and tokenization configuration. And legislation includes: legislative and regulatory needs and compliance organisation.

There are relations between real estate funds, blockchain, tokenization and legislation and the corresponding aspect but also independencies. Ultimately, implementation on this ensures that the tokenization in/of real estate funds is realised.

SQ5: What choices can be made in the implementation of tokenization in real estate funds?

It appears that in the implementation, it is of utmost importance that the fund is compliant and approved by the financial authority/authorities. As for the organisation of the real estate fund, it becomes clear that it depends on how the founder wants to do it. Basically, the structuring and set-up is up to the developer, provided it is compliant. As for the blockchain, it is expected to be highly distributed, large in transaction volume and much tested. And as for the token configuration, it is important that the protocol is simple, stable, well understood and tested to ensure trust.

Choices can be made on real estate funds, blockchain, tokenization and legislation. In the real estate fund, the choices made are: *non-listed funds* with a *closed-ended structure* in a *limited partnership vehicle*. The issuance and trading takes place on an *internal exchange* where the payout takes place on a *regular basis* in a *currency according to the investors' choice*. The blockchain consists of: a *private Ethereum blockchain* with a *proof-of-stake consensus mechanism*. For tokenization: ass*et-backed security tokens* on an *ERC-20 protocol*. The tokens are *revalued on a regular basis* and based on the *underlying assets* as well as on *supply and demand*. And to comply with legislation and regulations, choices have to be made to make the product compliant. These are: *KYC*- and *AML-procedures*, *registration of the toke*ns with a registrar and *guarantee of source of funds* (by a third party).

SQ6: What are the challenges in the implementation of tokenization in real estate funds?

Both the literature research and the empirical research have identified challenges that arise in the implementation of blockchain and tokenization in real estate funds. As mentioned earlier, legislation plays an important role in this. To get a product to market, it is essential to make it compliant. A total of 16 challenges are identified.

Regulation and *compliancy* are therefore one of the challenges. Other challenges are: *security* of the blockchain and user data, *standardisation* of processes, *processing speed* of transactions, demand for and need of *expertise/business partners*, *liquidity issues*, *privacy* problems caused by the transparency of blockchain, potential errors in the *fund set-up*, potential *reputation* damage, the *consequence of mistakes* is great but so is the chance of occurrence, a lot is still *unknown* about various matters, the product need to be *approved by the financial authority/authorities*, the *industry is risk-averse*, the market, industry and people in general need to *embrace the technology* and it takes place in a *fast-evolving environment*.

7.2 Implications for theory

This research provides a basis for what the convergence of blockchain, tokenization and real estate funds involves. It covers all facets and connects them. It also shows what is and is not relevant in this convergence. Furthermore, all the important facets are presented in a structured manner. For theory, this can be used as a foundation in what the convergence of blockchain, tokenization and real estate funds encompasses and can be expanded upon.

In addition, this research contributes to what the convergence of blockchain, tokenization and real estate funds implies. It establishes what choices have to be made, what the challenges are in this and what effects result from this.

As a motivation for this research, Baum (2020) indicated that real estate funds have the right underlying structure for the purpose of tokenization. This research shows that the underlying structure is indeed a good fit, however, the combination of tokenization and real estate funds have another problem in complying with laws and regulations. It is now clear for theory that Baum's (2020) observation is correct, but another problem is found in the form of compliance.

7.3 Limitations

This subsection addresses the four limitations of the research.

Firstly, the research is slightly modified over the course of the research in terms of methodology and intended outcome. This is due to the outcomes from the interviews, which showed that the intended outcome, to develop a method of organisation of tokenization in real estate fund, is not relevant. This is because the outcomes of the interviews showed that there is no uniformity among the experts' answers on how to implement the aspects of real estate funds, blockchain and tokenization and there are many possible ways to organise it. In addition, there appeared to be some challenges in the implementation of tokenization in real estate funds, which contributed to the fact that it is not directly relevant at this moment to establish a single method of organisation and proceed with this. Also, the development of the central subject is not yet advanced, which may also have an effect on this.

So, in the original method of this research, the goal is to establish a single concrete method of organisation that includes how to organise tokenization in real estate funds. The interviews are based on what follows from the literature research. These are real estate funds, blockchain, tokenization, their aspects and possible other topics. This could be the focus for questions on how to implement this and what else is important in this. Which also remained unchanged afterwards. Based on this, a

method of organisation would be established and this would be validated in a second round of interviews to the experts.

After the interviews showed that this is irrelevant, it is looked at what can be done with the results. Many interesting insights (with substantiations) are in fact gained from the interviews. These focus on how tokenization can be organised/implemented in real estate funds. In addition, it has thus been made clear that there is not one way of organisation possible, but many. So, the information is collected and structured so that anyone who wants to implement tokenization, can use it to gain insight in what the implementation entails and helps in making choices in the implementation. Still, with the literature and interview results, a way of implementation is established. But due to it being one of many possible ways, it is not relevant to proceed with this as intended in the prior method, given it is not the established way of implementation. Also, in this proposed way an important characteristic of tokenization: decentralisation, could not be incorporated.

The research has therefore been slightly modified, but this has a minimal influence on the result, as the approach has not changed, but based on the interview results the intended result is shaped differently.

Secondly, readers should note that the structured information is collected and is based on the results of the interviews. There is saturation in the interviews. However, information might be missing and finding more experts is difficult due to the number of experts in this field. Also, with interviews, it always remains that these are the insights from several individuals, which also may have different perspectives on a certain matter.

Thirdly, this research has tried to focus on the Netherlands and the Dutch real estate (investment) market. However, that appeared to be neither relevant nor possible due to the international nature of the subject, the novelty in terms of laws and regulations in this (given that it is mainly focused on the international context) and due to that the Netherlands is not specifically more advanced in its development here.

Fourthly, there are many developments taking place at the time of writing. So, it is a snapshot in time when the research is conducted. In the meantime, a lot can take place and mainly in the technological and legal/regulatory fields. Thus, new information may be missing from this research.

7.4 Recommendations

7.4.1 Recommendations for further research

From the research, several recommendations for follow-up research follow, which are described below.

The interviews show that there is a need for clarity and structure in the area of legislation and regulations. It is indicated that the possibilities of blockchain technology should be taken into account. A solution to this could lie in the form of legislative and regulatory frameworks. Follow-up research could focus on how this framework would encompass the opportunities in a way that is consistent with the legislation and regulations at hand. This should also go beyond a single country/jurisdiction as the international cooperation is of importance.

From the interviews it followed that in/of the tokenization of a real estate fund, it may require a new structure, form and/or vehicle. Follow-up research could be conducted to investigate how this type and structure of real estate fund should then be shaped. This type and structure should then align with the required characteristics and comply with applicable laws and regulations.

Complying with applicable laws and regulations is the big challenge in the implementation of tokenization in/of real estate funds. The international nature of tokenization is a major challenge in this. Further research on how to comply with laws and regulations within different jursidictions with tokenization helps to take steps in enabling tokenization in (real estate) funds.

One challenge in enabling and trading through tokenization is that it takes place in an international manner and goes across jurisdictional boundaries. A solution to this would be to have an international way of person registration to meet the necessary processes and enable trading across jurisdictions.

The interviews show that other technologies might achieve similar or the same effects as through tokenization and blockchain. In follow-up research, it would be interesting to find out what the differences between the different technologies would be and what this means on other aspects such as laws and regulations.

The proposed way of implementation could also be presented to experts in the field in follow-up research. They could point out further possible mistakes or steer directions on what could be done better and suchlike. This could result in a more concrete way of implementation.

Given the novelty of the combination in real estate funds and this technology, it is still unknown where the exact need lies in the market. The product developed, i.e. the choices that can be made in it, should match this. For this, it would be very interesting for follow-up research to see what the need from the market (investors, real estate funds and possibly others) is on the various choices identified in this research.

Similar to that, it would be interesting to see which target group matches which type of developed product. For instance, the approach of a product can be very different and could imply a different attracted target group. Follow-up research can investigate which products can be developed and which target group this attracts. This could have to do with the degree of change through implementation compared to the current situation without implementation.

In the fields of blockchain, tokenization and real estate and all that comes with it, a lot of developments are taking place. These developments are also happening rapidly. Therefore, research on a very regular basis is required to keep up with these developments and the state-of-affairs.

7.4.2 Practical recommendations

For practice, the research reveals several recommendations that should be taken into account.

To avoid future potential issues with tokenization and fragmentation of ownership, discussions should be held in advance about the impact widespread tradable fragmented property assets may have on the property and, in particular, the impact it may have on the users of the property. Governmental bodies, financial authorities and suchlike are advised to discuss and act on this in advance.

The interviews often mention that standardisation in real estate funds can have advantages. This can manifest itself both for optimisation in real estate funds, but also to help the development of tokenization in this regard. The former can be achieved by standardising processes and practices and thereby achieving optimisation. The latter can take place by standardisation in similar ways. It is therefore advisable to establish and form standardisation in both respects.

It has become apparent that the technological spectrum is very keen to cooperate more with legislators and regulators in order to push the development forward. At the moment, people on the technological side experience the contrary, and even consider the evolution of legislation and

regulations to be crucial. Thus, there needs to be more cooperation between the legislators and regulators and the technological developers.

The valuation of the real estate may be affected or act differently due to widespread tradability. This is related to the fact these financial instruments operate on the basis of supply and demand. It is therefore important that the potential effects of this on the real estate market and its valuations are taken into account at an early stage. In addition, it is unclear whether this will affect the real estate asset itself or the real estate sector as a whole.

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Appendix

Appendix I: Additional literature research

This section provides literature research which is excluded from the main report.

Real estate funds

The set-up and organisation of a real estate fund

In order to understand how real estate funds are created, this section looks at how they are set up and organised. This section explains how the two previously mentioned real estate funds (PPVs): Limited Partnerships and Property Unit Trusts are set up. These types largely cover the setup of PPVs.

Limited partnerships (LP)

Generally, non-listed funds are organised as independent companies and legally organised as limited partnerships, making them a pass-through company, meaning that they are exempt from tax and all profits and losses are distributed to the limited partners. Sometimes these are also legally set up as Private- or Public Limited Companies, Ltd. or Plc (*in Dutch: bv or nv*) (INREV, 2013).

The creation, design and structure of funds are usually set up by an overarching organisation. The fund sponsor usually lends his or her name to the fund and often has several (other) funds associated with it (Pozen, 2011). The establishment of LPs may differ by small differences or variations in practice, but the explanation that follows is generic. It starts with a lead investor/originator, usually these are institutional organisations that invest in real estate or institutional organisations that want to diversify or reduce their stake in their real estate portfolio (Stumpel, 2014).

The originator creates a General Partner (GP) who will act as the lead investor. The GP will have the responsibility of the management of the operational activities of the fund and will operate in the best interests of the LP. This GP can be a special purpose vehicle with unlimited liability and possibly owned by more than one lead investor. It will appoint, as mentioned above, an authorised operator who will perform administrative functions and possibly also a promoter to raise capital (usually the originator will do it themselves) (Baum & Fear, 2001).

Typically, the fund sponsor itself carries out the operational activities within the fund, despite its complexity and the differences between them. For larger LPs however, these are often delegated to disciplined management organisations. These fall into the category of investment, asset and real estate management. Often an investment or asset management organisation is used, which in turn may hire a real estate manager (Stumpel, 2014; Baum & Fear, 2001).

A common LP structure and relationship is visualised below in figure 10:

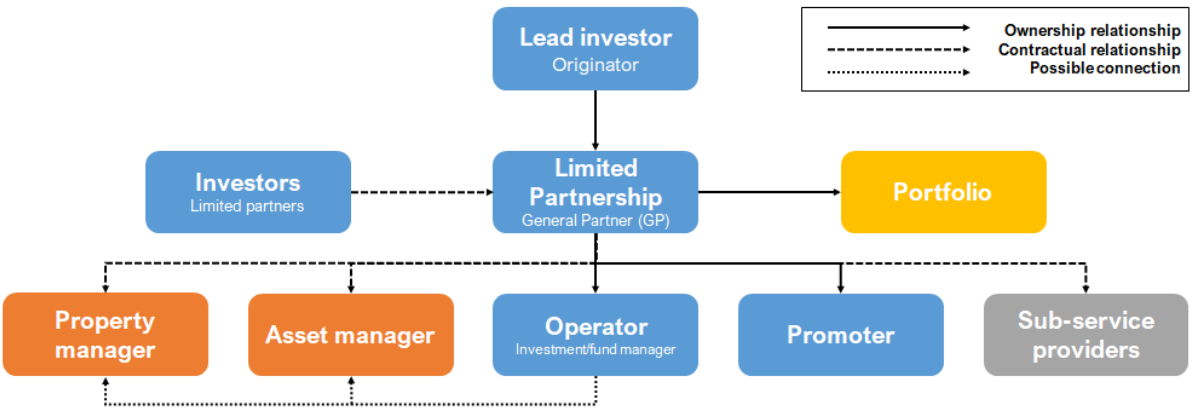

Figure 10: Common LP structure and relationships, based on Baum & Fear (2001) and Stumpel (2014)

Property Unit Trusts (PUT)

The main difference in the establishment of LPs and PUTs is the number of investors that are possible in them and the resulting implications. Furthermore, the formation of PUTs is similar to that of LPs. However, because PUTs can pool more investors (unlimited), a board is required. Moreover, more and more LPs are being set up with a board to look after the interests of the stakeholders (Baum & Fear, 2001).

In a PUT, that board is the 'board of trustees'. The initial lead investor will either appoint the first trustees or form the board itself with its management and act as an interim board of trustees. As with LPs, underlying organisations are essentially created. This almost always includes a contract for fund management between the fund creator and this underlying organisation. This link is also described as a virtual company, in which it maintains contact and monitors the delegated parties acting in the best interests of the investors (Baum & Fear, 2001; Stumpel, 2014).

PUTs are also sometimes managed, but also created by fund management companies connected to the fund. In these, the board of trustees is made up of the originator and other lead investors (Stumpel, 2014). The advantage of this is that a mixed board of trustees can preserve the investors' interest more independently. Also, unlike in LPs, it can terminate the contract with the fund management company more easily, where in LPs the GP is fixed. This is because of the GP's management of and contact with the delegated parties, but also because of the limited liability status of LPs. The board of PUTs can make decisions without losing its limited liability status, unlike LPs (Lindberg, 2002). For larger PUTs, other tasks (e.g., to sub-service providers) are also delegated which must be approved by the board of trustees (Pozen, 2011).

A common PUT structure and relationship is visualised below in figure 11:

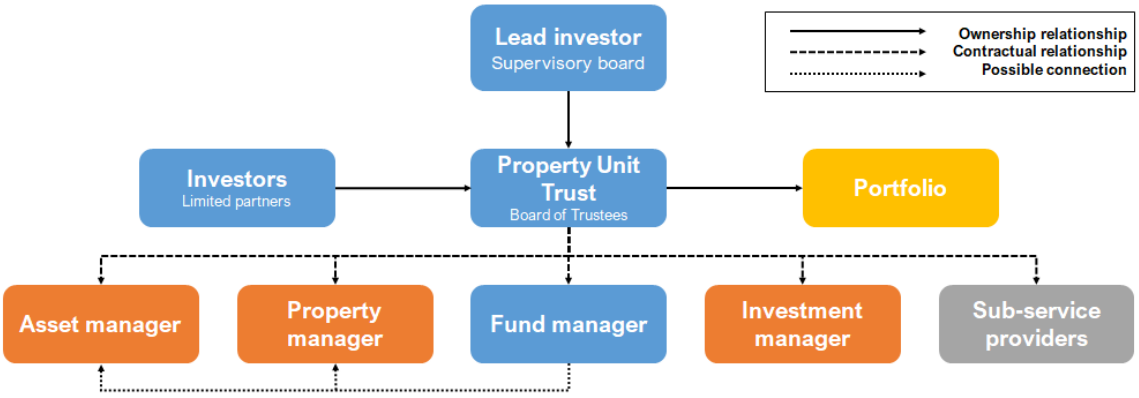

Figure 11: Common PUT structure and relationships, based on Pozen (2011) and Stumpel (2014)

Actors in real estate funds

In chapter 3, several types of managers have already been mentioned, which in the literature tend to fall under the category of fund manager. However, these also include other tasks such as investment manager, asset manager and property manager. The role and/or tasks of the type of manager may differ in practice depending on the type/design of fund structure. The practices listed are the most common and are explained in detail below.

The aim of the real estate fund management is to add value to the fund by applying the right strategy at the real estate object level. This management should consist of experts on either a regional market or on a specific type of property (Alstede, 2014).

Fund manager

The fund manager manages the fund and is responsible for the ultimate performance of the fund by controlling risks and generating profits that are distributed to investors. For this, the fund manager receives a fee. On an annual basis, the manager reports to the investors through reports and forecasts.

Investment manager

The investment manager is responsible for the leasing, purchase and sale of properties in line with the best interests of investors and investment objectives and measures. The exact tasks of the investment manager may differ per case or type/design of fund structure.

Asset manager

The role of the asset manager is facilitating to the management of the daily leasing and operational activities of the real estate objects within the portfolio (INREV, 2008; INREV, 2016). In addition, the asset manager is responsible for facilitating transactions, collecting and sharing portfolio management information from prospects at the local or property object level, the performance of the various property objects and the care and operation of the property objects (Alstede, 2014).

Property manager

The property manager team consists of an account manager and a property manager and their role is to carry out the day-to-day operations of the properties within the fund. They are in direct contact with the tenants and are also responsible for arranging service charges, managing accounts receivable,

outgoing payments, insurance and managing service personnel (maintenance and repairs) (INREV, 2008; Stumpel, 2014).

Legislation and regulations AIFMD

For the investment institutions within the AIFMD, there are 3 levels of relevant regulations that apply within just the Netherlands or the entire European Union (AFM, n.d.).

Level 1 - Directive and implementation

This includes laws and regulations for both Dutch and EU countries. These are the AIFM Directive within the EU and the Financial Supervision Act (Wft) and the Market Conduct Supervision (Financial Institutions) Decree (Wft) in the Netherlands.

Level 2 - Implementation measures European Commission

These include four different regulations, all of which apply to investment institutions within the EU or seeking to register within the AIFM (for non-EU Member States). These four regulations consist of: regulation level 2, opt-in procedure, open/closed ended AIFs and the determination of reference member status of non-EU AIFM.

Level 3 - Further details ESMA

The third level includes three guidelines from ESMA (European Securities and Markets Authority) consisting of: the key concepts of the AIFM, appropriate remuneration policies and reporting requirements.

Further important laws and regulations within the AIFMD are the: SFDR (Sustainable Finance Disclosure Regulation) in which information on sustainability must be disclosed in the prospectuses of the fund(s) (AFM, n.d.), the Wwft (Money Laundering and Terrorist Financing (Prevention) Act *or Wet ter voorkoming van de witwassen en terrorismefinanciering in Dutch*) in which the AFM supervises the monitoring and promotion of integrity in business operations and the prevention of involvement in money laundering (AFM, n.d.) and the Sw (Sanctions Act *or Sanctiewet in Dutch*) in which the investment institutions must comply with measures in their administrative organisation and internal control in relation to the sanctions regulations (AFM, n.d.).

It has also recently become compulsory for managers of investment institutions to complete a periodic questionnaire about the Money Laundering and Terrorist Financing (Prevention) Act and the Sanctions Act.

In addition, there are 10 other national legal and administrative provisions for the purposes of trading requirements applicable to the alternative investment funds as per regulation (EU) 2019/1156 of the European parliament and of the council of 20 June 2019 on facilitating cross-border distribution of collective investment undertakings (*pbEU* 2019, L188*)*. These apply in the Netherlands in addition to other legal provisions (where the Wwft and Sw have already been mentioned) (AFM, 2021):

- Dutch Civil Code;
- General Administrative Law Act; and
- Bankruptcy Act; and
- Competition Act; and
- Income Tax Act 2001.

Blockchain

Consensus mechanisms

In the literature research, a brief explanation was given of what consensus mechanisms exist that are suitable for public and private blockchains, according to Bains (2022). Below, these are further explained per type (private or public).

Public blockchains

Proof-of-Work (PoW): this is a consensus mechanism that requires participants in a network to solve a mathematical puzzle in order to achieve consensus in a decentralised way, where no one can manipulate the system. Bitcoin makes use of this. The process is called 'mining' and the performing 'miner' who solves the puzzle first is rewarded and their block is added to the blockchain. This is also very resource intensive and time consuming (Zhang, 2020; Bains, 2022).

Proof-of-Stake (PoS): This mechanism randomly assigned the node that will validate the block transactions (or mines in PoW) accordingly to the number of coins it has, the more coins the higher chance of being assigned. The participants are called validators. In the process, the validators verify the transactions as legitimate or not and add it to the blockchain, in this case consensus is reached. The participant who performs it is also rewarded here, but if the data is validated incorrectly or fraudulently, a penalty may follow. This form requires much less resources than the PoW process (Bains, 2022)

Delegated Proof-of-Stake (DPoS): DPoS is a follow-up to PoS, in which a democratic element is added to the process by partially outsourcing the validation process. Similar to its predecessor, the validation process is random and those with the largest number of assets are more likely to be able to do the validation and receive a reward from it. However, the DPoS model includes a voting system where the (chosen) participants who can perform the validation can outsource the work to a third party who is responsible for reaching consensus during the generation and validation of new blocks. Here, the rewards are shared between both. The advantage of this is greater democratisation, more and positive involvement, less resource intensive and more decentralisation (Bains, 2022).

Private blockchains

Practical and Istanbul Byzantine Fault Tolerance (pBFT/iBFT): The theory behind pBFT predates blockchains and is similar to Proof-of-Authority. In the latter, nodes are chosen based on identity and reputation rather than financial or computational basis. To add a block to the chain, the nodes share messages. Here, one node is the leader and there are several backup nodes. It is assumed that some nodes are fraudulent, therefore constant contact is maintained and efforts are made to ensure that most nodes are honest, so by assuming that most messages are correct, this is taken as true and false information is rejected.

Partially adapted for the blockchain is iBFT, where the principle is the same but the backup nodes (or validators in this case) are not static. Advantages of these mechanisms are settlement time, low energy consumption because there is no mining and the nodes are known to each other (Moniz, 2020); (Bains, 2022).

Federated Byzantine Fault Tolerance (fBFT): In this form, the problems that follow from the previous ones concerning centralisation are solved more easily. In fBFT, the identity of the nodes does not all

need to be known, which makes membership open and control decentralised. It relies on a Unique Node list which means that only some of the nodes are needed for agreement. The advantages of this are that it is both efficient and scalable. The risk is its financial integrity (Bains, 2022).

DiemBFT: This consensus mechanism is a BFT protocol based on the HotStuff protocol, which in turn is built on the pBFT. Its purpose is to increase speed and efficiency by providing a faster network with fewer messages and communications while maintaining security and accuracy. Disadvantages include potential data and privacy issues and barriers to entry (Liao, Xu, & Li, 2021); (Bains, 2022).

Proof-of-Elapsed-Time (PoET): This last form aims to reduce the consumption of energy, the locking of assets and the centralisation of rewards. It is also suitable for both permissioned and permissionless blockchains. In PoET, the possibility of obtaining validation is fairer due to the process behind it (Bains, 2022).

State of affairs of blockchain in the real estate sector

The *''FIBREE Industry Report Blockchain Real Estate 2021''* provides an overview of the current state of development of blockchain in the real estate sector (FIBREE, 2021). FIBREE is also involved as a consultative expert in this research.

The inventory on the state of blockchain in real estate in 2021 consists of products (i.e., companies or projects centred on real estate and blockchain) and subsequent in-depth analyses. This was done by means of desktop research in which first of all an inventory was made of all products from previous years and their progress. Secondly, the database was expanded with new products and verified for propriety.

Together with the inventory of two previous years, insight can be gained into the development of the number of products over those three years (figure 12). It appears that after a sharp decline of approximately 40% from 2019 to 2020, an increase occurred again in 2021. In 2021, the number of products is 394, which is an increase of more than 30% compared to 2020. Globally, it is observed that mainly Europe and North America are strongly represented in terms of number of products. Asia and the Pacific, Middle East and Africa, and Latin America follow respectively.

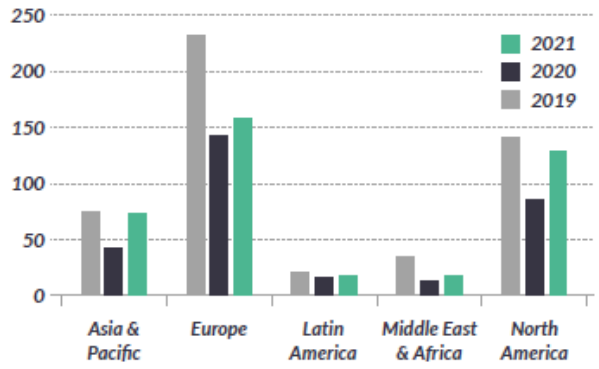

Figure 12: Geographic spread of products (FIBREE, 2021)

Furthermore, the report shows that 44.16% of the products are focused on investment and finance and 32.99% are focused on markets and platforms as shown in figure 13. Also, 39.34% of products originate from blockchain applications to real estate, 32.99% of products from a combination of and 17.51% originate from real estate to a blockchain application as shown is figure 14.

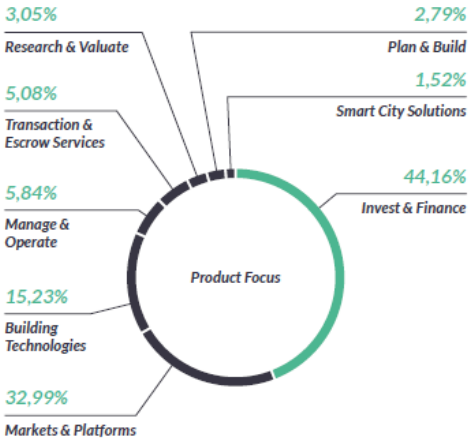

Figure 13: Product focus (FIBREE, 2021)

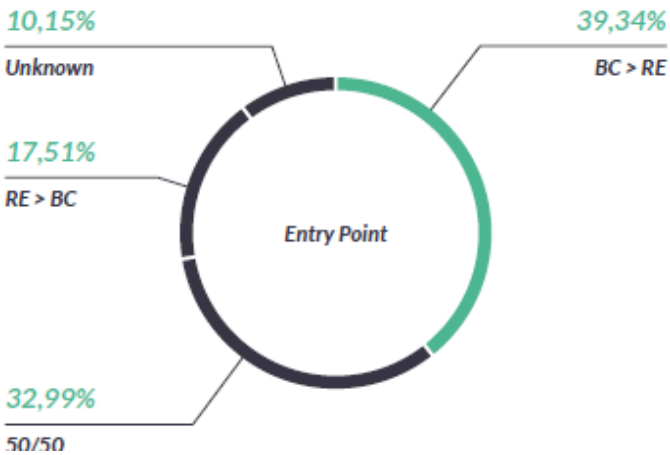

Figure 14: Entry origination (FIBREE, 2021)

Appendix II: Interview presentation format

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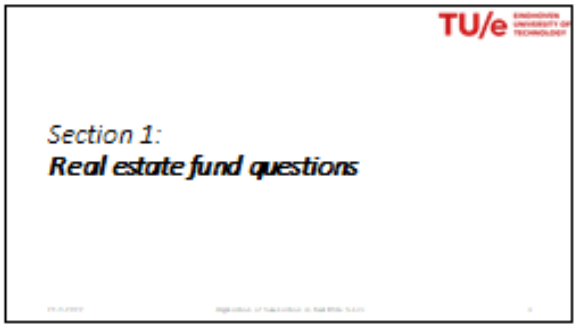

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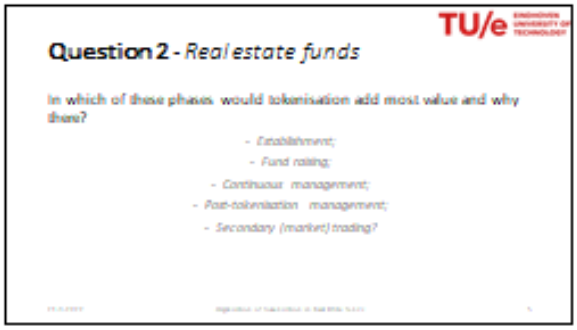

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Question 4 - *Real estate funds*

Which property fund structure would you use for tokenisation:

Open-ended, closed-ended, Unit Investment Trust or Unit trust?

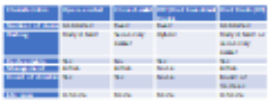
And why?

7

Question 4 (more details) - *Real estate funds*

Which property fund structure would you use for tokenisation:

Open-ended, closed-ended, Unit Investment Trust or Unit trust?



And why?

8

Question 5 - *Real estate funds*

Which pooled property vehicle do you think best suits the tokenisation of real estate funds:

limited partnerships (LP) or property unit trusts (PUT)

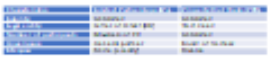
And why?

9

Question 5 (more details) - *Real estate funds*

Which pooled property vehicle do you think best suits the tokenisation of real estate funds:

Limited partnerships (LP) or property unit trusts (PUT)



And why?

10

Section 2:

Blockchain questions

11

Question 6 - *Blockchain*

Which blockchain would you build it on and why?

12

Question 7 - *Blockchain*

Would you choose a decentralised (public), centralised (private) or hybrid approach, and why?

13

Question 8 - *Blockchain*

Which consensus mechanism would you choose, and why?

14

Question 9 - *Blockchain*

What would be the role of smart contracts in the whole process and how?

15

Question 10 - *Blockchain*

What is the added value of blockchain in the whole process and why?

16

Section 3:
Tokenization questions

17

Question 11 - *Tokenization*

How would you configure the token and why so?

18

Question 12 - *Tokenization*

Which token type would you choose and why?

19

Question 13 - *Tokenization*

How would you design the payout and why so?

20

Question 14 - *Tokenization*

How can the tokens be issued and traded and why so?

21

Question 15 - *Tokenization*

What is needed in terms of legislative and regulatory requirements to stimulate the development and why?

22

Question 16 - *Tokenization*

What is the added value of tokenization in the entire process and how?

23

Section 4:
Concluding questions

24

Question 17 - *Concluding*

How do you envision tokenisation in real estate funds to be organised?

25

Question 18 - *Concluding*

What are the critical success factors herein?

26

Question 19 - *Concluding*

What would be the impact of this on the real estate industry?

27

The end

Thank you for your participation and I would like to see you in the next round!

28

Appendix III: Transcribed interviews and interview coding

The transcribed interviews and interview coding are excluded from this report. To get access to these, please contact the author.

Appendix IV: Structured information for the implementation of tokenization in/of real estate funds

The topics are discussed in the following order: the real estate fund, blockchain, tokenization and legislation. The aspects are listed under each topic. Behind each is the applicable label. Additional details may also be specified; these provide further information but are not directly applicable to one of the other specified points.

The real estate fund

This topic contains seven aspects focused on how to implement tokenization in/of real estate funds and its properties.

Real estate fund type

Non-listed real estate funds - *choice*

The impact of tokenization is greater for non-listed funds because:

- They can be traded on secondary markets;
- They can be listed on exchanges;
- There is more efficiency in the administration and back office of the fund;
- Other benefits of listed funds can also (partially) be enjoyed by non-listed funds.

However, it must be taken into account that these must comply with the same legislative and regulatory compliancy rules as listed funds. And that most real estate funds are dark pooled managed and want to remain so due to the pricing of the funds.

Listed real estate funds - *choice*

For listed funds, it can also offer advantages:

- More compliance, making it more efficient and cheaper and
- Reduce (manual) administration.

Additional details

The tradability of the shares is something that must be taken into account in both cases with regard to the listed characteristics that follow from making the tokens freely tradable.

Real estate fund structure

Choice of preference - *Insight*

In principle, the real estate fund structure does not have to matter much; it is more of a preference choice and the structure has to fit within the fund's set-up as desired by the originator.

Unit trusts - *choice*

Unit trusts would most closely resemble what is included in listed real estate funds given the fractional indirect ownership of the underlying asset, that they are traded on secondary markets and that the target market - retail traders - is the same.

Open-ended structure - *choice*

Open-ended funds can have the advantages in this that it can be updated with entries and exits and can reduce risk. However, open-ended funds often do not function well and ultimately behave more like closed-ended or hybrid forms.

Closed-ended structure - *choice*

Tokenization can offer more transferability and fungibility for closed-ended funds. In addition, it should be the better structure for real estate funds.

Unit investment trust - *choice*

As Unit Investment Trusts allow for different behaviours and this is convenient for operating within the laws and regulations in different jurisdictions, this is helpful in the tokenization of real estate funds through this structure.

Unit trust - *choice*

Unit trusts have the advantage of allowing many owners but have many differences per jurisdiction so they cannot be traded as easily as, for example, the closed-ended structure.

Additional details

The tokenization of a real estate funds may require a new structure that is different from the ones used at present. This could possibly coincide with new standards or legislative/regulatory frameworks.

Pooled property vehicle

Location & regulatory framework - *insight*

Similar to the real estate fund structure, the location of the fund and its assets and the presence of a regulatory framework are important in the case of the pooled property vehicle. If there is one, it should be chosen to fit. As several are possible.

Limited partnership - *choice*

The advantages of a limited partnership are that:

- Liability remains limited;
- It restricts or limits the management of the fund to specific individuals and
- It allows the flexibility to develop structures.

A disadvantage is that it can only have 20 participants, unless a convenient solution is found.

Additional details

It is important that the agreement is digitally facilitated, to facilitate negotiability. Also, a letter-of-intent would be easier to digitise than a deed because of the arrangement via the civil-law notary.

There is no further explanation for the choice of property unit trust.

Real estate fund organisation

From the literature research, the following five phases in a tokenized real estate fund follow: Establishment, fund raising, continuous management, post-tokenization management and secondary market trading. According to the experts, these phases are correct. But experts are divided in their

opinion as to at which phase tokenization and blockchain are of most added value. Below are some further insights or remarks that are made on them.

In addition, the activities and obligations are said to remain the same. In turn, these can be influenced in terms of operating practices by the application of the technology.

Establishment - *insight*

With the help of tokenization and blockchain, the establishment can be made smoother, simpler and more efficient. As this phase is crucial to the success of the real estate fund. As far as compliance is concerned, which is mainly established in this phase, it still requires a lot of effort and compliance across different jurisdictions which plays a major role for the tokenization of real estate funds.

Fund raising - *insight*

Fundraising can be improved by a lower threshold for entry and new channels that can be used for it. A bottleneck, however, is the effort and money it takes to explain the fund characteristics to every investor. This is something that needs to be resolved in order to reap the benefits.

Continuous management - *insight*

In this phase, administration, registration, dividend distribution, sending newsletters and more can be improved with the help of blockchain, tokenization and/or automation. For example, small transactions can be transferred at a high frequency with low administrative costs.

Secondary market trading - *insight*

By trading on the secondary market - through the fragmented shares - which is automated, more and faster liquidity can be created. This is also provided by the fact that they can be traded to a larger audience (lowering the entry threshold), as due to fragmentation and automation the entry price can be offered at a lower level.

Legislation & regulation in the fund - *applicable*

Compliance with legislation and regulation is crucial in setting up the real estate fund. It must be compliant by design. In addition, the right compliancy requirements in the jurisdiction must be met. These include Know-your-customer (KYC) and anti-money laundering (AML) policies and the tokens can only be traded between white-listed wallets.

In order to be compliant, the location of the token offering and the applicable laws and regulations must be taken into account, as well as the further implications of this.

Additional details

Organising the real estate fund together with blockchain and tokenization is possible and a good starting point, in which the existing is tokenized.

When setting up the fund, the importance of manageability, liability and reputation must be taken into account. Early in the setting up and during the setting up of the real estate fund, these issues must be taken into account and thought through. The structure must also be made clear to the investors.

In addition, as a fund founder you are accountable for who dividends are paid to.

Payout approach

The experts suggest different approaches, which in some cases can exist in parallel, to organise the payout.

Native token - *choice*

By means of a native token, various actions can be performed on the platform used by the real estate fund. This can take place in many different ways.

Buying outstanding tokens - *choice*

Instead of distributing, the fund can buy up outstanding tokens. By buying outstanding tokens from a limited pool of tokens and not issuing them again, the supply decreases and the value of the outstanding tokens increases. This creates indirect returns for the investors. In terms of taxation, this can be advantageous because no direct return is paid out and nothing has to be declared. However, all shareholders benefit from this, even those who do not choose this option.

More ownership - *choice*

The fund can also, if it acts as an intermediary between the investor and another real estate fund, disburse in the form of more ownership with the returns made. This increases the amount of ownership of the investor.

Compound interest - *choice*

A compound interest effect can arise from the payments. Also, the benefit of a revenue generating asset can generate demand from, among others, the crypto market.

Automated versus ad hoc - *choice*

Using blockchain and smart contracts, periodic payments can be done automatically. However, this could cause problems if a tenant does not pay and the payment is still made automatically. Therefore, triggers in the smart contract should prevent this from happening.

Currency approach - *choice*

Experts identify various options for which currency to apply:

- Native token;
- Stablecoins;
- Fiat;
- Central bank digital currency;
- Decentral coins (cryptocurrencies)

This digital currency issued by central banks and recorded on blockchain is a possibility. These make it possible to make automated distributions to banks. Thereby, old methods are eliminated. It also ensures trust in the transfer which is very important in real estate funds.

Decentralised currencies have high transaction costs, as these can be up to 1% of the transaction.

Issuance & Trading

Internal - *choice*

Issuing and trading can all be done internally. This means that the tokens are not traded on a secondary market and only the fund itself can be traded. This can also mean that tokenization and blockchain take place entirely in the background.

External exchange – *choice*
The issuance and trading can take place through an external exchange, i.e., the exchange is owned by another party. The advantages of this are that these parties provide the operations, have the knowledge and comply with the correct regulations. The real estate fund then commits itself to an exchange.

Internal exchange - *choice*

The real estate fund can issue and trade on its own exchange, which is cheaper to issue on and easier to monitor, manage and in terms of regulations and restrictions.

Blockchain

This topic discusses how the blockchain can be set up, what choices or considerations to make and what is important in this. It proceeds chronologically from a broader perspective to more specific, with the first three aspects being more general and the subsequent six going into more specific elements of the blockchain, and finally looking at an important consideration in choosing a blockchain or database technology.

Blockchain requirements - *insight*

It is important for the blockchain that it is fundamentally solid. Which means that it is large, i.e., widely distributed and in transaction volume, and that it has been tested extensively.

Blockchain effect - *effect*

Blockchain can have many effects:

- Efficiency, transparency, trust and security;
- Investors can gain more confidence to invest (through transparency);
- The ability to monitor and track transactions and time batched transactions;
- Management of the fund can be done very efficiently and at low cost;
- Administration can be reduced and therefore;
- Administration costs can be drastically reduced and;
- Secondary trading can become much easier and faster.

Tokenization effect - *effect*

Tokenization can have the effect of:

- Efficiency;
- Lower costs;
- Lower time utilisation and;
- Much faster processing to liquidity and subsequently increase the investor pool by this.

Where much of its added value is in the running of the registry and distribution in secondary trading.

Ethereum blockchain - *choice*

The Ethereum blockchain has the advantage of being widely tested, widely distributed and most widely used. Due to its size, it improves trusts and offers security and the safety that comes with it. That is required in the size and number of transactions that can take place on it. In addition, the Ethereum blockchain is well applicable for tokenization and smart contracts. A disadvantage, however, is the high transaction costs (gas fees).

Binance blockchain - *choice*

The Binance blockchain offers the advantages that it has a large user base, supports development and can handle large transaction volumes. Its disadvantage is the high transaction costs (gas fees).

Ignis blockchain - *choice*

Ignis can be a blockchain of choice when a project wants to develop non-tradable tokens, as the Ignis blockchain allows for this.

Consensus mechanism - *choice*

Different consensus mechanisms can be applied. Some of them are explained below.

- The proof-of-work mechanism is often written off because of its inefficiency and high costs.
- The proof-of-stake mechanism is then preferred, given its efficiency, better transaction evaluation and speed.

The disadvantages of consensus mechanisms themselves are that they often consume a lot of energy and are difficult for participants to understand. Although the proof-of-stake consensus mechanism has made improvements on this. Moreover, it is expected that governments will always opt for central consensus mechanisms.

Role of smart contracts - *insight*

Smart contracts are characterised by transparency, reliability and operational efficiency. It can drastically reduce costs in many activities in the real estate fund, especially for manual processes, activities and contracts. The transparency is recovered from the fact that no more alterations can be made in the time of operation.

Centralised, decentralised or hybrid approach - *choice*

Whether blockchain is approached in a centralised, decentralised or hybrid manner is often up to the person setting it up and their perspective on this spectrum.

The progression from a centralised to a decentralised or hybrid blockchain is often mentioned, in which this proceeds alongside the continuously evolving laws and regulations.

A hybrid approach is possible in which the decentralised aspect provides transparency and tradability is processed centrally.

If a blockchain is centrally organised, it is no different to any other database technology in that a central authority regulates it. Furthermore, a central blockchain is very expensive to develop, but in terms of tradability necessary to prevent money laundering.

Blockchain versus database technology - *choice*

Blockchain technology has flaws, so there are reasons to choose another database technology. This is therefore a consideration to be made. Below are reasons to use another database technology in comparison to blockchain technology.

First of all, a database technology is easier to organise or set up, cheaper and faster. The automation through digitalisation is the advantage that a database technology offers, as it can make processes faster and easier in real estate funds.

In addition, unlike tokens on a decentralised blockchain, shares are registered and there is no problem if the database is hacked. If someone loses his login data, this is also not a problem, because this can be traced back.

Furthermore, the regulation does not allow the free trading of financial instruments. It has to be tradable on a platform where everyone has gone through KYC and AML protocols, so tradability is limited. Also, the shares must be registered, which limits the free tradability.

Tokenization

This topic deals with how to set up the tokenization aspect in/of real estate funds, the tokenomics, what is at issue at the legislative and regulatory level, which choices can be made and further insights in this area.

Tokenization setup

Valuation of token - *choice*

The valuation of the token (i.e., share) can be done in two ways:

- By linking it one-to-one to the value of the property or
- By letting it fluctuate freely on supply and demand.

The former creates the opportunity for value creation.

The valuation moment can also take place in two ways:

- It can take place periodically and/or be extrapolated at the time of transaction or
- The valuation is given by a fully automated system at any time for a transaction.

Token type - *choice*

There are different types of tokens to use, which address what the token does and/or what it can be used for or what it is.

Two possible types of tokens are utility and security tokens. The former can be used to provide services within an ecosystem. Security tokens are like securities, where this is a share that is backed by an asset.

Regulation – *insight*

In legislative and regulatory terms, freely tradable financial instruments (including tokens) are not permitted. Financial authorities do not approve them. In addition, the trade must be approved by a third party, because the instruments may not be owned by individuals/parties who are not allowed to. Moreover, as a real estate fund, you must know to whom you are selling.

For a real estate fund to use tokenization, it is crucial to organise it in such a way that it is permissible within the applicable laws and regulations at that time and place.

Token configuration

Token protocol – *choice & insight*

For the configuration of the token, it is important that the protocol is simple, stable, well understood and well tested, i.e., has run large volumes to ensure trust.

Furthermore, the token protocol depends on how you want to structure your product; the token protocol must fit in with that. For the investors and the communication to them, it is important that the dynamics of the token are clear from the issuance.

Token relativity - *insight*

The word token is simply a designation for something that already exists in practice. Regarding the legal form, it is the same theory that has been used for a long time for this technology. In addition, it is something that takes place in the background and is therefore not freely tradable.

Registration of tokens - *applicable*

The shares (tokens) must be registered with registrars, which are for example the Central Securities Depository (CSD) or International Central Securities Depository (ICSD). This means that the shares cannot be freely passed around.

The diffusion of the token protocol does not matter in this respect, as it cannot be shared with a third party and the two different systems do not have to be using the same protocol.

Legislation

Legislation is crucial in the development of a tokenization product in/of real estate funds, as one expert calls it the bottleneck in speeding a product to the market. This topic deals, on the one hand, with what is required at the legal and regulatory level for the further development of tokenization in/of real estate funds and, on the other hand, with how real estate funds are to comply with current laws and regulations. The first follows from the perspectives of different experts. The second is comprehensive but could be missing information.

Legislative and regulatory needs

Proactive approach of legislators - *desirable*

A proactive approach is required from a legislative and regulatory perspective to reduce the risk of being outrun by other powers. This requires an attitude from regulators to participate in developments rather than just assessing them. A solution for ensuring that they cooperate is by not using new terms for things they have been working with for a long time and already exist. In doing so, they must also learn to understand the technology and its opportunities and challenges.

Harmonisation - *desirable*

Legislative and regulatory harmonisation is needed for further development. The European Union and the SEC in the United States are already working on this. Experts mention the importance of frameworks or global standards to work with and to create clarity for further development.

Additional details

The need for recognition of and adaptation in legislation of digital assets is also stressed by the experts.

Compliance organisation

Complying with the legal requirements - *applicable*

To comply with legal compliance, the regulatory requirements for trading – AML (Anti Money Laundering) and KYC (Know your customer) - must be carried out by third party transfer agents.

Centralisation - *applicable*

Given that shares (tokens) must be registered (within the legal setup of ESMA in Europe) and are restricted to only being traded to and from whitelisted wallets, and that the real estate fund must be able to fully guarantee the source of the funds, it must be organised centrally. This also prevents login details from being unrecoverable.