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Breaking the Blockchain Ceiling: Exploring the impact of external enablers on PropTech 3.0 entrepreneurship

A study of digital entrepreneurs disrupting Nigeria's real estate industry

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Abstract

Background: The real estate sector is the largest asset class in the world but is notoriously slow to embrace technological change (Baum, 2017). However, digital entrepreneurs are recently getting interested in the real estate industry, leveraging Blockchain Technology (BCT) to create PropTech 3.0 ventures (Baum, 2017; Chalmers et al., 2021b; Saari et al., 2022). PropTech 3.0 ventures are real estate companies integrating BCT (Baum, 2017). Thereby, BCT acts as an external enabler for the emergence of PropTech 3.0 ventures (Upadhyay, 2020). BCT was introduced already in 2008, but PropTech 3.0 ventures are only now emerging – thus, additional factors must be at play for enabling or hindering PropTech 3.0 entrepreneurship.

Purpose: This study aims to deepen the understanding of the emerging PropTech 3.0 entrepreneurship by disentangling these factors. More specifically, we examine the external changes that have led to the emergence of PropTech 3.0 start-ups to explore why the real estate industry is only now adapting to BCT. To better understand this dynamic of how external factors impact the creation of new ventures, we apply the External Enablers (EE) framework by Davidsson et al. (2020).

Method: We conducted a qualitative study examining four PropTech 3.0 ventures in Nigeria based on seven interviews with PropTech 3.0 entrepreneurs and additional company documents, whitepapers and pitch decks. To better understand the Nigerian context and the PropTech 3.0 industry, we also interviewed five regular PropTech entrepreneurs in Nigeria who

do not use BCT and one PropTech 3.0 entrepreneur in Germany as well as ten experts of the Nigerian economy, real estate, and Blockchain.

Conclusion: Our research aimed to answer the question of how the interplay of external factors influences entrepreneurial initiatives in the PropTech 3.0 space. The results show that the interplay strongly influences entrepreneurial initiatives, i.e., mechanisms and their relational qualities, and thereby ultimately leads to the emergence of PropTech 3.0 start-ups. How it influences entrepreneurial initiatives extends the EE framework by Davidsson et al. (2020) in several ways. We identified several additional external factors, such as regulatory and socio-cultural factors, that enabled the emergence of PropTech 3.0 start-ups. The interplay of these factors influences the mechanisms and their relational qualities to varying degrees and with different effects. Additionally, we found that ecosystems and founder teams also impact the relational quality of mechanisms. In addition to theoretical implications, the results yield practical and policy implications.

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Abbreviations

BCT	Blockchain Technology
EE	External enablers
DLT	Distributed Ledger Technology
NTD	New Technological Domain
YT	YouTube
NFT	Non-Fungible Token
ED	External detrimental

Key terms

Blockchain: Blockchain is a distributed ledger technology (DLT) (Johar et al., 2021; Xie et al., 2019; Wamba et al., 2019) that is an electronic database uniquely storing data (Sharma, 2022).

Web 3.0: The next iteration of the World Wide Web that will change the Internet and platforms we know today. From being able to read and communicate online, on social media, to owning and decentralizing your own data (Vernando et al., 2022). The transition to Web 3.0 is still evolving, as there is no concrete definition and shape of Web 3.0 in 2022 (Ramadoss, 2022).

PropTech 3.0: The combination of property and technology leads to a collective term for start-ups that offer innovative technical products and novel business models in the real estate markets (Siniak et al., 2020). The now-emerging PropTech 3.0 is marked by the adaptation of BCT (Baum, 2017).

External enablers: The construct of external enablers is defined as the "*single, distinct, agent-independent external circumstances which have the potential of playing an essential role in eliciting and/or enabling a variety of entrepreneurial endeavors by several actors"* (Davidsson, 2015, p. 683).

1. Introduction

The introductory chapter introduces the topic of this thesis. First, the general background of the thesis is presented, focusing on the phenomenon of venture creation in PropTech 3.0. Then, the research problem is outlined, highlighting the research gaps in the literature on venture creation and Blockchain adaptation in the real estate industry.

1.1 Background

As the largest asset class in the world, real estate remains one of the last sectors to fully embrace and leverage the potential of technological advances and the innovative solutions they provide. Additionally, there are many inefficiencies in the industry. For example, real estate transactions currently involve multiple entities such as banks, notaries, and courts. Furthermore, records are often paper-based, outdated, and poorly managed (Thakur et al., 2020). Also, accessing these records is costly, time-consuming, and requires physical visits to government officials. Records of property are typically kept in centralized databases that globally are subject to numerous threats, including data loss, theft, and record tampering (Gupta et al., 2019).

All of this makes investing in real estate and creating capital a lengthy and complex process that acts as a deterrent (Saari et al., 2022). It puts formal credit channels out of reach for a substantial share of the population, either because people cannot afford real estate or, if they can, their property often cannot be used as collateral due to a lack of documentation. This concerns many, especially entrepreneurs. One of the most significant barriers to entrepreneurship is lack of access to capital (Kshetri, 2021). Having clear property rights allows entrepreneurs to leverage these assets as collateral, which would enhance their access to capital (Kshetri, 2017). At the same time, this industry, due to its large size and inefficient processes, offers excellent opportunities for entrepreneurs (Baum, 2017).

Especially digital entrepreneurs have lately found much interest in the real estate industry (Nambisan, 2017; Saari et al., 2022), formulating business models around new technologies that make processes more efficient by reducing time and resource costs (von

Briel et al., 2018). Digital artifacts such as virtual tours, electronic signatures, and online services like Airbnb are examples of the use of these technologies in the real estate industry (Nambisan, 2017; Siniak et al., 2020). Recently, more entrepreneurs are integrating the next level of digital technologies into their ventures, including digital infrastructures such as Blockchain (Chalmers et al., 2021b).

Blockchain technology (BCT) is a technology currently revolutionizing many fields (Hughes et al., 2019). Luthra et al. (2022), among many others, state that this technology can be used for a variety of adaptations in different sectors and with many benefits (Agarwal et al., 2022; Ramadoss, 2022). In particular, the real estate registries sector has been cited as an industry where BCT has significant impact (Saari et al., 2022). Here, digital entrepreneurs who are able to combine the problem of property registration and BCT are creating so-called PropTech 3.0 ventures (Baum, 2017).

PropTech 3.0 combines property and technology, leading to a generic label for start-ups providing innovative technical services and new kinds of business models in the real estate industry (Siniak et al., 2020). The 3.0 era currently emerging is characterized by the adaptation of BCT (Baum, 2017). Due to BCT's specific features, many real estate industry challenges can be addressed by digital entrepreneurs (Thakur et al., 2020). For example, it can clarify ownership by recording all documents in a decentralized database (Thakur et al., 2020). This would increase the reliability of real estate registration and make transactions more secure (Podshivalov, 2022), reducing fraud and corruption (Saari et al., 2022). At the same time, real estate investments are becoming more accessible (Saari et al., 2022).

One external factor enabling the emergence of PropTech 3.0 is thus the digital technology Blockchain (Upadhyay, 2020). External enablers are defined as essential changes in the entrepreneurial ecosystem that have the potential to play a significant role in enabling multiple entrepreneurial ventures by diverse and potential actors (Davidsson et al., 2020). To better understand PropTech 3.0 venture creation, the External Enablers (EE) framework by Davidsson et al. (2020) can be applied to examine how external factors lead to the creation of firms, including the role of entrepreneurs in enabling mechanisms, the impact on firms, and consideration of context.

1.2 Problem Discussion

Entrepreneurship literature describes several industries where BCT acted as an enabler for venture creation (Hughes et al., 2019). However, there are few examples showing successful Blockchain adaptation at scale (Volodymyr & Gilles, 2020). In particular, the real estate industry has been slow to adapt to this technology compared to other industries (Aihie, 2020; Bennett et al., 2019; Siniak et al., 2020). Various researchers have discussed the theoretical benefits, challenges, and impact of the emerging technology in the real estate industry, but the literature lacks empirical studies and proper examination of so-called PropTech 3.0 start-ups (Podshivalov, 2022; Saari et al., 2022). Overall, the current literature on Blockchain adaptation in real estate calls for more empirical observations (Bennett et al., 2021; Saari et al., 2022).

PropTech 3.0 start-ups are emerging worldwide and are slowly gaining momentum (Aihie, 2020). Although BCT is acting as an enabler for these start-ups (Hughes et al., 2019), the fact that BCT was introduced in 2008 (Agarwal et al., 2022) and PropTech 3.0 companies are only now emerging shows that additional factors besides BCT have been at play. This calls for research investigating the factors leading to the creation of ventures that combine real estate and BCT and create PropTech 3.0 ventures (Saari et al., 2022), as well as the role of digital entrepreneurs themselves, their response to the various external changes (Kimjeon & Davidsson, 2022). Based on the assertion that BCT is a suitable tool for reducing the problems associated with real estate registries (Thakur et al., 2020; Graglia & Mellon, 2018), we explore why and how the emergence of PropTech 3.0 start-ups is currently gaining momentum.

We apply the External Enablers (EE) framework to capture how BCT enable the creation of new ventures (Davidsson et al., 2020). While it has already been stated that BCT is an external enabler, the interplay of enablers leading to the creation of PropTech 3.0 ventures still remains underexplored (Kimjeon & Davidsson, 2022).

To date, the literature examining the impact of external change on new venture creation is relatively small (Kimjeon & Davidsson, 2022). In addition to the lack of research on the interplay of different EE, there are hardly any empirical studies examining the

mechanisms at the firm level. At the micro level, not all enabling mechanisms are identified and/or utilized, and here research lacks consideration of the relational qualities of mechanisms, opacity, and agency intensity (Kimjeon & Davidsson, 2022). This particular knowledge is essential for understanding the phenomenon of digital entrepreneurs starting new businesses around PropTech 3.0. Moreover, it is essential for further developing the EE framework itself. Therefore, exploring the adaptation of Blockchain by applying the EE framework in the context of the real estate industry represents a new and relevant research direction in the entrepreneurship literature.

1.3 Thesis structure

Our thesis is structured as follows. First, the literature review discusses the areas relevant for this study, i.e. BCT and the EE framework (chapter 2), followed by the rationale for the chosen methodology (chapter 3). We then outline Nigeria as an appropriate research context due to its fairly established PropTech 3.0 scene. The four case studies of PropTech 3.0 ventures in Nigeria are presented (chapter 4) before moving on to our analysis based on the EE theoretical framework (chapter 5). We conclude with practical and policy implications, limitations of our study, and areas for future empirical research (chapter 6).

2. Literature Review

Considering that this thesis aims to better understand the phenomenon of digital entrepreneurs starting new ventures in PropTech 3.0, the following chapter presents the existing literature and theory used to frame the topic above. We first discuss digital entrepreneurship and introduce the technology of Blockchain and its adaptation to different industries to provide a general insight into the functions themselves and digital entrepreneurs adapting the technology. We then focus on Blockchain adaptation in the real estate industry, discussing the PropTech 3.0 literature and examining its progress and impact on entrepreneurship. Thereafter, the theoretical framework of external enablers is presented, and in conjunction with the PropTech 3.0 context, all major research gaps are outlined, leading to the research question of this thesis.

2.1 Digital Entrepreneurship

The term 'digital entrepreneurship' has recently attracted considerable interest from scholars. It is defined as "*the pursuit of opportunities based on the use of digital media and other information and communication technologies*" (Davidson & Vaast, 2010, p. 2). The field aims to understand how entrepreneurial opportunities are created through the interaction of digital technologies with everyday activities (Davidson & Vaast, 2010; Nambisan, 2017). Digital technologies have transformed the way new entrepreneurial activities emerge (Nambisan, 2017) by incorporating features that help entrepreneurs eliminate challenges faced by new ventures (Chalmers et al., 2021b).

The interactions between humans and technology facilitate ventures, with Twitter as prominent example (Nambisan, 2017). Digital entrepreneurs thus benefit from the coexistence of physical and digital worlds (Browder et al., 2019) and the connections between human and non-human actors (Davidson & Vaast, 2010). Furthermore, digital ventures are produced in new technological domains (NTD), and the success of those ventures is the reason for other digital entrepreneurs to follow suit (Leten et al., 2016).

Overall, digital entrepreneurs focus on exploiting the benefits of digital technologies by formulating their ventures around them. As a result, they now have more opportunities to innovate, expand to new markets and reach new customers (von Briel et al., 2018). Examples of digital technologies used are Artificial Intelligence and Blockchain (Chalmers et al., 2021a; Chalmers et al., 2021b).

2.2 Blockchain Technology

Blockchain technology is attracting widespread interest from academia and practitioners (Buldas et al., 2022). However, definitions of Blockchain vary widely (Wamba et al., 2019), and terminology confusion prevails (Saari et al., 2022). Nevertheless, relevant literature defines Blockchain as a distributed ledger technology (DLT) (Johar et al., 2021; Xie et al., 2019; Wamba et al., 2019) that is an electronic database storing data in a unique way (Sharma, 2022).

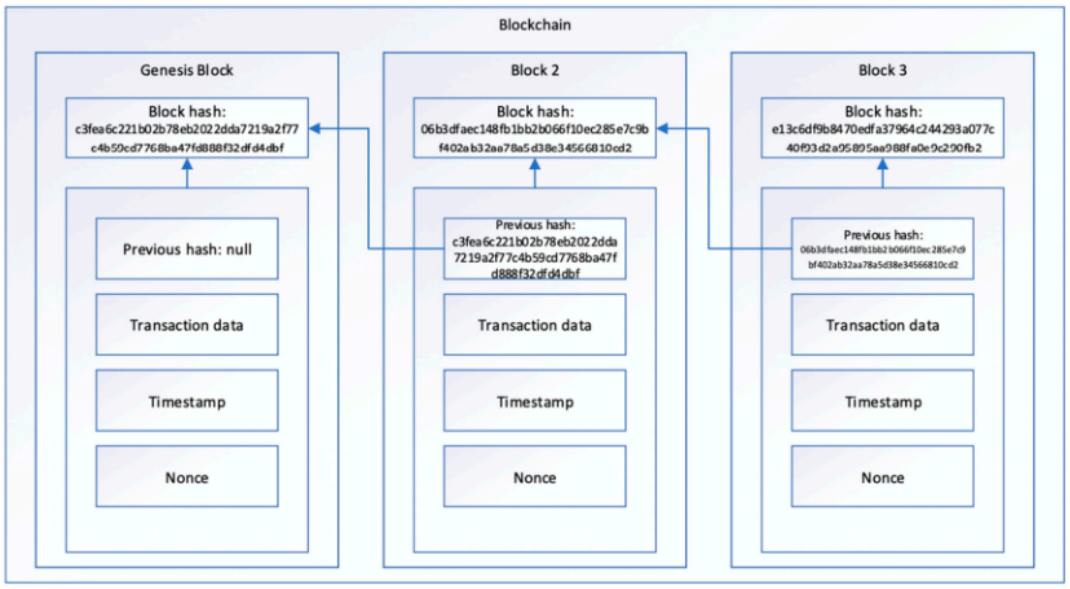
A pseudonymous individual or group named Satoshi Nakamoto introduced the concept of Blockchain in 2008 in connection with the peer-to-peer electronic money system Bitcoin (Hughes et al., 2019). Blockchain was developed as a solution addressing the long-standing user trust problem (Johar et al., 2021), which was particularly prevalent regarding intermediaries such as banks during the financial crisis in the same year (Agarwal et al., 2022). The advent of the well-known cryptocurrency Bitcoin created an architecture that allows individuals to trust a decentralized system rather than an intermediary (Johar et al., 2021).

DLT is a distributed, transparent, secure data storage and transfer technology with no central trusted third party (Xie et al., 2019). This decentralized database, a ledger, is managed by multiple nodes, usually a computer, over a peer-to-peer network. The ledger gets verified and replicated by each node (Xie et al., 2019). Blockchain is only one type of DLT (Xie et al., 2019; Ramadoss, 2022), there are others, such as hashgraphs, but Blockchain is, to date, the most developed (Volodymyr & Gilles, 2020). Sharma (2022) highlights the difference between DLT and Blockchain, which is that DLT is a more comprehensive concept and includes several other design mechanisms in addition to the chain structure used by Blockchain.

Blockchain is a series of blocks connected by hashes (Johar et al., 2021), which are cryptographic ‘fingerprints’ of all previous blocks (Volodymyr & Gilles, 2020). Once a block is complete, the entire transaction history is recorded and can be easily traced using the previous nodes (Agarwal et al., 2022). That is because each block has a unique identifier and is marked with the hash of the previous block, a nonce number, and an

accurate timestamp. The first block is the genesis block and does not contain a previous hash (Johar et al., 2021). The blocks are arranged chronologically to the previous block (Agarwal et al., 2022), forming a chain, as shown in **Figure 1**. How Blockchain works is thoroughly explained in Appendix 1.

Figure 1 Blockchain with all transaction information



Source: Adapted from Sladić et al. (2021, p. 4)

As an emerging technology, BCT has many beneficial characteristics (Xie et al., 2019). The most commonly cited characteristics in the related literature are immutability, security, transparency, and decentralization (Johar et al., 2021; Agarwal et al., 2022; Xie et al., 2019; Hughes et al., 2019; Wamba et al., 2019). All transactions, once entered into the ledger, cannot be edited, deleted, modified, or destroyed because the data is replicated across all nodes in the network (Hughes et al., 2019). Small changes will result in a different hash code (Volodymyr & Gilles, 2020). Since previous block's hash is linked to another block's data, the changes cause the two hashes to no longer match, thus breaking the chain (Johar et al., 2021). This makes Blockchain immutable and secure (Agarwal et al., 2022; Xie et al., 2019).

Decentralization is another crucial characteristic of BCT, as it eliminates the role of a central authority (Johar et al., 2021) by maintaining it on a peer-to-peer basis (Agarwal et al., 2022). Since every node can verify the record of all network transactions without a

central node or trusted third party (Hughes et al., 2019), middlemen and inefficient processes are eliminated (Xie et al., 2019). In addition, BCT allows anyone in the network to access all transaction records stored in the blocks (Xie et al., 2019; Johar et al., 2021), making them transparent and traceable throughout the lifespan of Blockchain (Agarwal et al., 2022). In this way, all data can be accessed quickly at any time.

Blockchain adaptation

The general idea of Blockchain was shaped in October 2008 as part of the concept of Bitcoin, a virtual currency that dispensed with central authorities for issuing money, transferring property, and validating transactions (Iansiti & Lakhani, 2017). Bitcoin is the first adaptation of BCT (Iansiti & Lakhani, 2017), and cryptocurrency remains its most sought-after adaptation (Upadhyay, 2020). Bitcoin then initiated the launch of several other cryptocurrencies (Ramadoss, 2022). Although Bitcoin has attracted the financial market to convert digital transactions, digital entrepreneurs are adapting Blockchain to many different markets (Upadhyay, 2020).

However, it was not until 2015 that the introduction of the Ethereum Blockchain initiated several other programmable chains and acted as a testing ground for many BCT experiments beyond money transfers (Ramadoss, 2022). A year later, in 2016, Blockchain was considered the most trending technology that can impact many businesses (Upadhyay, 2020). BCT can be used for various adaptations in different fields and can benefit governments and businesses, but at the moment it is mainly digital entrepreneurs who are experimenting with the technology (Luthra et al., 2022). The fields are mainly finance, healthcare, supply chain, Internet of Things, and energy (Agrawal et al., 2022; Jameela & Nader, 2019; Upadhyay, 2020).

Many researchers have already studied various BCT adaptation areas and showed that BCT brings benefits such as greater trust, transparency, and secure records (Agrawal et al., 2022; Luthra et al., 2022). Such adaptations are part of what is known as Web 3.0, the next iteration of the World Wide Web, which uses technologies such as Blockchain to decentralize data on the Internet (Vernando et al., 2022). A common adaptation of BCT is in supply chain, where transparency is achieved by showing customers the product lifecycle and enabling product tracking (Liu et al., 2021). BCT is also used in healthcare

to schedule patient appointments with different doctors and pay bills to reduce the burden of managing healthcare data (Iqbal et al., 2021).

The emerging field of BCT has already seen notable developments, innovations, and experiments, especially by start-ups (Ramadoss, 2022). However, there is a debate in the literature about whether the nascent field is a rapid development. While Ramadoss (2022) and Sharma (2022) talk about the field developing rapidly, Iansiti and Lakhani (2017) compare Blockchain to early email, which only gradually replaced more traditional local network technologies and standards. Although the technology has the promise to establish new foundations for our social and economic systems (Iansiti & Lakhani, 2017), many researchers believe it may take decades for Blockchain to penetrate our infrastructure (Iansiti & Lakhani, 2017; Luthra et al., 2022; Upadhyay, 2020). This has been shown by Volodymyr and Gilles (2020), who outline that 26,000 new Blockchain projects were launched in 2016, and only 8% were active the following year.

Adapting BCT is not an easy task and brings many challenges. These are technological challenges, and organizational, cultural, legal, and regulatory challenges (Hughes et al., 2019; Iansiti & Lakhani, 2017). Given these challenges and the fact that BCT is still in its early stages and lacks widely accepted standards (Luthra et al., 2022), few ventures are successful (Hughes et al., 2019). Nevertheless, more and more new start-ups are integrating BCT into their business model (Siniak et al., 2020), making Blockchain an enabler of technological change (Hughes et al., 2019). What other factors are influencing the BCT adaptations that are just emerging is still a subject of research (Upadhyay et al., 2020).

2.3 PropTech 3.0

One adaptation that is also currently on the rise is PropTech 3.0 (Aihie, 2020). PropTech, or Real Estate Technology, is a collective term for start-ups offering innovative tech products and novel business models in real estate markets (Siniak et al., 2020). The adaptation of BCT marks the now emerging PropTech 3.0 and is thus part of the Web 3.0 era (Baum, 2017). It started with the emergence of online listing websites in 2007, continued with the use of virtual reality and data analytics, still practiced by many start-ups such as Airbnb, and led to the first experiments with BCT (Siniak et al., 2020).

The real estate industry is a key focus area when considering Blockchain adaptation and is often cited as an example of the benefits of the practical application of BCT (Saari et al., 2022). Goldman Sachs reports estimates that BCT has the potential to save $2 billion to $4 billion annually in just the real estate title insurance market (Graglia & Mellon, 2018). This strong influence of technology is due partly to the fact that the industry accounts for approximately 60% of the world's wealth (Saari et al., 2022), making it a vital and significant industry for digital entrepreneurs.

Additionally, the current centralized databases are vulnerable to numerous threats, including data loss, theft, and record tampering (Gupta et al., 2019). This happened in Haiti, for example, when an earthquake destroyed many different land records and property deeds in 2010 (Graglia & Mellon, 2018). Such inefficient processes, the industry size, and unnecessary transaction costs simultaneously represent a huge opportunity for digital entrepreneurs (Baum, 2017).

Creating a PropTech 3.0 venture ultimately allows transferring real estate and storing all related data in a decentralized ledger, i.e., a real estate registry (Thakur et al., 2020). This eliminates the reliance on intermediaries involved in the verification process, such as notaries, and enables a faster, more straightforward, and less costly property registration process (Thakur et al., 2020). PropTech 3.0 provides clarity on ownership and valuation (Thakur et al., 2020), increases the reliability of real estate rights registration, and makes real estate transactions more secure (Podshivalov, 2022), thereby reducing fraud and corruption (Saari et al., 2022).

In general, with a PropTech 3.0 solution, all property-related data can be permanently linked to the authorized system, ensuring that no one can manipulate this data (Yadav & Kushwaha, 2021). Each time a transaction takes place and ownership is transferred, it must be validated by all parties involved and is then updated and added to the shared database (Yadav & Kushwaha, 2021). The parties involved include sellers, buyers, and banks (Kshetri, 2021). Information included in the real estate register and hashed for identification are e.g., the property number, the exact location of the property, the exact date, and time of the transaction and all information about the owner and seller (Kshetri, 2021).

While most start-ups in PropTech 3.0 focus on real estate registration, some digital entrepreneurs are further enhancing real estate registration by integrating tokenization (Podshivalov, 2022), thus enabling fractional rights. Fractional rights in this context can be defined as multiple actors sharing the rights to own property (Graglia & Mellon, 2018). Fractional owners receive a proportion of the resale price when the property is sold and a share of the rental payments when the property is rented out (Bennett et al., 2019). This makes investment in real estate simpler and more accessible (Graglia & Mellon, 2018). The technology behind this, tokenization, is replacing the tangible object of the right, the property, with tokens that represent it as a digital object. This enables secure and fast division of ownership and trading of real estate or, rather, real estate tokens (Podshivalov, 2022). How the technology behind PropTech 3.0 works in detail is explained in Appendix 2.

Development of PropTech 3.0 ventures

Despite the global economic, social, and environmental importance of real estate, the digital maturity of the industry is consistently rated lower than that of many other industries (Saari et al., 2022). Due to the many technical, regulatory, and financing challenges in the industry (Kshetri, 2021), PropTech 3.0 only began to receive more attention in the real estate literature twelve years after the introduction of BCT (Saari et al., 2022).

Here, the general hypothesis explored is that BCT could theoretically address several significant challenges in the real estate sector, such as lack of transparency, inefficiency, and unaffordability (Saari et al., 2022). While there are now more discussions of PropTech 3.0 in the peer-reviewed real estate literature (Starr et al., 2020), most theoretically elaborated PropTech 3.0 benefits still need to be empirically confirmed (Saari et al., 2022). **Table 1** illustrates some of the research in this area.

Table 1 BCT literature review table

Article Title	Author(s)	Year	Type of study	Journal	ABS list	Blockchain definition	BCT Real Estate	BCT Application/ challenges	Enablers
Blockchain and Property in 2018: At the End of the Beginning	Graglia & Mellon	2018	Conceptual	MIT Press Direct OA Journals	3				
A Survey of Blockchain Technology Applied to Smart Cities: Research Issues and Challenges	Xie et al.	2019	Literature Review	IEEE Communication surveys and tutorials	3				
Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda	Hughes et al.	2019	Literature Review	International Journal of information Management	2				
Distributed Ledgers and operations: What operations management researchers should know about Blockchain technology	Volodymyr & Gilles	2020	Qualitative Study	Manufacturing & service operations management	3				
Blochchain Technology: An overview	Ramadoss	2022	Literature Review	IEEE potentials	3				

Note. This is an abridged version of the literature used. The detailed literature table can be found in Appendix 3.

The research that has been done in PropTech 3.0 is limited. Yadav and Kushwaha (2021) applied BCT to optimize the operation of land registries in India to increase trust. Gupta et al. (2019) introduced Land Ledger, a property management system with integrated Blockchain, to achieve security, efficiency, scalability, and transparency in the Indian real estate industry. Moreover, Rodima-Taylor (2021) examines the example of Georgia, another country where BCT has been introduced into the land registry system to cut out intermediaries, shorten the purchasing process, and make it safer.

Nevertheless, the sudden emergence of PropTech 3.0 start-ups remains completely unexplored (Podshivalov, 2022). While Hughes et al. (2019) mention Blockchain as one of the enablers of PropTech 3.0 start-up emergence, other enablers were not mentioned. Additionally, Saari et al. (2022) mention that Blockchain alone does not lead to the creation of PropTech 3.0 start-ups and empirically demonstrate that other factors, such as the environment and institutions, might also influence the process. Further research should, therefore, also focus on investigating other enablers of Blockchain adaptation in the real estate sector to understand the sudden emergence (Saari et al., 2022). In this

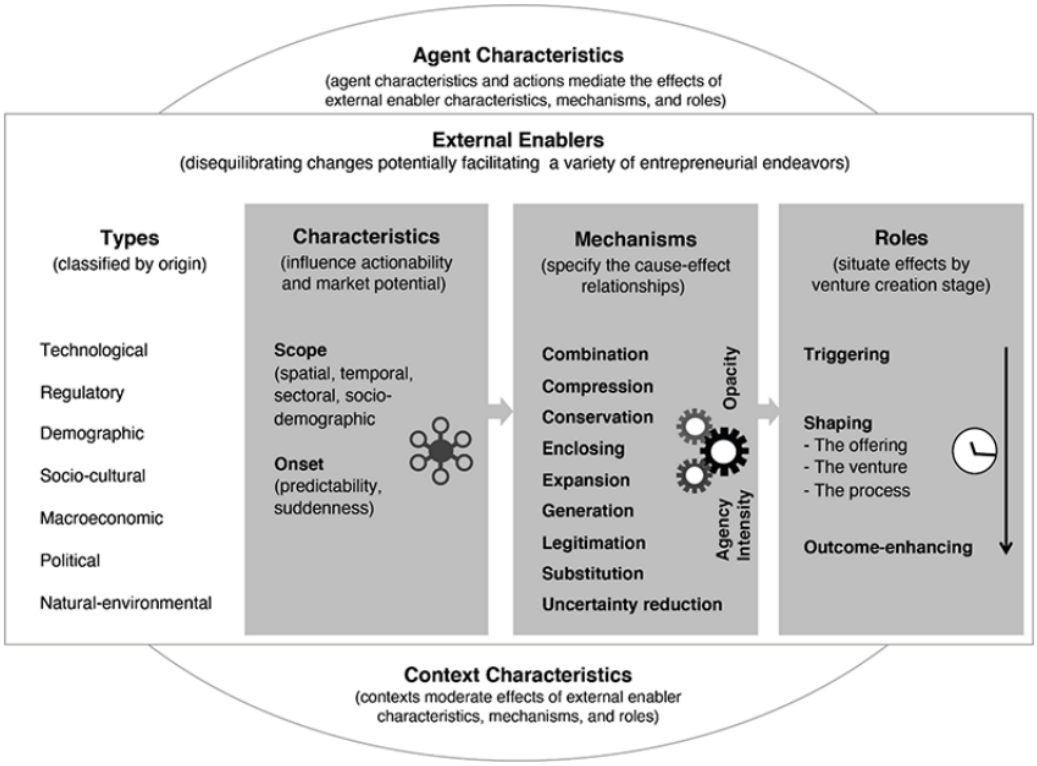
context, the role of digital entrepreneurs is critical, and there is a need to better understand how and why they respond to various external changes (Kimjeon & Davidsson, 2022).

2.4 The External Enablers Framework

An instrument suitable to examine the external factors enhancing venture creation is the External Enablers framework by Davidsson et al. (2020). The use of the EE framework can provide a distinct and heightened analytical perspective on the concept of opportunity discovery and creation, especially in an emerging industry such as PropTech 3.0. (Davidsson et al., 2020). External enablers are described as "*single, distinct, agent-independent external circumstances which have the potential of playing an essential role in eliciting and/or enabling a variety of entrepreneurial endeavors by several actors*" (Davidsson, 2015, p. 683). Its main objective is to explain why, when, and how external changes can lead to the creation of new ventures (Davidsson et al., 2020). Examples of such EE cited by many researchers is the introduction of new technologies such as Blockchain (Chalmers et al., 2021b; von Briel et al., 2018).

There have been several variants of the EE framework since its first conception (Davidsson, 2015; Bennett, 2019; Bennett, 2021; Kimjeon & Davidsson, 2022), but the main framework is that by Davidsson et al. (2020) '*External Enablement of New Venture Creation: A Framework*'. This paper develops and refines a framework by Davidsson (2015) to propose that external enablers consist of different characteristics, mechanisms, and roles, showing the impact of different types of external changes in a firm-level analysis, as displayed in **Figure 2**. Nevertheless, the literature addressing the impact of external changes on new venture formation is still small and requires further research (Kimjeon & Davidsson, 2022).

Figure 2 The External Enablers Framework



Source: Adapted from Davidsson et al. (2020, p. 315)

The refined framework

The framework defines external enablers as the distinct macro-level external changes that could affect the existence of a company (Davidsson, 2015). There are different types of EE, such as regulatory changes (Chalmers et al., 2021a), the introduction of new technologies (von Briel et al., 2018), demographic trends (McAdam et al., 2020), natural disasters (Davidsson et al., 2021), or socio-cultural/economic/political changes (Browder et al., 2019). In addition, each enabler possesses specific characteristics, referred to as scope and onset in the context of EE (Davidsson et al., 2020).

For the venture-level analysis, the EE framework introduces mechanisms which display the cause-effect relationships between the external enablers and the new ventures (Schade & Schuhmacher, 2022; Davidsson et al., 2020). Mechanisms are limited to specific EE and ventures, meaning that only specific external enablers can activate certain mechanisms, which may also not be applicable to all ventures (Kimjeon & Davidsson, 2022). At the same time, different EE can provide the same types of mechanisms, but no

venture can use mechanisms that cannot physically be provided by specific enablers (Davidsson et al., 2020). For this reason, there is a two-way relationship between EE characteristics and mechanisms (Kimjeon & Davidsson, 2022).

Six different mechanisms - compression, conservation, expansion, substitution, combination, and generation - were first introduced by von Briel et al. (2018) for the context of digital technologies. Davidsson et al. (2020) reconceptualized this proposal by introducing new mechanisms (uncertainty, legitimacy and enclosing) and later dividing them into three categories. The first category includes mainly supply-based mechanisms, i.e., combination, compression, conservation, resource expansion, and substitution. The second category consists of mainly demand-based mechanisms: demand expansion and substitution generation, legitimation, and uncertainty reduction. Finally, one last mechanism related to value appropriation is enclosing.

In the EE framework, mechanisms, just like external enablers, also have specific characteristics known as relational qualities, namely opacity and agency intensity (Davidsson et al., 2020). Relational qualities are the link between external enablers and entrepreneurs who realize and act upon the external changes, thus leveraging the mechanisms (Davidsson et al., 2020). Based on Davidsson et al. (2020), opacity indicates whether any actor considers the outcomes of a particular mechanism obvious or whether a certain level of knowledge is required to recognize them. Agency intensity is the characteristic that shows that an actor possesses individual traits such as courage, dexterity, and increased risk tolerance when making bold and resource-consuming decisions to activate a particular mechanism (Davidsson et al., 2020).

More in terms of individual traits, the entrepreneurs' level of information is a critical factor in their decision-making process, as no two individuals can have the same information simultaneously (Shane & Venkataraman, 2000). In contrast to this statement, Frederiks et al. (2019) state that an entrepreneur's ability to think is a more important attribute for understanding the relationships that lead to entrepreneurial ventures than the preliminary information needed. Consequently, the entrepreneur's individual traits influence a given mechanism's degree of opacity and agency intensity.

Moreover, the extent to which entrepreneurs perceive the relational qualities of a mechanism is also related to the institutional level of a region. Countries with a high level of digital infrastructure tend to attract more entrepreneurs who want to start new businesses (Schade & Schuhmacher, 2022). Furthermore, Bennett's (2019) research in private and public infrastructure investment highlights that regions that focus on investing in the first type encourage entrepreneurs to start businesses as they could have access to resources and skills that can take them to the next level. Alongside, Leten et al. (2016) mention that entrepreneurs actively choose to seek resources in NTDs to gain a competitive advantage, even if they are located far away from their business. Overall, the institutional level of a region affects the entrepreneur's decision to act upon specific mechanisms and as a result, the level of its opacity and agency intensity.

In conclusion, for mechanisms to be considered of low opacity and agency intensity, it should be evident for any entrepreneur to identify their existence and evaluate if the resources invested in them will decisively help their business (Davidsson et al., 2020). On the other hand, when these relational qualities are high for the average entrepreneur, only those who can predict better and/or are more fortunate can achieve better outcomes than the rest (Davidsson et al., 2020). Therefore, the entrepreneur's decision to respond to mechanisms with a certain degree of opacity and agency intensity has strategic significance for the future of his or her firm. (Davidsson et al., 2021; Davidsson et. al., 2020).

Continuing the analysis on the micro level, the EE framework includes the part of roles that shows the point at which external enablers influence specific ventures (Davidsson et al., 2020). Based on the framework, there are three roles: triggering, outcome enhancing, and shaping. All roles have strategic importance for a venture's success and are activated by entrepreneurs based on the strategic benefits they want to pursue at a given time (Davidsson et al., 2020).

Finally, it should be noted that both the macro and the micro level analysis are applied under two specific conditions related to agency and the context. The EE framework emphasizes that any entrepreneurial activity, including new venture creation, cannot exist without the existence of the actors (Davidsson et al., 2020). Moreover, context plays an

important role, as similar enablers may have a massive impact in one case and little or no impact in another (Chen et al., 2020). As a result, external enabler outcomes differ across countries and industries (Davidsson et al., 2020).

2.5 Unexplored research areas

Although the EE framework has been applied recently in various contexts (**Table 2**) it is considered relatively new. As a result, there are several research gaps in certain facets that have not been explored in-depth and require further investigation (Davidsson et al., 2020; Kimjeon & Davidsson, 2022). Additionally, even though discussions about PropTech 3.0 are increasing, many gaps still need to be explored in that area (Podshivalov, 2022).

Table 2 EE literature review table

Article Title	Author(s)	Year	Type of study	Journal	ABS list	Technology	Infrastructure	Socio-cultural	Regulatory	Natural/ Environmental
The emergence of the maker movement: Implications for entrepreneurship research	Browder et al.	2019	Conceptual	Journal of Business Venturing	4	■		■		
External Enablement of new venture creation: An exploratory, query-driven assessment of China's high-speed rail expansion	Chen et al.	2020	Quantitative Study	Journal of Business Venturing	4		■			
Local economic freedom and creative destruction in America	Bennett	2021	Quantitative Study	Small Business Economics	3				■	
Blockchain as an external enabler of new venture ideas: Digital entrepreneurs and the disintermediation of the global music industry	Chalmers et al.	2021	Qualitative Study	Journal of Business Research	3	■				
External Enabler in existing organizations: Emergence, novelty and persistence of entrepreneurial initiatives	Cestino Castilla et al.	2023	Qualitative Study	Strategic Entrepreneurship Journal	4					■

Note. This is an abridged version of the literature used. The detailed literature table can be found in Appendix 4.

The external enabler BCT (Davidsson, 2015; Chalmers et al., 2021a) was one of the factors that led to PropTech 3.0 ventures as a solution to real estate registration problems due to its unique characteristics such as transparency, immutability, and security (Agarwal et al., 2022; Xie et al., 2019; Podshivalov, 2022). Based on Chalmers et al. (2021b), the entrepreneur's ideology and market volatility are also considered external enablers that influence the creation of Blockchain ventures. In addition, natural disasters such as Covid-19 have been considered EE (Davidsson et al., 2021) that have driven BTC

adaptation (van Hoek & Lacity, 2020). For this reason, Chalmers et al. (2021b) and Davidsson et al. (2020) suggest that a combination of multiple enablers may have a more significant impact on new venture creation in a given industry than any single enabler on its own. However, the interaction of the different factors has not been sufficiently studied (Kimjeon & Davidsson, 2022). Further research on this topic should provide answers to the question of what other external enablers have led to the recent surge of PropTech 3.0 companies, especially since BCT has been around for almost 15 years (Agarwal et al., 2022).

At the micro-level, external enablers produce mechanisms that are not always obvious or easy to activate (Davidsson et al., 2020). This results from how opaque or intense in terms of agency the nature of a specific mechanism is (Kimjeon & Davidsson, 2022). The role of entrepreneurs is to identify and exploit the benefits derived from a particular mechanism that leads to new entrepreneurial initiatives (Davidsson et al., 2020). The differences in entrepreneurs' background, pre-knowledge (Chen et al., 2020), and thinking abilities (Frederiks et al., 2019) are some factors that reduce the natural levels of mechanism opacity and agent intensity, therefore leading to different levels of entrepreneurial outcomes in a given context. Consequently, the role of the entrepreneur determines whether or not an EE ultimately leads to the creation of a venture (Davidsson, 2015; Davidsson et al., 2020). Nevertheless, recent studies rarely address the strategic importance of opacity and agency intensity (Kimjeon & Davidsson, 2022). Additional research is considered essential to further explore the role of digital entrepreneurs in creating PropTech 3.0 ventures.

Accordingly, and to address all these research gaps, we integrate external enablers, entrepreneurship, and PropTech 3.0 to ask:

RQ: How does the interplay of external factors affect entrepreneurial initiatives in the PropTech 3.0 space?

Consequently, this study aims to deepen the understanding of the emerging PropTech 3.0 start-up phenomenon. More specifically, we examine the external changes that have led to the emergence of PropTech 3.0 start-ups and how they are interrelated to explore why

the real estate industry is only now responding and adapting to the technology. In addition, we examine the role of digital entrepreneurs and how the interplay of external changes affects their ability to identify and leverage enabling mechanisms.

On the one hand, this provides a practical contribution by helping entrepreneurs solve many real estate-related problems, such as unregistered and unaffordable properties, using Blockchain. On the other hand, it fills a gap in the entrepreneurship literature. It builds on the existing framework of EE (Davidsson et al., 2020) by contributing to how different enablers interact at the individual level and influence the relational qualities of the enabling mechanisms. We aim to understand why PropTech 3.0 entrepreneurs have chosen to start their businesses based on external changes and to understand the role of digital entrepreneurs responding to various external changes.

3. Methodology and Method

In this chapter, we present the methodological framework of our thesis, and how we will answer the research question. First, we focus on the research philosophy, design, and methodology to lay the groundwork for collecting, analyzing, and using the data. Then, we introduce the research context and describe the cases. Third, we exemplify our data collection procedure and outline our data analysis to demonstrate how we moved from raw material to theorizing. Finally, we show how our research ensures appropriate research quality and present our ethical considerations.

3.1 Research philosophy

A philosophical viewpoint is critical as it defines the entire research process, from data collection to proper interpretation of data, and provides researchers with a clear sense of their reflective role regarding research methods (Easterby-Smith et al., 2015). Understanding philosophical issues allows researchers to go further and use research designs that are new to them and not consistent with their subjective knowledge (Easterby-Smith et al., 2015). Research philosophy consists of ontology and epistemology.

Ontology deals with the nature of existence and reality and distinguishes four main views of reality: realism, internal realism, relativism, and nominalism (Hugly & Sayward, 1987). Internal realism is a philosophical ontology proposed by Hilary Putnam in the 1980s stating that scientific knowledge is not a direct representation of the world but a product of the interaction between the observer and the world (Putnam, 2015). According to Putnam (1987), the world is not a fixed entity that exists independently of our knowledge or merely a product of our subjective experience. Instead, she assumes that there is a middle ground between the two extremes, where the world is both mind-independent and mind-dependent. Such a middle ground means that there is one single truth, however, it is not directly accessible to researchers, instead only through indirect evidence (Putnam, 1987). Thus, it is impossible to ever obtain complete and objective information about a given phenomenon, since empirical observations themselves determine the observed state of the phenomenon under study. Nevertheless, internal realism fully accepts that once discovered, scientific laws are independent and absolute of further observations (Easterby-Smith et al., 2015).

Studying the PropTech 3.0 phenomenon will not lead to a complete and objective understanding, as it will be highly influenced by how we conduct this study, which is in line with an ontology of *internal realism*. However, since we are researching a niche area, we can still make rational statements about the absolute truth. Additionally, using such an ontology allows us as researchers to acknowledge the role of our perspective and cognitive framework in shaping further methods and conclusions (Putnam, 2015). Moreover, internal realism has informed debates about the nature of scientific research and the relationship between theory and observation (Putnam, 2015). As researchers applying this ontology, we can explore these issues more deeply and pay attention to how theories and observations interact and how we influence them. This is particularly important as we use Davidsson et al.'s (2020) EE framework to explain the PropTech 3.0 phenomenon while further developing the framework used.

Epistemology is the study of the nature of knowledge (Easterby-Smith et al., 2015). The basic idea of positivism is that the social world exists externally, and its features can be measured by objective methods rather than subjectively through intuition and reflection (Easterby-Smith et al., 2015). In positivist research, the focus is on objective, observable, and measurable phenomena, and this is done through systematic observation and recording of phenomena during data collection. Since complete objectivity cannot be given in our thesis, a *post-positivist* epistemology was chosen. This philosophical approach emerged in the mid-20th century as a reaction to the limitations of positivism, to recognize the role of the observer and subjectivity in knowledge generation (Engle, 2014).

There are several reasons why a post-positivist philosophy of research is helpful for this work. First, it underscores the importance of critical inquiry, which helps us as researchers to identify and acknowledge biases in our research (Silva, 2013). Second, it encourages us to consider multiple perspectives, which can lead to a more nuanced understanding of the phenomenon under study (Engle, 2014). This is particularly important when studying complex and multi-faceted phenomena (Easterby-Smith et al., 2015). A post-positivist philosophy can be useful for making a general contribution to the entrepreneurship literature (Easterby-Smith et al., 2015; Engle, 2014). By developing theories or parts of theories that can be applied to other contexts beyond our specific context of PropTech

3.0, post-positivist research can contribute to a broader body of knowledge and inform policy and practice (Engle, 2014).

3.2 Research methodology

The methodology forms the basis of this study for how data was collected and analyzed to answer the research questions. It facilitates the presentation of the research findings and the coherence of the entire research along the process (Easterby-Smith et al., 2015). However, to ensure this coherence, the researchers must pursue a methodology appropriate to the study's topic and objective (Easterby-Smith et al., 2015). Since our objective was to deepen the understanding of the emerging PropTech 3.0 start-up phenomenon by contributing to the External Enablers framework, an abductive, multiple-case study was conducted.

The abductive reasoning process is initiated by a surprising observation, according to Cassell et al. (2018). The reason it is surprising is that existing theoretical frameworks and prior assumptions do not appear to adequately explain it. Abduction is the act of providing a theoretical explanation to this empirical enigma. Under the best circumstances, solving the enigma enables a new set of theories and concepts to be developed (Cassell et al., 2018). The main difference with inductive studies is the role of the framework. In studies based on abduction, the initial framework is modified successively, partly because of unexpected empirical results and theoretical findings obtained during the process (Dubois & Gadde, 2002).

In line with our research purpose, an *abductive approach* was thus chosen. While Kuhn and Propper had argued that post-positivism is a deductive approach, more recently scholars have argued that post-positivism aligns with an abductive approach (Hagen, 2017). The reason for this is that abduction helps address the post-positivist approach's severe difficulties with deduction that arise in showing the relationship between scientific concepts and empirical research (Hagen, 2017).

Abductive research is often associated with qualitative research (Farquhar, 2012). It was also chosen as the most appropriate strategy in our thesis to deepen our understanding of the PropTech 3.0 phenomenon while considering different viewpoints. The chosen

method is also consistent with our chosen epistemology of post-positivism, as we acknowledge the role of the observer and subjectivity in the process of knowledge generation (Engle, 2014). Additionally, we generalized from a sample to a theory and not to a population, which is why a qualitative study is needed (Yin, 2009). Unlike a quantitative research strategy that focuses on statistics and numbers to develop generalized perspectives (Creswell, 2014), this thesis required a more focused perspective to properly investigate the empirical enigma of the emergence of PropTech 3.0 ventures. Therefore, the *qualitative research* strategy contributes to a deeper understanding of the research problem, strengthened relationships with respondents, and considers the findings in the context in which they emerged.

While there are many different methods for collecting qualitative data, the most appropriate method for investigating the enigma at hand was a multiple case study. According to Yin (2009, p. 18), a case study is "*an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."* We therefore looked in depth at four PropTech 3.0 ventures. Unlike a single case, multiple cases were selected to better capture the phenomenon of their emergence and provide a broader picture to make more vital theoretical contributions to the EE framework.

3.3 Research setting

The PropTech 3.0 ventures studied in our thesis are all based in Nigeria, a country in West Africa. Nigeria was chosen as a suitable country for our research because studies have recently shown that the country is the most curious nation in terms of cryptocurrencies (Nyambura, 2022) but is also one of the countries with the most significant interest in Blockchain technology in general (Wamba et al., 2019). This high interest in crypto and Blockchain, along with many other factors affecting the real estate market, leads to Nigeria being one of the countries with a high number of PropTech 3.0 ventures (Saari et al., 2022).

It has been shown that most PropTech 3.0 companies are found in developing countries in general (Saari et al., 2022). The reasons for this are most likely the many problems associated with the world's largest asset class, real estate, and the urgent need to address

them (Saari et al., 2022). For example, about 90% of land in rural Africa is unregistered, which means that citizens often do not know if they are the rightful owner of a property and land, even if they have a contract of sale (Kshetri, 2021). The lack of proof of ownership has resulted because many of these fields were informally passed down from generation to generation at times when there was no active archiving of land ownership by the government (Kshetri, 2021). In addition, the current institution responsible for legalizing these lands, the Land Use Act, operates through a process that is not only prohibitively expensive for the average Nigerian but is also time-consuming (PwC, 2019).

As a result, several Nigerian ventures are now developing unique technology-based solutions to address these local issues (PropTech in Nigeria, 2019). Currently, the country's PropTech scene includes more than 70 active start-ups combining any kind of technology to solve the problems in the real estate market (Karam et al., 2022). The implementation of Blockchain is one of the technologies used by some of those ventures, especially in dealing with the lack of transparency that exists in the industry (Karam et al., 2022). For all these reasons, we consider Nigeria a suitable case setting for our research.

3.4 Case sampling

In line with our research purpose of investigating the specific phenomenon of PropTech 3.0 start-up emergence, we conducted a purposive sampling of PropTech 3.0 ventures in Nigeria. This is because the research question aimed to contribute to the EE framework. Purposive sampling was chosen as appropriate because it is theory-driven and, as the name implies, serves a specific purpose (Easterby-Smith et al., 2015). Therefore, a clear understanding of what sampling units are needed depends on the mentioned purpose of our research (Easterby-Smith et al., 2015). Thus, eligible potential sample members were selected according to the established criteria (Easterby-Smith et al., 2015):

1. Each case had to meet defined standards for a start-up. According to the European Startup Monitor (2020), no generally accepted official definition for the term 'start-up' exists. Nevertheless, the European Startup Monitor (2020) defines it as a company that is younger than ten years, has an innovative business model,

service, and/ or products, and aims to scale up in terms of a number of employees, market share, and/or revenue (European Startup Monitor, 2020).

2. The business model of the cases had to have Blockchain integration, which is used to solve real estate registration issues and/or facilitate real estate investments.
3. All cases had to be located in Nigeria, Africa.

Whether the cases met the established criteria was investigated in preliminary interviews between November 2022 and February 2023. While we spoke with five companies contacted through LinkedIn, only three ultimately met our criteria: *HouseAfrica, Ellamediate, and Vank*. We also attended a demo day hosted by Nigerian incubator PropTech 54 on January 19, 2023. Of the eight PropTech ventures that participated, only one used BCT and therefore ultimately met our criteria: *Relsify*. However, three other companies were used for additional information.

Thus, four PropTech 3.0 ventures were selected. This is primarily because no other ventures accessible in Nigeria met our three criteria. In addition, the selection of four ventures allowed us to collect the rich data typically found in studies that examine only one or two firms (Navis & Glynn, 2010). However, it also allowed us to compare findings across companies using multi-case study logic (Graebner & Eisenhardt, 2007). Making such a comparative analysis across cases enables us to create more generalizable theoretical findings than possible with a single case (Eisenhardt & Graebner, 2007). We have decided for these four ventures to strike a balance between the necessity of comparability and maximizing the ability to detect variation (Mattley et al., 1999).

While the cases we selected have many similarities, such as the fact that they all applied BCT in some way, operate in the private real estate sector, were founded in 2019 or later, and are located in the larger Lagos area, there were also crucial differences. The most significant difference between these four cases is how Blockchain has been applied. While HouseAfrica focuses solely on the land registry, using the technology for a digitized database of all necessary information, the other three case companies have, in addition to a Blockchain-based real estate database, a primary focus on fractional ownership and thus tokenization, making real estate more affordable. Furthermore, the case entrepreneurs have different skill sets, including different entrepreneurial

experience, technical expertise, and real estate expertise. However, all case entrepreneurs have some sort of technology background and personal experience in real estate. **Table 3** provides an overview of the selected cases.

Table 3 Overview case ventures

Case	Founded	Headquarters	Business model
HouseAfrica	2019	Lagos, Nigeria	Real estate registration
Ellamediate	2021	Lagos, Nigeria	Tokenization
Relsify	2021	Lagos, Nigeria	Tokenization
Vank	2021	Abuja, Nigeria	Tokenization

Data collection

The data collection for our thesis took two months and consisted mainly of interviews and additional material on the four selected cases. We conducted a total of seven case interviews, varying between one and two individual interviews per case, depending on whether the case consisted of a team of founders or a single founder. This was done in order to get a comprehensive picture of the start-up and the role of all entrepreneurs involved in the start-up process.

Additional data from the case venture was collected to gain further insights. These are divided into external data, which is public and available to anyone, and internal data, which we received directly from the company. External data includes the websites of all cases, articles about the selected PropTech 3.0 cases, YouTube videos (YT), podcasts and online interviews of the team, as well as articles written by the founders. Internal data includes company pitch decks, founder resumes, and whitepapers. Whitepapers are documents that start-ups use to share their vision for a new proposition. They usually include assessments of their business model, technical specifications, market, industry, and technology trends (Chalmers et al., 2021b). The Blockchain community has given particular importance to whitepapers for early concept codification (Pilkington, 2016). Scholars such as Fisch (2019) have therefore realized its worth providing an empirical lens into the activities of companies.

In addition, we attended a Demo Day organized by incubator PropTech 54 and watched one case company, Relsify, present its business idea. Hearing and seeing the pitch and listening to the venture capitalists' questions and the Relsify founders' answers gave us a

better understanding of the company and also showed us the reactions of others to their business model. In total, we had 454 pages of additional data on the case ventures. All the additional data we collected alongside the case interviews served not only to better understand the ventures and what the entrepreneurs were saying in the interviews but was also very valuable in our analysis. Public data that protects respondent anonymity is referenced, while internal data is anonymized.

In addition, we interviewed five regular PropTech ventures in Nigeria that actively decided against using BCT and one PropTech 3.0 venture in Germany (PT1-6). Again, purposive sampling was used, with the criteria being that the companies have the same business model as the case companies except that they are based in a developed country or that they are based in Nigeria but have similar business models to the case companies only without BCT. Considering such boundary conditions allowed us to more confidently generalize our findings. The concept of boundary conditions is widely recognized as a crucial element in abductive research, encompassing a given theory's 'who, where, when' aspects (Busse et al., 2016). Understanding why certain entrepreneurs undertook different entrepreneurial initiatives in the same context or how a German PropTech 3.0 entrepreneur acted similarly created an understanding of what is globally applicable.

To better understand the Nigerian context, we also conducted ten interviews in the context of PropTech 3.0 in Nigeria. We interviewed additional experts on Blockchain in general, the economy in Nigeria, a venture capitalist, real estate agents, experts and lawyers, a data protection specialist, Nigerians investing in real estate, and entrepreneurs (N1-10). Again, the experts were selected based on purposive sampling in that all had to know the PropTech 3.0 industry in Nigeria and had some expertise in this regard. Expertise was defined as at least five years of professional activity in the respective field.

Next to the expert interviews, data were collected in a webinar hosted by the established PropTech 3.0 company SESO from the UK, now operating in Nigeria, on February 16, 2023, on Nigeria's economic outcomes. We participated in a 45-minute panel discussion with three real estate developers from Nigeria and Ghana. We also attended the Frankfurt School of Finance and Management's Crypto Asset Conference 2023 on March 29 and 30. Looking at the context in which these PropTech 3.0 ventures and entrepreneurs

operate is essential to deeply comprehend what is happening in the real world (Korstjens & Moser, 2017a). Furthermore, understanding what practitioners feel, do, or think in their natural environment can lead to more efficient, effective, humane, and equitable clinical and evidence-based practices and interventions (Korstjens & Moser, 2017a). Awareness of the case context is essential for effectively interacting with interviewees, analyzing data, and accurately communicating findings (Svensson, 2021). In addition, this allows our readers to reflect on whether and how the results of our thesis can be applied to their context (Korstjens & Moser, 2017a). Such diverse data collection and consideration of multiple perspectives are consistent with our chosen post-positivistic epistemology (Engle, 2014).

Overall, we conducted 23 interviews, in total lasting 19 hours. **Table 4** provides an overview of all data collected. Among the interviewees, out of the 23 people only three were women. We aimed at getting some gender diversity, but since the industry is male dominated this attempt was not very successful.

Most interviews were conducted in English and online via Microsoft Teams, Google Meets, and the Zoom video platform. One interview was conducted in German as this is the native language of both the interviewee and one interviewer and created a more comfortable environment; therefore, more information could be derived. Afterwards that transcript was translated into English. The interviews lasted between 30 and 65 minutes, and we were always both present to ensure the data's reliability. The shorter interviews were more contextual, and the longer ones were mainly about the cases themselves.

To ensure the accuracy of the data, we recorded each interview and transcribed them immediately afterwards using either Microsoft Teams itself or otto.ai software, using the simple transcription system of Dresing and Pehl (2015). The interviews followed a semi-structured approach, allowing us to ask open-ended questions to gain deep insights and probing respondents for more detailed explanations on their motivations for starting a PropTech 3.0 company by asking follow-up questions.

To successfully conduct semi-structured interviews, a prepared interview guide is essential (Easterby-Smith et al., 2015). Our guide was divided into sections to provide a

rough structure and ensured that no necessary aspects were left out. Section one dealt with general information about the entrepreneur and the business to better understand who the founder is and what exactly they are doing. Section two then went more in-depth about the entrepreneur and his or her role in the venture creation process. This was necessary to better understand the relational qualities of leveraging specific entrepreneurial initiatives. The third part was about the external factors and mechanisms, and the closing part was more to get additional information. After each interview, the interview guide was revised according to our experience (Eisenhardt, 1989). While the interview guide for the cases and the PropTech ventures used as boundary conditions remained the same despite small iterations, different interview guides were used for the expert interviews. All interview guides can be found in Appendix 5.

Table 4 Overview of data collection

Case 1: HouseAfrica					
Type of data	**References**	**Job description**	**Nationality**	**Gender**	**Duration**
Interviews	C1.1	Co-founder and CEO	Nigerian	Male	43:00:00
	C1.2	Co-founder and COO	Nigerian	Male	56:00:00 40:00:00 (informal)
Type of data	**Reference**	**Amount**	**Data**	**Year**	**Pages**
Internal additional information		1	HouseAfrica Pitch deck 1	2023	19
		1	HouseAfrica Pitch deck 2	2022	10
		1	HouseAfrica Whitepaper	2018	16
	CV, C1.1	1	Curriculum vitae C1.1	2023	3
	CV, C1.2	1	Curriculum vitae C1.2	2023	2
Public additional information		18	Article about venture	2019-2023	58
	YT 1-20	20	Firm's YouTube videos	2019-2023	42
		1	Firm's Product website	2022	5
		1	Firm's website	2021	4
		1	Social Media Posts	2023	6
Case 2: Ellamediate					
Type of data	**References**	**Job description**	**Nationality**	**Gender**	**Duration**
Interviews	C2.1	Co-founder and CTO	Nigerian	Male	65:00:00
	C2.2	Co-founder and Senior Software Development Engineer	Nigerian	Male	51:00:00
Type of data	**Reference**	**Amount**	**Data**	**Year**	**Pages**
Internal additional information		1	Ellamediate Pitch deck	2022	40
	CV, C2.1	1	Curriculum vitae C2.1	2023	3
	CV, C2.2	1	Curriculum vitae C2.2	2023	3
Public additional information		11	Article about venture	2021-2022	30
		2	Article from founder	2021-2023	20
		1	Firm's website	2023	7
		1	GFA interview with team	2022	8
		1	Think BIG for Africa podcast	2022	18
Case 3: Relsify					
Type of data	**References**	**Job description**	**Nationality**	**Gender**	**Duration**
Interviews	C3.1	Co-founder and CTO	Nigerian	Male	57:00:00
	C3.2	Co-founder and Head of Growth	Nigerian	Male	58:00:00
Type of data	**Reference**	**Amount**	**Data**	**Year**	**Pages**
Internal additional information		1	Relsify Pitch deck	2022	19
		1	Relsify Whitepaper	2021	32
	CV, C3.1	1	Curriculum vitae C3.1	2023	3
	CV, C3.2	1	Curriculum vitae C3.2	2023	3
Public additional information		1	Article about venture	2021-2022	4
		13	Blog entries from venture	2021-2023	74
		1	Firm's website	2023	15
		1	PropTech 54 Demo Day	2023	6
Case 4: Vank					
Type of data	**References**	**Job description**	**Nationality**	**Gender**	**Duration**
Interview	C4.1	Founder and Head of Operations and Strategy	Nigerian	Male	58:00:00
Type of data	**Reference**	**Amount**	**Data**	**Year**	**Pages**
Internal additional information*	CV, C4.1	1	Curriculum vitae C4.1	2023	3
Public additional information		2	Blog entries from venture	2021-2023	5
		1	Firm's website	2023	4
		2	Socia Media Posts	2023	5

Boundary condition					
References	**Type of venture**	**Job description**	**Nationality**	**Gender**	**Duration [in min]**
PT1	PropTech	Co-founder and CEO	Nigerian	Male	59:00:00
PT2	PropTech	Co-founder	Nigerian	Male	38:00:00
PT3	ProTech 3.0	Co-founder	German	Male	30:00:00
PT4	PropTech	Co-founder & computer	Nigerian	Male	57:00:00
PT5	PropTech	Co-founder and CEO	Nigerian	Male	47:00:00
PT6	PropTech	Co-founder	Nigerian	Male	33:00:00
Total time					261

Context					
References	**Type of data**	**Job description**	**Nationality**	**Gender**	**Duration [in min]**
N1	Interview	Nigerian living in Germany & investing in Real Estate	Nigerian/ German	Male	30:00:00
N2	Interview	Senior Economist at The Nigerian Economic Summit Group	Nigerian	Male	34:00:00
N3	Interview	Serial Entrepreneur/ Blockchain Specialist	Nigerian	Male	40:00:00
N4	Interview	Executive Director of African Blockchain Institute/ Ph.D. researcher	Nigerian	Male	50:00:00
N5	Interview	Real Estate Investment Advisor	Nigerian	Male	43:00:00
N6	Interview	Business consultant at a large consulting firm in Nigeria	Austrian living in Nigeria	Female	63:00:00
N7	Interview	Real Estate Agent and Lawyer	Nigerian	Female	52:00:00
N8	Interview	Real estate Agent and marketing Communications Specialist	Nigerian	Male	57:00:00
N9	Interview	Nigerian Interellectual Property Lawyer & Data Privacy Expert	Nigerian	Female	52:00:00
N10	Interview	Venture Capitalist at a big Real Estate corporation	American	Males	30:00:00
	SESO webinar 2023	Economic Outlook of Nigeria			45:00:00
	Crypto Asset Conference 2023 by Frankfurt School of Finance	Blockchain as an enabler for different business models			60:00:00
Total time					556

Note. Additional data corroborates the interviews and provides an even more accurate picture of the respondents. *Vank was unable to provide additional data due to data protection.

3.5 Data analysis

Once we had collected all the data needed for our research, we performed an abductive analysis of the data. Thus, while we approached our case ventures endowed with the EE framework and respected terminology (Davidsson et al., 2020), we also remained open to generating new insights and new ways of thinking (Eisenhardt, 1989; Eisenhardt et al., 2016). That is, we were guided by theory but not driven by existing theoretical

understandings (Kelle & Bird, 1995), thus engaging in iteration between the empirical material, literature, and emerging concepts.

We first conducted a within-case analysis and became familiar with each case, and then conducted a cross-case analysis (Eisenhardt, 1989). We integrated the Eisenhardt method into an abductive approach rather than the inductive approach usually used in this method. To do this and to move from raw data to theoretical interpretation, we followed four distinct systematic phases of empirical discovery and analysis. Throughout the process, the interviews' transcripts formed the basis of our analysis, which we analyzed and interpreted individually and then discussed to see if we came to the same conclusions and, if not, to discuss the differences.

In phase one, we conducted a context analysis. Here, we developed a detailed story of the industry and the situation in the country to better understand the context in which our case companies operated and to which they adapted. This is particularly important to better comprehend the external factors in Nigeria that lead to venture creation. The contextual analysis included interviews with experts in Blockchain, real estate, PropTech, entrepreneurship, and economics in Nigeria, among others, to understand the rationale behind their actions and thought processes. The case interviews and additional information, such as articles about the ventures and whitepapers, were also used.

In phase two, we developed a thick description of each case by conducting a within-case analysis. Here we established a rich case study for each PropTech start-up by incorporating the interviews and the additional data collected about the ventures and digital entrepreneurs. This was done primarily to describe the entrepreneur, his or her motivation and background, and the entrepreneurial venture. It was also done to not rely solely on the interviews, but also have information that supports what is being said and adds to your knowledge regarding what is being said. Additionally, the collected data around the cases and entrepreneurs allowed us more insights for further data collection.

We first looked at the key information of the cases, then the business model and how BCT was integrated, then the cases strategic partners, community and team, leading to the individual case founders and their backgrounds and characteristics. When we analyzed

the cases, we found different characteristics among them. It was particularly evident that three out of four cases focused mainly on tokenization, while HouseAfrica focused more on property registration. Furthermore, it was interesting to note that all of the case ventures were moving from the public real estate sector to the private sector. Moreover, all of them had some technical background and had experienced problems in the real estate industry themselves, so the motivation to solve the problem drove their venture idea.

In phase three, we structured our analysis according to the EE framework. Here we have considered three different parts of the theory: external factors, mechanisms, and relational qualities. First, we looked at the external factors that influenced the case entrepreneurs when creating ventures in the PropTech 3.0 space. In doing so, we first analyzed the factors on a case-by-case basis; then, after thoroughly understanding each case and the context in which they operate, the next steps in our analysis involved comparing the different cases according to Eisenhardt's (1989) multiple studies model. The findings from the first two phases were always considered and strongly influenced how we interpreted and analyzed the data in the following steps. After a cross-case analysis, the boundary condition interviews were compared with the cases.

Finally, the constant comparison between cases and boundary conditions led to the identification of contradictions and new aspects related to the external factors captured in the EE framework. We found that external factors had different influences, which we categorized as external enablers, external disablers, and external detriments. An interplay of external factors also became apparent. This led to the development of a theoretical contribution to the relationships between these two aspects.

After, we focused on analyzing the different entrepreneurial initiatives and, thus, the mechanisms used by the case ventures. Following the same procedure as for the external factors, different mechanisms emerged, most of which were also found in the EE framework. In the end, we analyzed the relational qualities of the mechanisms. Here, based on the analytical approach, we found that relational qualities can be influenced by the interaction of external factors and the ecosystem. In addition to relational qualities, it was found that other factors also influence whether mechanisms are used.

We employed tables as analytical tools to compare our initial inferences using the replication logic across multiple cases, following Eisenhardt's (1989) methodology. This comparative analysis led us to identify several discernible patterns. Subsequently, we conducted a cross-case and boundary condition analysis to test these patterns. Upon validation, we reviewed the entrepreneurship literature on opportunity recognition and entrepreneurial initiatives, which we then applied to our data to refine our initial inferences into a preliminary theoretical contribution. The reviewed literature was selected because it was most likely to report findings comparable to ours. Contradictory results in relation to the literature prompted us to explore the construct more deeply. Results consistent with the literature increased the framework's validity and strengthened it (Eisenhardt, 1989). This iterative analysis cycle enabled us to produce valuable insights and develop a coherent theoretical contribution.

In phase four, we expanded the EE framework. After contributing to different parts of the EE framework, we considered how to connect these three parts and expand the overall theoretical framework. Connecting the different parts with cross-case analysis, boundary condition analysis, and appropriate literature led to an expanded framework that considers the context of developing countries, the entrepreneur, and the interplay of external factors. We stopped the analysis when we had reached theoretical saturation, i.e. no additional insights were gained from additional information (Rowlands et al., 2015).

3.6 Research quality

In qualitative studies, trustworthiness is considered a highly critical issue as certain concepts cannot be adequately interpreted in a naturalistic approach (Shenton, 2004). In this case, research quality is provided by the degree of relevance compared to rigor in quantitative studies (Guba, 1981). To ensure trustworthiness of this thesis and consider the naturalistic approach, we have followed Guba's (1981) proposed criteria: Credibility, Transferability, Dependability, and Confirmability.

Credibility is the naturalistic interpretation of truth value and refers to the degree to which study results are accurate (Guba, 1981). We spent two months collecting data to justify our findings' credibility. We created a coherent structure of the data by including the different perspectives of the respondents. When finalizing our thesis, we verified that our

findings were consistent with the raw material from our transcripts, presentations, and whitepapers. In addition, our data and findings were constantly reviewed by our supervisor and colleagues in one-on-one meetings and seminars, respectively (Shenton, 2004).

Moreover, on March 16, 2023, we participated in the first external enablers workshop hosted by Jönköping International Business School. There we had the opportunity to present our thesis to researchers from the UK, Germany, and Australia, including the EE framework's creator, Per Davidsson. Discussing our research with qualified researchers helped to clarify errors and misinterpretations of our findings (Shenton, 2004). In addition, we used 'member checks' and sent our final draft to the case entrepreneurs to ensure that factual correctness (Guba, 1981).

Transferability refers to the extent to which the results of our study are transferable to other contexts (Guba, 1981). The best way to ensure transferability was to describe in detail the research context, sample size, sampling criteria, demographics, setting, and interview guide (Korstjens & Moser, 2017b). In addition, all material was justified and included a dense description of possible changes (Eisenhardt, 1989).

Dependability is the third criterion, which can be equated with consistency and aims to check the stability of the results over time (Guba, 1981). In other words, it shows that "*if the study had been repeated in the same context, with the same methods, and with the same participants, it would have produced similar results*" (Shenton, 2004, p.71). To test this, we applied investigator triangulation, where both research team members analyzed each transcript separately and compared their results at the end (Korstjens & Moser, 2017b). In case of disagreement, a discussion took place to understand which analysis was closer to the data collected.

Confirmability is the naturalistic interpretation of neutrality and is related to the ability of the reader to recognize that the results come only from the data collected and not from the author's biased opinion or perspective (Guba, 1981). The first strategy to ensure confirmability is our reflexive approach, as we decided to keep a journal with all our notes on each step of our research. Next, we triangulated the primary information by mostly

interviewing two people from the same company. We also continued the triangulation process by incorporating additional case data, including blogs, whitepapers, articles.

3.7 Ethical consideration

Ethics is an integral part of research as it sets the boundaries of moral behavior for the individuals involved (Easterby-Smith et al., 2015). Dealing with a study without a framework is considered a poor strategy because it shows that any potential ethical issues can be addressed by the researcher's biased behavior (Collins, 2000). The framework we used for this study is the eleven key principles of research ethics introduced by Bell and Bryman (2007), which focus on protecting the interests of the participants, the research community, and the research team (Easterby-Smith et al., 2015). Since the study falls under the category of management research, it is crucial to note that we also had to proactively protect our interests due to the power relations created between us and our participants who hold high-status positions in their companies (Bell & Bryman, 2007).

Our top priority was to focus on not causing any potential *harm to the participants*, especially those considered more vulnerable as members of specific social groups (Orb et al., 2001). For this reason, we conducted debriefing with each participant at the end of the interview (Appendix 5) to ensure their *dignity* was maintained and feelings of distress were avoided (Hennessy et al., 2022). Moreover, it was vital for us to continuously remind the participants of the principles of *privacy* and *informed consent*, meaning that they are free to share any information they choose. As a result, the participants had every right to stop the interview process at any given time (Orb et al., 2001).

Anonymity is the criterion that ensures the protection of the participants' identities (Bell & Bryman, 2007). We asked the participants if they were willing to conceal their identities by hiding any information, like name and age that might reveal them as individuals. Asking if they do not want to reveal their identity is a valid approach since, they may wish to own their stories (Grinyer, 2002). In our case, the participants did not want their identity to be revealed, and as a result, they were replaced using pseudonyms (Bell & Bryman, 2007). As for the identities of the companies, even though some researchers view them as *'corporate individuals'* and, as a result having the same rights

as ordinary people, we were allowed by the case entrepreneurs to keep them public to maintain our credibility (Bell & Bryman, 2007).

Confidentiality protects the information that derives from any participant (Bell & Bryman, 2007). To ensure confidentiality, we sent each of our interviewees a GDPR consent form (Appendix 6) before each interview to guarantee that GDPR legislation protects the data we received. In addition, we explicitly informed the participants during the interview that information related to legally inappropriate behavior by individuals or the company itself should be excluded from the confidentiality criteria (Easterby-Smith et al., 2015; Orb et al., 2001).

During every stage of the interview, we mentioned to our participants that we consider them equal collaborators in our project and that we were seeking mutual benefit as we were working under the criterion of *reciprocity* (Bell & Bryman, 2007). Furthermore, we did not try to *deceive* them by obtaining information based on lies but instead aimed to build trust through *honesty and transparency.* This resulted in our participants providing truthful valuable insights that were not influenced by our behavior or the interview itself (Orb et al., 2001; Easterby-Smith et al., 2015). By the end of the study, we also included that we had no possible conflict of interests and/or *affiliations* that could have altered our findings (Bell & Bryman, 2007). Finally, we sent a copy of our study to our participants to ensure that no *misinterpretation* of their quotes had led to false results.

4. Empirical findings

This chapter presents the empirical results. In order to better understand the Nigerian context and the external factors that led to the creation of PropTech 3.0 ventures, the economy, society and politics of the country in question, the entrepreneurial and technological situation and finally the real estate industry and its use of technology are further outlined. In addition, case vignettes are provided to develop a more in-depth knowledge of the cases.

4.1 The Nigerian Context

Nigeria is located in West Africa, with a population of 206.14 million people being the most populous country on the continent (Statista, 2021b). The Nigerian economy has suffered greatly in the last decade partly due to the increased inflation rate, which reaches 17.33% at the beginning of 2023 (SESO, 2023). This result directly impacts consumer prices since *"the whole country is an importing country. That means if you want Western stuff here, such as Kellogg's, they cost more here than there"* [N1]. Another issue is that Nigerian's income per capita rate is expected to decline since the country's GDP growth is slower than its population growth. This is signalling extreme levels of poverty in the years to come (PwC, 2019). In addition, Nigerian's currency, the Naira, has depreciated over three years, with its exchange rate undervalued against the USD more than twice, from 360N (2020) to 775N (2023) for $1 (SESO, 2023). Unemployment has also risen to 5.94% (Statista, 2021a), especially among the young (N9).

Today in Nigeria, the *"[w]orking population lives with less than $50 a month"* [PT1] which leads many of them to move abroad seeking for a better future. These people living in diaspora are still very interested in investing in Africa's development, such as low-cost housing (C3.1). An example of their impact on Nigeria is that Nigerians living in the diaspora own 70% of property purchases in Lagos (Relsify Whitepaper, 2021).

Regarding the political situation of the country: In February 2023, Nigeria held elections to choose a new president. Bola Tinubu, 71, of the All-Progressives Congress, was elected the country's new president (N2). The data showed that the pre-election period could be described as political instable and uncertain due to sudden regulation swifts. One was related to *"a policy that the government introduced at the moment, which is the currency*

conversion as they plan to redesign the country's currency" [N2]. This regulation brought scarcity cash issues to the country, something that was dealt with much criticism from a share of people mentioning that *"in Nigeria, I can phantom that we have the worst set of leaders"* [N4].

4.1.1 Entrepreneurial landscape

When it comes to the entrepreneurship of the country, *"[if] you're trying to do anything start-up related in Africa, you probably want to start in Nigeria. Nigerians are a lot more eager to accept new things, try out new things than anybody else. [...] Tech still has a very good reputation here"* [PT4]. As of February 2023, Nigeria accounts for four of the continent's seven unicorns, three of which were in the fintech industry (N10). Most entrepreneurial activities occur in Lagos, one of Nigeria's biggest cities (N2).

A significant development is that in 2022, the government enacted a policy to support the Nigerian start-up ecosystem as a measure to encourage and support the creation of local new businesses (N2). Overall, entrepreneurship in Nigeria is not an easy task since there are a few factors that hinder every entrepreneur's journey, including the lack of funding: *"[L]ook at the African continent, we almost have none of our companies from the US or Europe or AIPAC support Africa. And it's genuinely a cost issue"* [N10].

Technologies play a central role in every entrepreneurial endeavor today, and Nigeria is no exception. Nigeria has embraced several technological innovations since the beginning of the millennium, with the latest one being Blockchain (ABI, 2021). In 2019, the former president of Nigeria, Muhhamadu Buhari, took the initiative to diversify the economy of the country, moving from oil and gas to digital technologies. As such, the National Information Technology Department Agency created a National Blockchain Adaptation Strategy (NITDA, 2019). Nigeria is considered *"[...] one of those very hot emerging markets for the Blockchain industry"* [PT3], and one of the reasons is due to the very young population it has.

The fact that the average age for the Nigerian population is 18.1 years old (Worldometer, 2022) shows that Nigeria has all the potential to learn how to use this technology to solve everyday problems (NITDA, 2019). However, currently, the *"[...] skillset is not*

available, especially in Africa for organizations that want to leverage Blockchain" [N3]. The reason why this occurs is *"because most regulators confuse cryptocurrency with Blockchain. They don't understand the differences. So, they do want to adapt Blockchain technical knowledge in itself for whatever business processes they have or to innovate around"* [N3]. As a result, in Nigeria, like in many countries in Africa, it is clear that governments follow a 'Wait and See' approach to Blockchain regulation instead of a 'Wait and Experiment' approach that encourages innovation (ABI, 2023). Indeed, all these external dimensions affect every industry in Nigeria.

4.1.2 Real estate market

Our research focuses on the country's real estate industry; as a result, a more in-depth analysis is required to deepen our understanding of the context's uniqueness. The Nigerian real estate market is considered one of the strongest in terms of revenue on the African continent, having contributed over seven trillion naira to the country's GDP in 2022. It is expected to grow by 6.5% (SESO, 2023). However, due to the yearly population growth of 2.62% (Worldometer, 2022), Nigeria faces a housing deficit of 22 million people (The Cable, 2023). Therefore, *"Nigeria is looking for an ability to build three million units of housing every year for the next ten years to meet our housing gap"* [PT1].

However, data shows that the population growth rate is not the only factor contributing to the housing gap issue. In fact, given that 88.4 million people live below the poverty line (Statista, 2022), the demand for low-end houses is very high. Purchasing a property is extremely expensive, to the extent that 90% of real estate assets are owned by 1% of the population (Think BIG for Africa Podcast, 2022). As a result, there is the belief that the real estate market is *"so far it has just been open for the elite to invest because not everybody has 100,000 just to make a down payment in Nigeria"* [C3.1].

Another challenge within the Nigerian real estate industry is the lack of transparency and trust between the various parties (N7). Currently, trust in real estate transactions is built informally through close communities, which are not easily accessible in larger cities, so selling one's land to a potential buyer can be challenging without the required proof of land ownership: *"Everybody knows everybody. Nobody will question it, but legally they*

don't have documentation to support that. That becomes a problem in the urban areas, where people do not know you" [C1.2].

As a result, each transaction is closed through the intermediary of a trusted third party, a real estate agent (N8). *"What typically happens in a country like Nigeria is if you go through the normal process, it can take months for you to get a response. But then if you get somebody, like a middleman, you can just be anywhere in the world, and then the person would help you go through the process, and then you pay him a fee"* [N2]. Aside from saving time, hiring a real estate agent is also crucial for fraud protection (N7). Frauds are so prevalent in Nigeria that 75% of Nigerians have been scammed or know someone who has been a victim of fraudulent activities such as double land allocation (HouseAfrica Pitchdeck, 2023). *"You can have multiple sales of a single plot of land and that usually leads to land disputes"* [N3].

Technology adaptation in the real estate sector in Nigeria is considered slower than in other sectors, such as finance, manufacturing, and telecommunications (N5). *"It is probably the most inefficient sector in the world, because they make really good money still, as in from a revenue and profit perspective, they've done it for so many years without tech"* [N3]. Moreover, the lack of market transparency creates scepticism among the government and key stakeholders and results in stalling the introduction of new regulations and investment opportunities (N3).

Despite the challenges in funding, the PropTech industry has evolved significantly in recent years (N10). While in 2021, there was $2 million flowing into PropTech companies, the following year, there was over $8.9 million of local and international funding, and even more is expected in 2023 (Karam et al., 2022). This recent surge can be explained by the fact that *"[i]nvestors are getting tired of fintech so a lot of them are looking to PropTech"* [PT5]. Much of this funding went to ventures that use Blockchain as a solution for the real estate market (N10).

Consequently, Blockchain-based solutions are on the rise with the aim of providing people with ease and a sense of security (N4). Furthermore, through "*fractional ownership of properties, you can use a small amount on a large property to be part owner*

of [the property]" [N8]. This can also be applied through the use of Non-Fungible Tokens (NFTs) (Crypto Conference, 2023) where all part-owners of a property can get to know each other as they all have access to the same collectible image of this specific property. Finally, solutions built in decentralized databases have replaced the old, centralized counterpart, which helps create transparency by eliminating the danger of tampering with the data within the Blockchain (N3). **Table 5** provides illustrative data for the context presented.

Table 5 Illustration table of context

Nigeria in General	
"The population's average age is low. Now a whole new middle class is being developed." **[N1]**	"So, in Africa, we pride more in society than individually. So now that there's this problem of cash, we come together, and think on how we can collectively solve it." **[N4]**
Politics	
"The government doesn't understand the technology of Blockchain and how it's going to solve thought solutions for them. They have to understand that for them to be able to absorb it into the system and allow it with them." **[N5]**	"There was a time where crypto was banned in Nigeria. It was a crime. And the only reason for that was because they felt that people are making a lot of money from cryptocurrency. And a lot of times, the government doesn't really help people to innovate and find solutions for a problem." **[N8]**
Entrepreneurship	
"And then there's also a very tough business environment, you know, access to credit for entrepreneurs, regulatory bottlenecks and so many other. So, it's not easy to do business in Nigeria because of multiple taxes and so on." **[N2]**	"I think one of the biggest challenges for entrepreneurs is definitely funding." **[N6]**
BCT/ Technology	
"Oh, I think it's very technology friendly, I think the country is evolving rapidly, especially because of the young population. And then the fact that there's a lot of people having tech skills at the moment, studying AI. Technology is changing the way things are done across, but only in the private sector." **[N2]**	"A lot of people still view crypto as a scam. They're afraid. They confuse Blockchain with Bitcoin or cryptocurrencies in general." **[N3]**
Real Estate in Nigeria	
"In the real estate industry in this part of the world, agents are the major decider in the in the way the transaction plays out. They are the ones that interface between you the owner of the property and prospective borrower." **[C2.1]**	"We don't have mortgage. Some banks claim they have mortgage facilities but this mortgage verses are very difficult to assess. The collateral is like asking for you to bring your great grandparents as debt. Like the things they asked for are outrageous, you can't even get that." **[N7]**
PropTech 3.0	
"Most are using Blockchain technology to use it to tokenize assets, so that whatever transaction stays there."**[N9]**	"There are several funding opportunities for investment in PropTech, and Blockchain. So many investments going to PropTech and Blockchain." **[N3]**

4.2 Case vignettes

In the following part, a detailed description of each case is given in order to let the reader get to know the case companies and co-founders and later to better understand the entrepreneurial initiatives and the external factors leading to these initiatives.

4.2.1 HouseAfrica

HouseAfrica is a decentralized real estate platform that uses Blockchain and map technologies to simplify buying, selling, and verifying land and property in Nigeria (HouseAfrica, 2021). It was founded in 2019, is headquartered in Lagos state, Nigeria, and currently employs 14 people (HouseAfrica Pitch Deck 1, 2023). The company's vision is to become the leading platform for real estate in Africa by using transparent and trustworthy solutions (YT 4, 2022).

To address the issue of unregistered land, HouseAfrica leverages Blockchain and NFT solutions to create digital certificates of ownership that prove the valid owner of each property (HouseAfrica, 2021). These digital certificates are created on Blockchain; to date more than 4,000 of them have been issued (HouseAfrica Pitch Deck 2, 2022; YT 8, 2022). They have also developed Sytemap, a digital interactive map system that simplifies finding a property with all the necessary information (YT 2, 2023). Verifying the exact location of a property, helps to increase the confidence of buyers, leading them to make faster decisions about buying land or property (HouseAfrica, 2021; YT 1, 2022).

Through HouseAfrica's collaboration with the Nigerian Mortgage Refinance Company, mortgages are now more accessible as every property on HouseAfrica’s platform is already legally verified (YT 1, 2022; YT 2, 2023). This partnership not only helps establish fundamental property rights for landowners but also helps create wealth through the active use of these properties (YT 9, 2021). Other benefits of using Sytemap include detailed and live information about the status of the land, the possibility to choose the payment method, and the digital management of your properties on one platform (Sytemap, 2023). These innovative solutions have helped HouseAfrica digitize over 200,000 properties to date (YT 5, 2022; YT 3, 2022).

HouseAfrica takes a large-scale thinking approach, as its solutions can be transferred to other countries in Asia and South America facing similar problems (Anikwe, 2023; Odukoya, 2023). The visual representation of properties via satellite map enables confidence in the process (Sytemap, 2022). It eliminates the old challenge of buyers needing a physical inspection, which involves increased cost, time, and loss of interest (YT 6, 2022). The project will soon expand to other African countries, including Kenya, Rwanda, Tanzania, Ghana, South Africa, and Angola (C1.1; Odukoya, 2023).

Their current team consists of eleven people with diverse backgrounds (Sytemap, 2023). Most have technology backgrounds, including front/backend engineering, UX/UI design, and DevOps engineering. The head of this team, C1.1, is the CEO and co-founder of HouseAfrica (CV, C1.1). He also has a technology background, having earned a bachelor's in information management technology and a certificate in human-computer interaction from Stanford University in the United States (C1.1). In addition to his education, he has spent many years working with technology, particularly telecommunications, and has experience developing software packages and operating systems (CV, C1.1).

C1.1 has a great passion for technology and everything related to it (C1.1). His curiosity and desire to expand his knowledge of new technologies led him to explore and learn more about Blockchain solutions and cryptocurrencies. His passion for Blockchain and entrepreneurial mindset led him to co-found a cryptocurrency exchange company in 2017 (YT 7, 2022). He describes himself as a solution-oriented person who always wants to stand out from the competition (C1.1). In this sense, he prefers to take high risks once he knows that only a few people are using the same solution as him (C1.1).

C1.2 is the other co-founder of HouseAfrica, who also acts as the company's COO (C1.2). Although he studied metal and metallurgical engineering (CV, C1.2), he describes himself as a real estate professional with six years of experience in the sector (YT 5, 2022; YT 4, 2022). During his professional experience, he also developed numerous skills, including print design, web design, logo design, and marketing (CV, C1.2), giving him knowledge of technology (YT 2, 2023). In 2017, he co-founded the cryptocurrency exchange with C1.1, where he gained his first experience in running a business (C1.2).

After six years in the real estate industry, C1.2 gained enough knowledge to identify market gaps and seek solutions. During this time, he recognized the problem that there were not many real estate developers and agents using technology to reach new markets, which he solved by founding HouseAfrica (YT 4, 2022). The most important thing to know in this field is a basic knowledge of bureaucracy and connections with authorities (C1.2). Similar to C1.1, he likes challenges and high risks. His 'I like to reinvent the wheel' mentality makes him unafraid of failure (C1.2). He is open-minded, patient, and empathetic (C1.2). Ultimately, his primary motivation is to solve problems, and technology is his tool. Therefore, he focuses on his work by developing disruptive solutions that are not based on policy, hoping that one day the government will follow his innovation and apply Blockchain-friendly regulations (C1.2).

4.2.2 Ellamediate

Ellamediate is a PropTech company that provides access to real estate opportunities for everyone through the use of Blockchain technology (Ellamediate, n.d.). The company was founded in 2021 and is headquartered in Lagos State, Nigeria, and currently employs five people (Ellamediate, n.d.). Ellamediate's main vision is to create inclusion in property ownership (Think BIG for Africa Podcast, 2022).

Achieving this vision is mainly done by offering their customers the opportunity to co-own prime, verified and approved, unencumbered real estate in multiple countries and currencies (Ellamediate Pitch Deck, 2022). Ellamediate has created a platform where it is safe to buy and sell real estate in fractions with the help of asset tokenization and, therefore, Blockchain (C2.2). Their use of BCT makes it possible to fractionalize the value of quality real estate assets, significantly reducing the cost of owning real estate and making it easier for people to sell their real estate assets for cash by exchanging assets on their platform or mobile application through smart contracts (Ellamediate Pitch Deck, 2022).

With the adaptation of BCT, the acquisition and conveyance of property assets and their title are seamless, and documentation is fast via the smart contract (Oluwatoyin, 2022). This eliminates the typical intermediaries associated with real estate transactions, removes the cumbersome entry and exit barrier, and guarantees and protects the security

of the asset and the client's title (Oluwatoyin, 2022). Property ownership is then protected around the clock and can be accessed at any time on the Blockchain (Ugochi, 2022). They issue non-fungible utility tokens that allow buyers and sellers to seamlessly interact online across the globe selling and buying real estate assets in various currencies (Ugochi, 2022). Their proprietary offering enables tokens to be instantly exchanged, secured by smart contracts on the Blockchain, and validated by title cards issued as physical proof of ownership (Ugochi, 2022).

A significant selling point that Ellamediate has is its strategic partnerships. The partnerships that Ellamediate has formed help the company a lot (C2.1). First, the security of purchasing real estate assets without fear of lousy title, fraud, or having to deal with intermediaries or third parties typically associated with traditional real estate is ensured by strategic partners. They play a crucial role in guaranteeing the security of the assets, the security of the title, and the security of the transactions through the Ellamediate platform (The pointer, 2023). Allied Trust Asset Management Limited as a partner, manages the client’s assets and ensures maximum return on assets (The pointer, 2023). United Bank for Africa, and Global Investors Services Division are partners to secure the title documents of all assets purchased by our clients (Lawal, 2022).

In addition, Ellamediate's partnerships have made it possible to provide access to flexible financing options. To make real estate assets more accessible to customers, Ellamediate offers different payment packages where one can spread their payments over up to twelve months (Ellamediate Pitch Deck, 2022). There are two forms of financial assistance for real estate acquisition: ‘Buy now, pay later’ by accessing micro-mortgages, and a targeted initiative where customers can save for a real estate asset within the Ellamediate mobile application (Ellamediate Pitch Deck, 2022).

In addition to strategic partnerships, their community of like-minded individuals with values and interests in real estate is vital (GetFundedAfrica, 2022). Here the focus is very much on education and going to different platforms and talking about the idea and the technology behind it so that people can understand it (GetFundedAfrica, 2022). Moreover, the team behind all the operations is crucial and brings different skills. Besides technology also communication skills were mentioned (C2.2). The team took many pay

cuts initially but stayed with the company because they believe in the idea, so C2.1. It is a strong bond in the team that moves the company forward (C2.1).

Both informants interviewed were co-founders of Ellamediate. In addition to being a co-founder, C2.1 is also the CEO of the company and is responsible for product management development and architecture (C2.1). Regarding Blockchain experience, C2.1 has a pure technology background. Previously, C2.1 was a developer and web designer (Think BIG for Africa Podcast, 2022) and a solutions manager at a company dealing with e-wallets and tokens for the collection, exchange and transfer of funds and assets (CV, C2.1). C2.1 is exceptionally skilled in Blockchain architecture, smart contracts, and project management (CV, C2.1). And his journey in Blockchain started about six years ago, first playing around with Bitcoin and making forex investments. He quickly delved deeper into the topic by attending some courses and technical trainings and doing a lot of self-education in the field (C2.1).

Meanwhile, C2.1 is also the CTO at a time online school that teaches many different classes, including IT skills, to students of all ages (CV, C2.1). He is helping a good friend to build this online school, which is the first purely online school in Nigeria and has been recognized as one of the top 50 start-ups in Africa in the education sector (Think BIG for Africa Podcast, 2022). Continuous learning is essential for C2.1, when it comes to Ellamediate, they have several WhatsApp groups where articles and information about the industry are shared and discussed (Think BIG for Africa Podcast, 2022). In terms of real estate, C2.1 has a strong interest in the sector and has done some real estate transactions privately for himself, family, and friends, where he has encountered some bad actors (C2.1). Personally, he sees himself as a disruptor, looking for change, especially in the real estate sector and in general in terms of education in Nigeria (Think BIG for Africa Podcast, 2022).

C2.2 is the lead software development engineer at Ellamediate. His experience is purely in technology and Blockchain, with no prior knowledge of real estate. C2.2 has also been the team lead manager at a company dealing with e-wallets and tokens for collecting, exchanging and transferring of funds and assets (CV, C2.2). He has also been a senior software development engineer at a human resource consulting firm and a backend

developer of a complete school management solution for educational institutions (CV, C2.2). In addition to this extensive technical knowledge and skills, C2.2 has a payments background from working at an e-wallet company. Without a degree in computer science or the like, C2.2 has learned all he needs to know about technology in a variety of ways, including YouTube and his friend group (C2.2).

4.2.3 Relsify

Relsify is a property technology venture that utilizes Blockchain to deliver a compelling real estate experience, unleashing untapped potential while solving decades-old real-time problems (Relsify, 2022a). The company was founded in 2021, is headquartered in Lagos State, Nigeria, and has employed ten people (Relsify, 2022a). Its main vision is to enable everyone to make profitable real estate investments (Relsify Pitch Deck, 2022).

Given the significant problems with the unregistered and unverified property, a viable real estate investment means buying verified land (C3.2). However, buying verifiable land is more expensive than buying unverified land and is hardly affordable for most Nigerians (C3.2). Following its vision, Relsify, therefore, focuses mainly on tokenization through BCT, making real estate accessible, liquid, and flexible for everyone (Relsify Pitch Deck, 2022). This is achieved by showcasing real estate using unique digitally backed assets to offer opportunities for partial investment and quicker financing for property developers through their marketplace (Relsify Whitepaper, 2021).

A unique feature of Relsify among PropTech 3.0 companies is the RELS token (Relsify Pitch Deck, 2022). Relsify has its own currency in the crypto world, the RELS token, which is a utility token within this ecosystem that creates a currency expressing a specific value (Relsify Pitch Deck, 2022). RELS token differs from other cryptocurrencies because its price is not fluctuated by the market but instead, is fixed, making it a stable coin. There are 20,000,000 RELS tokens in total, which are used to access cheaper fees, invest in real estate, receive dividends and rewards, host real estate, and create security tokens (Relsify, 2022a). It is designed to regulate participation and liquidity within Relsify's real estate marketplace (Etokakpan, 2021).

The overall product that Relsify offers is a platform or mobile application with four main functions (Relsify Pitch Deck, 2022). First is the marketplace, where real estate assets are displayed and can be selected by potential investors (Relsify Pitch Deck, 2022). Another function is the wallet system, where the digital assets are held, and the real estate portfolio can be tracked. The last two are buying and selling systems, where transactions are handled to buy assets and/or sell them (Relsify Pitch Deck, 2022).

What drives Relsify most, according to both interviewees, are the people behind it, the strategic partnerships, the community, and the Relsify team (C3.1; C3.2). Regarding strategic partnerships, the company is in communication with African-based Blockchain companies that provide services ranging from data analysis of the African real estate market to land title verification on Blockchain and NFT marketplaces. Reputable African developers and international organizations and communities involved in developing the African real estate market also work with Relsify (Relsify, 2022b). In addition, there are links to individuals within the government that provide access to specific data and documentation required for some properties (C3.1).

Relsify's community has been built strongly through rewards and loyalty programs, resulting in over 3,000 community members today (Relsify, 2022c). The goal is to build a robust and engaged community that they can listen to and get valuable feedback from (Relsify, 2022b). The communities are primarily online communities through email subscribers, Telegram, medium and micro-influencers, and WhatsApp (Relsify Pitch Deck, 2022). The biggest strength behind Relsify is, however, the team. Relsify has a very diverse team (C3.2), with each member having extensive experience in their fields, from Blockchain developers to real estate experts to lawyers (Relsify Pitch Deck, 2022). However, all members have also worked in the crypto space for some time and bring sufficient knowledge regarding Blockchain (Relsify Pitch Deck, 2022).

The two informants from the Relsify team were both co-founders of the company. In addition to being a co-founder, C3.1 is the technology developer (CV, C3.1). In terms of technology experience, C3.1 has a lot. Besides having studied computer science as his bachelor in Nigeria, C3.1 also has his own IT service company for almost a decade and a fantasy football platform (C3.1). Most of his environment and friends are from the

Blockchain and crypto community, where he is constantly developing his skills (C3.1). In real estate itself, C3.1 has no knowledge. However, C3.1 has also gained a lot of business knowledge along with his technical knowledge. First, with a master's in business administration (C3.1). However, also by running three start-ups at the same time.

Personally, he sees himself as a digital entrepreneur who is not new to risk. He is aware of the consequences of failure. "*Every project is a 50/50 thing at the end of the day. I think we're more focused on success: if it works, great! If not, move on to the next one*" [C3.1]. For him, being an entrepreneur also means focusing on solving the problem first and then pursuing the knowledge. Although he has a strong technology background, his motivation is to improve things, not use technology wherever possible (C3.1).

The other informant C3.2 is, in addition to being the co-founder of Relsify, also the head of growth (Relsify Pitch Deck, 2022). Regarding technology background, C3.2 has six years of experience navigating Blockchain and crypto. He identifies himself as a Blockchain enthusiast and part of the crypto community (CV, C3.2). Being passionate about technology, everything he knows about programming and Blockchain is mostly self-taught (C3.2). Before Relsify, he was a front-end developer, business growth hacker, and web developer (Relsify Pitch Deck, 2022), with Relsify being his first start-up (CV, C3.2).

In terms of real estate knowledge, C3.2 has "*very humble knowledge*" [C3.2]. He is a real estate investor passionate about real estate and making it affordable for everyone. His experience is limited to his own experience of investing in real estate, along with some friends from his Blockchain community (C3.2). In general, C3.2 would describe himself as a digital entrepreneur who is always looking for opportunities and likes to take risks, but in a conservative way, where he is also reflective and weighs all the positive and negative aspects (C3.2).

4.2.4 Vank

Vank is a PropTech 3.0 company that uses Blockchain technology to create a digital wallet for real estate that can be accessed on a mobile phone (Vank, 2023a). It was founded in 2021, is headquartered in the Nigerian capital, Abuja, and currently employs

six people (Vank, 2023c). Its vision is to become Africa's number one real estate bank by ensuring secure transactions with its community (Vank, 2023a).

Vank's solution to the unregulated land registry and housing gap is to create a mobile platform based on Blockchain technology to enable more transparent real estate transactions (Afrikan Heroes, 2022). Using Blockchain, all property ownership details are stored in a decentralized system that protects these records from alteration, rather than keeping them in a centralized government system prone to fraud (C4.1).

Vank's mission is to purchase land from the community in the private sector, divide it into different plots, and then list them in the application for users (C4.1). A trusted law firm has carefully reviewed all of the properties listed in the app for proper and legal documentation, giving the community confidence (Press, 2023). Users have a number of advantages when using Vank's services. First, they can become co-owners of part of a property and earn passive income from it. They can also buy, sell, and even mortgage their properties, using them as collateral for low-interest loans (Vank, 2023a).

Other benefits of using the Vank include the possibility of paying for the purchase of a property in instalments or in advance (Press, 2023). Plus, by viewing properties on their mobile screens (Press, 2023), users can access and manage their properties more efficiently. This fact contributes to faster transactions that save users a lot of time and effort (Vank, 2023b).

Vank puts the interests of its community first and tries to find ways to solve their problems when buying real estate. Through the fractional ownership model, Vank minimizes the risk and uncertainty of investing in a property individually. By leveraging the money of others, one also has access to higher-quality properties, which would not have been possible with the funds of a single person (Vank, 2023c). In general, co-investing also has social benefits as people interact, network, and share knowledge (Vank, 2023c). In the future, Vank plans to add the ability to digitize proof of ownership and pay with cryptocurrencies to the app (C4.1).

Vank is now able to provide *"[...] a safe channel for people to do real estate transactions"* [C4.1], which would not have been possible without the contribution of its CEO and founder. C4.1 has a financial and business background, holding a bachelor's degree in economics and statistics and a master's degree in management (CV, C4.1). In addition, his professional experience has given him a good knowledge of emerging technologies, including Blockchain, such that he describes himself as *"[...] one of the front liners of Blockchain in Nigeria"* [C4.1]. His understanding of Blockchain and his knowledge of crypto finance and economics led him to co-found a Blockchain company in 2018, which he later had to abandon due to the uncertainties surrounding Initial Coin Offerings (C4.1).

Although he does not come from the real estate industry, he had to familiarize himself with this market's special challenges to sell a family's property. Again, he combined his education and experience and founded Vank (C4.1). He took inspiration from large technology companies in Nigeria and tried to adapt their business models and apply them to the real estate sector (Press, 2023). He sees himself as a risk taker because he is applying a technology that is not proven yet, but whose potential he believes is worth the risk (C4.1). Through his journey in the real estate industry, he understood that market knowledge is the most important asset one can possess. Therefore, he surrounds himself with a team of experts and aims to do his best in the interest of the Vank community (C4.1).

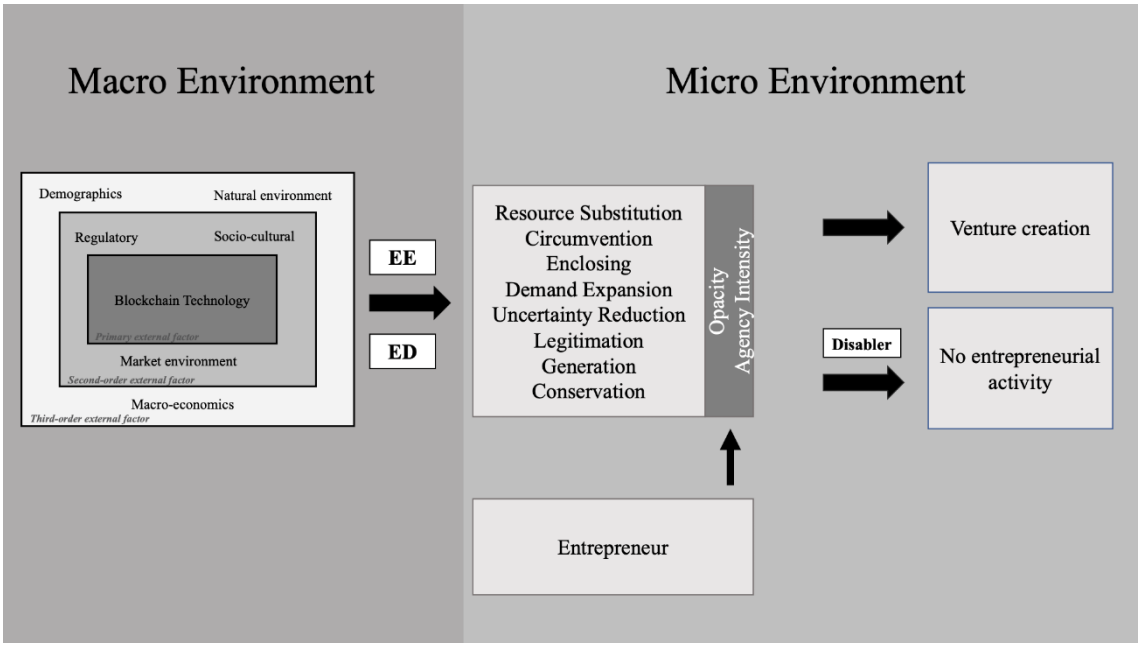
5. Analysis and discussion

This chapter presents our analysis and discussion. Our extended EE model for creating new ventures in the micro and macro environment within PropTech 3.0 will be presented and elaborated. It illustrates how the interplay of external enablers emerging in the macro environment also influences the mechanisms and their relational qualities in the microenvironment. The different parts of the model, and thus our analysis according to the EE framework, are described in more detail afterwards.

5.1 An extended EE model for creating new ventures

Our findings show that digital entrepreneurs at the forefront of Blockchain-enabled PropTech 3.0 ventures shape their new start-up ideas through the macro and microenvironment. In particular, at the macro level, several other external factors and their interplay play a role in addition to Blockchain. This interplay strongly influences the microenvironment, its mechanisms, and relational qualities. In addition to the various micro-level mechanisms, the entrepreneur is an essential factor in developing their new start-up ideas. All of these can either lead to the creation of a venture or not. To explain the relationship between the different external factors, mechanisms, their characteristics, and the entrepreneurs in our data, we developed the model in **Figure 3**. In the following we explain the model in depth.

Figure 3 A model for creating new ventures in the macro and microenvironment



5.2 Macro environment

Our data demonstrates many of the external factors identified in the EE framework (Davidsson et al., 2020). Looking at the macro environment, in addition to Blockchain technology, regulatory, socio-cultural, market environment, demographic, natural environment, and macroeconomic factors play an essential role in the emergence of PropTech 3.0 ventures. According to our data, a new external factor of high importance for Davidsson et al.'s (2020) EE framework are market environment factors. It became clear that the interplay of all factors ultimately leads to venture creation. Surprisingly, we also discovered that some external factors merely enabled entrepreneurial activities, while others were detrimental (Cestino Castilla et al., 2023) or even disabling.

External detrimental (ED) factors interrupt a start-up's new business idea or ongoing activity, making it impossible to continue with this particular business idea or activity, thus partly hindering the start-up. Due to this influence, other entrepreneurial initiatives emerge within the venture creation process. PropTech 3.0 companies still emerged in our case but in a different form. In the case of external disablers, no venture creation occurs as it leads to permanent destruction (Bennett, 2019). Our data show that entrepreneurs decided against a PropTech 3.0 company in this case and created a regular PropTech company. **Table 6** shows the different external factors, their influence on the start-ups, and how the external factors are related to each other.

5.2.1 Additional external factors

In the following subsection, we first explain the additional external factors individually and how they influence entrepreneurial initiatives, and after their interplay, leading to the creation of PropTech 3.0 companies. **Table 7** provides illustrative data for the presented external factors. Since Blockchain technology is the primary external factor, the additional external factors are presented according to the strength of their influence on entrepreneurial activity in our case data.

Regulatory

Davidsson et al. (2020) always mention the external factor regulation immediately after technological changes. Our data show that regulatory factors were most frequently mentioned alongside Blockchain technology and were even described as very important

in one interview: *"I think the most critical factor is the regulatory part*" [C3.2]. Regulatory changes refer to the changes in government regulations and policies, in our case, mostly related to BCT and real estate.

Table 6 Analysis of external factors

External factors						
Types of EE	External factors	Description	Cases in which it has been identified	Influence	Interplay with BCT	Interplay with additional factors
Blockchain Technology						
Regulatory	Crypto ban	The crypto ban is enforced by the Nigerian government	Relsify, Vank	External detrimental, External disabler	Yes	**Interplay with Socio-cultural** Misconception between crypto and Blockchain; High willingness to find solutions around regulations
	No BCT regulations in place	Absence of BCT regulations	HouseAfrica, Ellamediate, Relsify, Vank	External enabler, External detrimental, External disabler	Yes	**Interplay with Socio-cultural** Government learns from adapters
	Government is now starting to look into Blockchain	Government slowly starting to leverage Blockchain adaptation.	Ellamediate, Relsify, Vank	External enabler	Yes	**Interplay with Social-cultural** Government collaboration with BCT increases social acceptance
	Currency change	Government changed currency to minimize briberies during elections	HouseAfrica, Ellamediate	External enabler	Yes	**Interplay with Socio-cultural** Greater adoption of fintech
	Lack of land registry regulations	Inefficient land registry system and a lack of land regulations	HouseAfrica, Relsify, Vank	External enabler, External disabler	Yes	**Interplay with Socio-cultural** Lack of education **Interplay with Market environment** Lack of cadastral regulations affecting the industry
Socio-cultural	Social acceptance of BCT increased	Increased knowledge about BCT led to greater social acceptance of BCT	Ellamediate, Relsify	External enabler	Yes	**Interplay with Demographics** Younger population understands BCT
	BCT media coverage	Higher BCT acceptance through media	Ellamediate	External enabler	Yes	**Interplay with Regulatory** Media coverage of regulations
	Social inacceptance of BCT	Venture creation for BCT acceptance growth	HouseAfrica, Ellamediate, Relsify	External enabler, External disabler	Yes	**Interplay with Regulatory** Regulations causing unacceptability **Interplay with demographics** Targeting younger audiences
Market environment	Housing gap	Availability of affordable housing less than demand	Ellamediate, Relsify, Vank	External enabler	Yes	**Interplay with socio-cultural** High acceptance of alternatives due to unaffordability
	Lack of trust in real estate	No trust in current real estate systems	HouseAfrica, Relsify, Vank	External enabler	Yes	**Interplay with socio-cultural** High acceptance of alternatives due to lack of trust
	Inadequate real estate services	No digitized structures	Relisfy	External enabler, External disabler	Yes	**Interplay with regulatory** Regulations influenced by current structures
Natural environmental	Covid	Covid-19 impacted real estate industry	HouseAfrica, Ellamediate, Vank	External enabler, External detrimental, External disabler, No effect	Yes	**Interplay with Socio-cultural** Move to digital communications
Demographics	Young population	Average age of 18.1 years	HouseAfrica, Ellamediate, Relsify, Vank	External enabler	Yes	**Interplay with market environment** Lack of ability to afford housing **Interplay with socio-cultural** Greater acceptance of technology **Interplay with regulatory** Greater agility
Macro-economics	High inflation	Real estate investment is on the rise as a hedge against inflation	Relsify	External enabler	Yes	**Interplay with market environment** Increase in real estate investment **Interplay natural environment** Covid-19 impact on inflation rate **Interplay with demographics** Increase in real estate investment by young people
	High interest rate	High interest rates lead to larger housing gap	PT3	External enabler	Yes, but only in Germany	**Interplay with market environment** Real estate investments more expensive **Interplay natural environment** Covid-19 impact on interest rate

In the Nigerian PropTech industry, government policies have influenced almost all companies. The changes that impacted these companies, PropTech 3.0 and regular PropTech ventures in Nigeria, were the crypto ban in early 2021 (N3), the lack of regulations related to Blockchain in general, the fact that the government is now starting to address BCT, the currency changeover during the elections in early 2023 (N2), and the lack of land registry regulations. Each of these factors influenced entrepreneurial initiatives and venture creation in different ways, namely as external enablers, external detriments, or external disablers.

Many entrepreneurial initiatives during the venture creation process emerged under the influence of external enablers. Regarding the lack of BCT regulations, C2.1 from Ellamediate mentioned that *"[t]he application of Blockchain in different industries is new to everybody. So, there was no prior constitution or prior regulation before now. We will continue to come up with business ideas and leverage the technology. The government will find a way to regulate."* Likewise, C3.2 from Relsify acknowledges that Blockchain is only partially regulated as it is still too early, and the government is still learning of how it can be regulated. Building on a gray, unregulated space can create many opportunities for new ventures in the industry, but it also presents many challenges (C3.2).

In addition, the fact that the government is now starting to look at BCT adaptation by slowly leveraging on different projects is working positively for the people in Nigeria based on Ellamediate, Relsify, and Vank. *So, when the government [...] is in line moving in that direction, you tend to get easy acceptance from the people"* [C2.1].

The currency change also positively affected these start-ups, as they could rely more on BCT and learn how to go around policies. *"I mean, we needed to stop payments here in Nigeria. That's kind of the reason actors are powered by. Young people have identified this problem and think they can quickly solve it. They try to build things around the policy that has already existed"* [C1.2]. Relsify noted the same external enabler. The other two case companies did not mention it, but this does not mean much since we did not specifically ask about it, and it could have been forgotten.

Finally, in the PropTech industry, the lack of regulation and inefficiency in the land registry provides many opportunities for ventures. HouseAfrica focused on the complicated processes with a lot of bureaucracy (C1.2), Relsify focused on the fact that people cannot afford to buy expensive, vetted real estate (C3.2), and Vank focused on the inefficiencies of the system because the existing infrastructure does not support seamless transfer and ownership of real estate (C4.1).

While many entrepreneurial initiatives in our case studies emerged due to external enablers, some can be better explained by considering the external detrimental effects of regulatory factors. For example, the Nigerian government issued a crypto ban in February 2021 because cryptocurrencies have a lousy reputation globally, including fraudulent transactions and scam projects. Using crypto would mean that all accounts would be frozen (C3.1) due to that, the initial business idea of two cases was negatively influenced, leading to different entrepreneurial initiatives. Vank, on the one hand, needed to iterate from their original idea of including crypto. "*[...] we had to choose between going 100% crypto or keeping the aspect of crypto out of the equation completely"* [C4.1].

Relsify, on the other hand, has not taken crypto out of the equation entirely. Instead, they have integrated an alternative currency, a stable coin, into their PropTech 3.0 business model as the only case company (C3.2). Instead of skirting the regulations altogether, Relsify is trying to get the government to learn from adapters.

HouseAfrica's original business idea was also impacted by an external detrimental factor. While the lack of BCT regulations acted as an external enabler for Relsify and Ellamediate, it harmed HouseAfrica's original idea to create a Blockchain-based land registry in partnership with the government. The idea failed due to the lack of regulations and therefore had to be switched to the private sector. The fact that various factors negatively influenced the original business idea in three out of four cases, which led to different entrepreneurial initiatives and thus to the creation of ventures, shows that external factors can have not only positive but also negative effects on new ventures without automatically being a disabler (C1.1).

Nonetheless, regulatory changes also became one of the most significant external disablers affecting our regular PropTech ventures, serving as boundary condition. All these additional ventures, except for the German PropTech 3.0 ventures (PT3), cited regulations as one of the reasons why they have not implemented BCT, and thus started a PropTech 3.0 venture. This is reasonable because PT3 is the only company outside of Nigeria and the only additional venture using BCT. The most frequently cited reason was the crypto ban. Here, it became clear that there is a misunderstanding between Bitcoin and BCT in Nigeria, stating that because cryptocurrencies are banned, Blockchain is also not allowed (PT4).

The unregulated nature of the land registry process was another external disabler for the analyzed PropTech ventures not using BCT. Firstly, it prevented PT6, for example, from using a BCT solution, as he states that the government does not want a decentralized land registry and would rather keep it centralized. However, the lack of regulations also led to the decision not to use BCT, as digital entrepreneurs preferred to wait and follow the regulations (PT5).

Table 7 Illustration table of external factors

Types of EE	External factors		Explanation by entrepreneurs	
Regulatory	Crypto ban	External detrimental	"If you put a crypto on that transaction your accounts will be frozen. So we have a government that's quite hostile to crypto and blockchain projects. One of the Relsify's challenges is to actually get the license that shows that you offer security on Blockchain. They don't want to give the license because they don't understand how the Blockchain works." **[C3.1]**	"The main reason we've kept away from crypto is because of the rules within Nigeria. The central bank, which is like the Federal Reserve, or the central bank in Nigeria is not really friendly towards crypto." **[C4.1]**
		External disabler	"Technology alone won't solve it, you need political will." **[PT4]**	"In Nigeria, the regulatory landscape for Blockchain is very rigid. All this bad reputation and regulations stop you right now. You want to want to be mindful of regulation, you want to be on the good side of regulators." **[PT5]**
	No BCT regulations in place	External enabler	"Regulation, of course, is a factor that is impacting all of this Blockchain activity that companies are doing." **[C2.2]**	"So, I think the reason why people are being slow on adapting or using Blockchain technology to solve problems, is that regulations have not met yet. But people will not wait any longer a regulator cut off to innovation." **[C3.2]**
		External detrimental	"[We] started first with the state government in Nigeria in order to learn how we can transfer the paper documents to the Blockchain, something which was very difficult due to government's bureaucracies. In 2021, we decided to move our application to focus on the private sector." **[C1.1]**	
		External disabler	"So, I think that that process has to go first, once the government has fully digitized and regulated it, then they can start to look at adding another layer something like a Blockchain on top of it." **[PT6]**	"The first thing is the regulation, because as with building anything, you want to be aware of the regulation, you want to be on the good side of the regulators." **[PT5]**
	Government is now starting to look into Blockchain	External enabler	"It's gotten on the trend of conversations in the business space and everyone is going all crazy about Blockchain. And that is why the government has a very strong role on everything that we do in life." **[C2.1]**	"The eNaira itself is Blockchain based, is a multi-blockchain project. And even now, at its current phase, they're trying to introduce programmable currency within the project." **[C4.1]**
	Currency change	External enabler	"We have a huge shortage of the USD. Nigerian bank cards but also Visa or MasterCard cannot pay for international bills. This also is getting people to begin to rely on stablecoins and Blockchain more." **[C3.1]**	"The government has put restrictions on the prices of what people can spend their money on. So now people have found ways around it. That's why the adoption of crypto and in general BCT by people is skyrocketing." **[C3.2]**
	Lack of Land Registry regulations	External enabler	"We realized something similar can be done, we don't have policies for stable land registries, right. They're not really effective. We have policies about property records and data and all of that, but they are not working" **[C1.1]**	"The existing infrastructure doesn't support seamless transfer and ownership of real estate." **[C4.1]**
		External disabler	"I think courts will dismiss tokens as a proof of ownership because it's not a legally binding document for landownership." **[PT6]**	"The key thing with Blockchain is that it's decentralized in some way. And most governments want a centralized land registry. So that becomes an issue." **[PT6]**

Socio-cultural	Social acceptance of BCT increased	External enabler	"Now it's the right time, actually, because people are more open, people are more interested, not just customer interest. All Africans are looking for alternative ways of doing business and making it easy to scale." **[C2.1]**	"The market is ready for it at this point. I mean, we're moving towards that point where people are looking at the government as they are physically being ripped off by them." **[C3.2]**
	BCT media coverage	External enabler	"What all those reports will do is it will give new and fresh ideas, fresh businesses that are going to launch on this infrastructure." **[C2.1]**	"Media is not doing enough just yet. And just because there's so much bias in the media, even the communication and the education of the crypto markets are driven by the crypto enthusiasts themselves." **[C2.1]**
	Social inacceptance of BCT	External enabler	"It's not because of the bad reputation is more because a lot of people do not even know what NFT is in Africa. So, I can't talk about them when a lot of people don't even understand what they can do with it." **[C1.1]**	"The fundamental knowledge that crypto is not scam, is missing. And then we need to see more people build from web2 to web3. When more people begin to integrate crypto wallets, and use their tokens to buy stuff, it will give other people the confidence." **[C3.1]**
		External disabler	"Maybe if some more research comes around, you would be open to also look into it. I have done not much research on Blockchain. It's still strange." **[PT2]**	"I guess in a way it depends on people's belief systems. So, if people believe that Blockchain is a good way of securing the ownership, then it could start to thrive in that sense. For the moment, most people prefer the it the old-fashioned was." **[PT6]**

Market environment	Housing gap	External enabler	"There is the housing gap in African cities. So people are looking for companies that are solving these things." [**C3.1**]	"You have a property in the market for many years unsold. And that's because there is no matching between the people who have the money to buy the property, and who wants to buy the property at the price. The owner puts that price." **[C4.1]**
	Lack of trust in real estate	External enabler	"One title can be used to sell a single property up to 10 times but the ownership doesn't change. People don't go to the government to ask for the person who owns this property. Many people buy from other people that they know and trust. Now I want to increase the trust in such a way that you can have a platform where you don't need to know the owner." **[C1.1]**	"You need to create a system where people trust that the property is real, they're not buying thin air, right? Then they can verify that. Third, they can trust the fractionalization of the property, that when they own a tiny fraction, it will always be there in their wallet." **[C4.1]**
	Inadequate real estate services	External enabler	"In the real estate market across the world a lot of times people don't know, the value of their property when they're willing to sell, right." **[C3.2]**	
		External disabler	"Everything boils down to the fact that we don't have a structured system. We don't have a database for people, there's no way to verify any information." **[PT1]**	"The infrastructure is not yet available. But it's starting to be available now. It was not there when we started, especially with the regulations. So, it did not make sense to try BCT." **[PT2]**

Natural-Environmental	Covid-19	External enabler	"Covid-19 was as much a blessing as it was a curse. Because Covid-19 changed a lot of things. A lot of developers took that period, to work on projects." **[C2.1]**	"Covid-19 actually made people in Nigeria discover that they need to start. They have more desire to start now." **[PT1]**
		External detrimental	"Covid-19 had happened in 2020, it slowed everything down and ended with us achieving nothing." **[C1.1]**	"The whole situation opened the doors for us to start brainstorming for the future because we weren't making money." **[C1.1]**
		External disabler	"A few months after we started, COVID started, and then it became a whole mess. And by the time we were ready to do any Blockchain integration, we decided we're going to completely pivot away from Blockchain." **[PT4]**	
		No Effect	"Not Covid-19. But government regulations." **[C4.1]**	"Yes and no. In regard to what we are doing, like running a real estate marketplace, Covid-19 itself has not changed too much." **[PT3]**

Demographics	Young population	External enabler	"Young people in the country who have identified this problem think they can solve it quickly. I mean, regardless of what the authority has replaced, they try to build things around the policy that already existed." **[C1.2]**	"Nigerian youths understand Blockchain." **[C2.2]**

Macro-economics	High inflation	External enabler	"I think we will have a lot of users investing from Nigeria right now, because people, especially young people are looking for ways to beat inflation and invest their money and make money for themselves." **[C3.2]**	
	High interest rate	External enabler BUT only in Germany	"Because of the high interest rate, you can see very clearly the gap in who can afford private housing for their families." [**PT3**]	

Socio-cultural

In line with the socio-cultural external factors anticipated by Davidsson et al. (2020), we identified these factors based on their frequency of being mentioned by case ventures and regular PropTech ventures, with their importance coming right after regulatory factors. Again, it was mentioned by all case ventures and all regular PropTech ventures, except for the German PropTech 3.0 venture (PT3), which can be explained by the fact that the setting is entirely different. It is important to note that socio-cultural factors only had external enabling and disabling effects on venture creation, not detrimental ones. This can be explained by the fact that the socio-cultural factors were mainly social acceptance of BCT increasing and social unacceptance of BCT. Since these are very broad factors that

do not affect just one aspect of a start-up, the effects identified in our study either led to venture creation or did not.

Accordingly, C3.2 from Relsify claims that the market is now ready for Blockchain adaptations in the real estate industry. C2.1 from Ellamediate confirmed this and added that people are now more interested in technology and looking for alternative ways of doing business. Another reason for accepting BCT is also related to the fact that Nigerian youth understand technologies and Blockchain well (C2.2).

Nevertheless, a large number of people do not accept BCT because of the missing knowledge about the technology (C2.2). In addition, another factor is that *"[...] to participate in Blockchain, you need Internet access. And a lot of Nigerians are still not on the Internet, and then when you get on the Internet, you want to stay on the Internet for a few more years before using Blockchain, starting with sending an email and then a WhatsApp message"* [C4.1]. Relsify also identified the knowledge gap, and C3.1 mentioned that in Nigeria, two things are missing, the knowledge that crypto is not a scam and the will to move from web 2.0 to web 3.0. Although all the case ventures recognized the factors, it acted as an enabler, providing the case ventures with many different ways to act on it. One factor that could have helped to increase the necessary knowledge would have been the media, which, according to Ellamediate, still does not show enough effort and objectivity (C2.1).

Understandably, the lack of acceptance of BCT and its education is a significant problem and is also a strong disabler for many entrepreneurs (PT4). The following statement sums up the challenges of why some choose not to integrate BCT into their business models: *"At first [we] wanted to do it with Blockchain. But we started in 2019. And at that time, Blockchain wasn't really known. So, we thought it would be too much work to teach our customers about Blockchain. So, we decided we'll just do it without Blockchain"* [PT6]. During the interviews with regular PropTech companies, it also became clear that these entrepreneurs are not fully educated about BCT, as many believe that BCT is also prohibited due to the crypto ban (PT4).

Market environment

An external factor that was cited the third most of all additional factors and by all case ventures is the market environment. This type of factor has been discussed by other EE researchers but has not been fully recognized as a type of EE. The market environment was examined from the perspective of how entrepreneurs fill market gaps (Sarason et al., 2006). However, it is seen more as a market access mechanism, for example, that the market makes it easier for entrepreneurs to operate because it has a high level of digital infrastructure, rather than an actual external enabler (Schade & Schuhmacher, 2022). In addition, the market is often seen as a factor that makes entrepreneurs more likely to stay in their local market where they have tacit knowledge, but researchers such as Bennett (2019) do not address this as an external factor.

Nevertheless, it is vital to capture it due to its importance and strong influence on venture creation. In our case data, the various factors of the housing gap, lack of trust in existing real estate, and inadequate real estate services opened many opportunities for entrepreneurs, thus acting as EE.

The identified market environment factors are EE applied to the specific context of the PropTech industry. The lack of trust in the real estate market combined with the housing market gap were external changes that Ellamediate, Vank, and Relsify identified. As a result, they decided to move forward with a fractional ownership business model, i.e. tokenization. *"As an entrepreneur, the fact that housing finance is a problem, and all of that, the opportunity that's in that gap is fractional ownership"* [C3.2]. This example clearly illustrates that different identified factors can lead to different ventures. HouseAfrica is the only case venture that did not mention the housing gap in Nigeria, but only the lack of trust in the market, leading to a business model that focuses only on land registration and does not apply for fractional ownership.

Evidence that the market environment is an external factor, such as socio-cultural factors, is that these factors lead to the creation of new businesses and also act as a disabler. In some regular PropTech ventures, inadequate real estate services prevented entrepreneurs from moving forward with Blockchain adaptation because the system itself is not yet ready and there is no database to verify (PT1). Therefore, these PropTech companies are

waiting for the structures to be in place rather than doing it themselves, as HouseAfrica, Ellamediate, Relsify, and Vank are doing.

Natural environmental

Another external factor influencing new venture creation is the Covid-19 pandemic, as extensively captured by Davidsson et al. (2021). This natural environmental change had a positive impact on venture creation in most cases. For example, during the lockdown, entrepreneurs took the time to experiment, learn, and search for possible venture opportunities (C2.1). Similarly, at Relsify, C3.2 explained that he got into real estate due to the pandemic and invested with his friends in a property that they sold with 100% profit immediately after. He realized that this could be a good business model. Covid-19 made many people aware of what is wrong in Nigeria, such as the unregulated real estate industry, and increased their desire to make a difference (PT2).

Important to notice is that there is, again a difference between the cases. Instead of being positively affected by Covid-19, HouseAfrica was negatively affected by the pandemic. *"[...] the pandemic held us back because talking with the government requires a series of meetings, which due to Covid-19 we couldn't meet in person"* [C1.1]. The interviewee continues by mentioning that when Covid-19 happened, it slowed everything down and led to the fact that they did not get anything done. However, instead of it being a disabling factor, the external factor had a detrimental effect, not on an idea for a new venture, but as Cestino Castilla et al. (2023) capture on ongoing activity. The reason why we only see it in this one case is most likely because all cases except HouseAfrica were founded a year after the pandemic started, in 2021, while HouseAfrica was founded in 2019 and was therefore already operating when Covid-19 started. The detrimental effect of natural environmental change is illustrated in the following statement: *"The whole situation opened the doors for us to start brainstorming for the future because we weren't making money"* [C1.1].

While in most cases, the pandemic led to venture creation, Vank and PT3, the German PropTech 3.0 venture, reported that Covid-19 did not affect their venture creation process. One explanation for this could be that this natural environmental factor had only an indirect effect on opportunity recognition, which is why these entrepreneurs did not

recognize it. At the same time, it had a disabling effect on one of the normal PropTech ventures that served as a boundary condition. As a result of Covid-19 and all its consequences, they decided to focus on other things, shifting the idea of using Blockchain completely (PT4).

Demographics

Another external factor mentioned by all cases, but only briefly and mostly in combination with socio-cultural factors, is the age distribution in Nigeria. According to our case data, the average age of 18 in Nigeria has facilitated starting businesses (N1). On the one hand, because of the young population, Nigerians have a better understanding of technology (C4.1). On the other hand, the aforementioned housing gap is increasing as young people cannot afford to have real estate due to the high prices (C3.2). This shows that the demographic factor impacts opportunity recognition, according to Davidsson et al. (2020), but in our research, it is not as strong as anticipated.

Macroeconomics

Although the macro-economy has had a significant impact on the real estate industry in the past, according to N2, not many factors were mentioned. Relsify mentioned the inflation rate as an enabling factor, saying that many Nigerians, especially the younger generation, want to invest in real estate to beat inflation (C3.2). The only other time something like this was mentioned was when PT3 talked about the high interest rates leading to a larger housing gap. However, they were talking about Germany. In Nigeria, there are other issues to focus on. Interest rates are not one of them, as most Nigerians do not have bank accounts or access to formal mortgages (N7).

This lack of identified macroeconomic factors could therefore have two reasons. It was mentioned in conjunction with other external factors and therefore tends to be in the background, influencing the more present external factors. Moreover, we are looking at a different context compared to previous EE researchers. While the framework was designed in the Western world, in Nigeria and developing countries, macroeconomic factors are less present alongside all the other first-hand problems.

5.2.2 The interplay of external factors

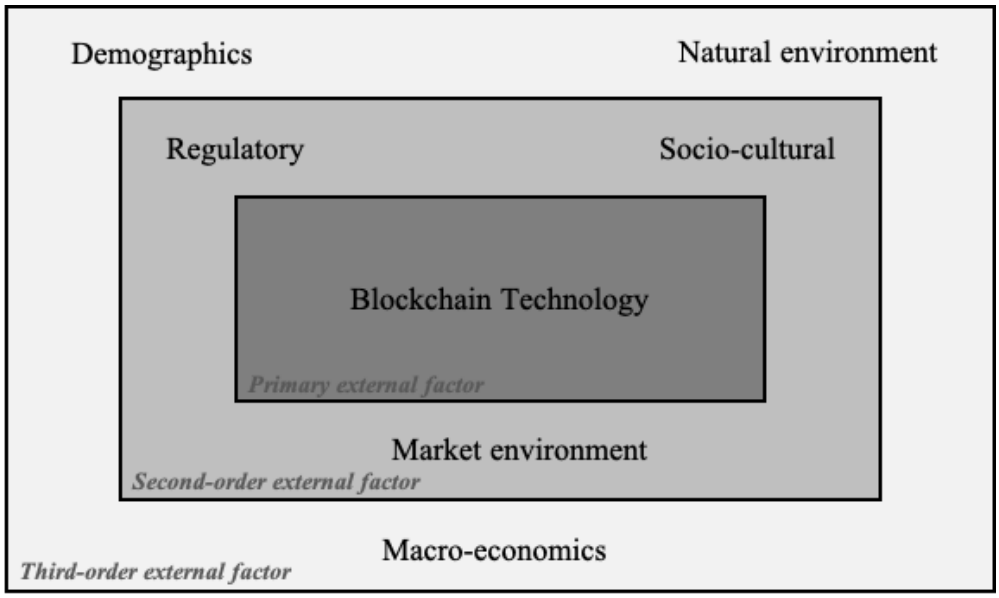
One issue that has received little attention to date, but which became apparent in our research, is the interplay of external factors (Kimjeon & Davidsson, 2022). Blockchain technology is the main external factor leading to venture creation in the PropTech 3.0 space. However, this factor alone has not led to venture creation, as Blockchain technology has been around since 2008 and new ventures are only now emerging. This is underscored by one interviewee's assertion that *"technology alone won't solve it"* [C2.2]. While some entrepreneurs, like our Nigerian regular PropTech ventures, did not recognize or perceived differently various external factors, our four case ventures created PropTech 3.0 companies because of the interplay of external factors. This became evident when many pointed out that BCT alone was not enough, but as, for example, the socio-cultural factor of BCT acceptance increased, the timing was right for a PropTech 3.0 project (C2.1).

It is important to note that all the additional external factors mentioned interact with the main external factor, BCT. Moreover, there is also an interplay between these additional factors. For example, the interplay between regulatory and socio-cultural external factors became particularly clear. **Table 6** shows the interplay between the different factors. Next to BCT, the most interdependent external factors are the socio-cultural factors. These are linked to the regulatory factors, the market environment, the natural environment, and the demographic factors. The reason for this high level of interdependence can probably be explained by the fact that, according to Hofstede Insights (2019), Nigeria is a very collectivist society. Therefore, there is a strong focus on a society that promotes strong relationships where everyone takes responsibility for the people around them, including in the business world (Hofstede Insights, 2019).

While the interplay of external factors often illustrates an enabling effect, it can also have a disabling effect. An example is the following: *"The infrastructure is not yet available. But it's starting to be available now. It was not there when we started, especially with the regulations. So, it did not make sense to try BCT"* [PT2]. Here it becomes clear that while the market environment is starting to look better and therefore creates an opportunity, the interplay with regulations led to the fact that PT2 did not create a PropTech 3.0 venture.

The analysis of the various external factors revealed the interplay of different factors, as well as the strength of the various interactions and factors. Not all factors were mentioned equally often or even noticed by every entrepreneur, illustrating different levels. **Table 8** shows the external factors combined with BCT directly leading to entrepreneurial initiatives. This clearly shows that external factors have a different impact on venture creation. Regulatory, socio-cultural, and market environment factors in combination with BCT are the only factors that leads directly to entrepreneurial initiatives and are therefore captured in **Figure 4** as second-order external factors behind BCT as the primary external factor.

Figure 4 The interplay of external factors



As shown in the external factor analysis, demographics, natural environment, and macroeconomic factors were identified less and are more influencing second-order external factors than actually leading directly to venture creation. Therefore, these three are referred to as third-order external factors or supporting external factors. This is supported by the fact that Vank, for example, did not identify Covid-19 as an external factor. Many studies have shown, however, a positive effect on increasing social acceptance of technology and thus BCT (Ogirima et al., 2022). Also, demographics have mainly influenced socio-cultural factors such as the increasing acceptance of BCT and the housing gap (C3.1).

5.3 Microenvironment

Turning now to the corresponding mechanisms and its relational qualities, i.e. the microenvironment, our data demonstrate many of the mechanisms identified in Davidsson et al.'s (2020) EE framework. While the mechanisms are always there, they are not universally noticed or acted upon by every entrepreneur, depending on the amount of resources and risks involved, i.e. opacity and agency intensity. Such a phenomenon has been observed in the PropTech 3.0 sector. However, the interplay of external factors reduces the relational qualities.

5.3.1 Entrepreneurial initiatives and the corresponding mechanisms

The case data revealed five different entrepreneurial initiatives, three to five per case, as some were identical, representing nine different mechanisms. We list them from most present to least present, starting with resource substitution, circumvention, enclosing, demand expansion, conservation, uncertainty reduction, legitimation, generation, and resource expansion. **Table 8** shows the different entrepreneurial initiatives initiated by the various external factors and the corresponding mechanisms for each case venture. While most are external enablers (EE) mechanisms created by Davidsson et al. (2020), we have identified a new mechanism. Based on the previously identified external detrimental factors, there is also an external detrimental (ED) mechanism, designated as circumvention. However, circumvention can also be an EE mechanism.

Table 8 Analysis of mechanisms

Mechanisms				
External factors besides BCT	Entrepreneurial initiatives	Description of initiative	EE/ ED mechanism	Specific cause-effect relationships
HouseAfrica				
Regulatory (land registry, no BCT regulations); **Socio-cultural** (inacceptance)	*Real Estate database*	Blockchain-based database of real estate information	Circumvention **[ED mechanism]** Enclosing, Resource substitution [EE mechanism]	BCT can improve the poor cadastral system
Socio-cultural (inacceptance) **Market environment** (lack of trust) **Regulatory** (land registry)	*Sytemap*	Interactive digital property map	Circumvention, Legitimation, Resource substitution, Uncertainty reduction [EE mechanism]	Lack of education and acceptance of BCT, lack of proper land registry, lack of trust in real estate systems, lack of cooperation with government
Socio-cultural (inacceptance)	*NFT*	Non-fungible tokens represent digital or real-world items such as real estate	Resource substitution, Uncertainty reduction [EE mechanism]	Lack of education and acceptance of BCT
Regulatory (land registry); **Socio-cultural** (inacceptance)	*Real Estate transaction platform*	Blockchain-based real estate transaction platform	Circumvention [EE mechanism]	Lack of trust in real estate systems and many Nigerians living outside the country
Ellamediate				
Regulatory (land registry, no BCT regulations)	*Real Estate database*	Blockchain-based database of real estate information	Circumvention **[ED mechanism]** Enclosing, Resource substitution [EE mechanism]	BCT can improve the poor cadastral system
Market environment (housing gap)	*Tokenization*	Property rights shared by multiple actors	Demand expansion, Legitimacy, Resource substitution [EE mechanism]	Shared ownership on the rise due to housing shortage
Socio-cultural (inacceptance)	*NFT*	Non-fungible tokens represent digital or real-world items such as real estate	Resource substitution, Uncertainty reduction [EE mechanism]	Lack of education and acceptance of BCT
Regulatory (land registry); **Socio-cultural** (inacceptance)	*Real Estate transaction platform*	Blockchain-based real estate transaction platform	Conservation, Circumvention, Demand expansion [EE mechanism]	Lack of trust in real estate systems and many Nigerians living outside the country
Relsify				
Regulatory (land registry, no BCT regulations)	*Real Estate database*	Blockchain-based database of real estate information	Circumvention **[ED mechanism]** Enclosing, Resource substitution [EE mechanism]	BCT can improve the poor cadastral system
Regulatory (crypto ban); **Socio-cultural** (inacceptance)	*Own stable coin: RELS token*	Relsify's native token, allowing access to specific utilities in the firm's Blockchain ecosystem	Circumvention **[ED mechanism]** Demand expansion, Enclosing [EE mechanism]	Leveraging their own token to build trust with people and government
Market environment (housing gap); **Regulatory** (land registry)	*Tokenization*	Property rights shared by multiple actors	Demand expansion, Legitimacy, Resource substitution [EE mechanism]	Shared ownership on the rise due to housing shortage
Regulatory (land registry); **Socio-cultural** (inacceptance)	*Real Estate transaction platform*	Blockchain-based real estate transaction platform	Conservation, Circumvention, Demand expansion [EE mechanism]	Lack of trust in real estate systems and many Nigerians living outside the country
Market environment (lack of trust; inadequate real estate service)	*Property valuation tool*	Four metrics property valuation calculator	Generation [EE mechanism]	Lack of knowledge about real estate value due to inadequate real estate services

Vank				
Regulatory (land registry)	*Real Estate database*	Blockchain-based database of real estate information	Circumvention **[ED mechanism]** Enclosing, Resource substitution [EE mechanism]	BCT can improve the poor cadastral system
Market environment (housing gap); **Regulatory** (land registry)	*Tokenization*	Property rights shared by multiple actors	Demand expansion, Legitimacy, Resource substitution [EE mechanism]	Shared ownership on the rise due to housing shortage
Regulatory (land registry); **Socio-cultural** (inacceptance)	*Real Estate transaction platform*	Blockchain-based real estate transaction platform	Conservation, Demand expansion, [EE mechanism] Circumvention **[ED mechanism]**	Lack of trust in real estate systems and many Nigerians living outside the country

Circumvention and the other frequently mentioned mechanisms are discussed in the following subsections. **Table 9** provides data in support of all identified mechanisms. It was surprising that mechanisms such as conservation, uncertainty reduction, and legitimation were barely mentioned, and compression was not mentioned at all. Especially considering the characteristics of Blockchain, such as decentralization, which eliminates the role of central authorities (Johar et al., 2021) and thus also time, and its network of nodes, which makes transactions more secure (Hughes et al., 2019; Volodymyr & Gilles, 2020). Again, this could be explained by the fact that the EE framework was created in the Western world where other economic measures such as focus on efficiency are paramount, while in a developing country like Nigeria, the business focus and entrepreneurial initiatives are more problem solving. This is also mentioned by most of the digital entrepreneurs interviewed, such as C1.2 from HouseAfrica: *"But for us, the main focus is solving problems."*

Resource substitution

The most frequently mentioned mechanism in our case data was resource substitution. According to Davidsson et al. (2020), for example, this refers to the replacement of old technology with new software. As all cases revolutionized the real estate industry by digitizing everything and replacing it with Blockchain, most entrepreneurial initiatives represent the EE mechanism of resource substitution. An example here is Ellamediate, Relsify, and Vank's business model of tokenization. *"So, we just leverage the technology to bring property and real estate assets closer to the average Nigerian "* [C2.1]. While

fractional ownership can be done without applying Blockchain, the three cases use Blockchain and therefore replace the old software.

In particular, because of the housing gap identified by these three cases, it was recognized that investing in real estate is for 99% of the population not possible (C3.2). This, together with the increasing social acceptance of Blockchain, partly because of Covid-19 but also because of the currency change and the young population, initiated the entrepreneurs to identify and act on the EE mechanism of resource substitution, again emphasizing the importance of the interplay of external changes. *"Now, another thing driving us is, the housing gap, especially now and especially for young people. That's why we employ the fractional ownership model"* [C2.1].

Table 9 Illustration table of mechanisms

Mechanisms			
Cases and initiatives	***EE mechanism***	***Explanation by entrepreneurs***	
HouseAfrica			
Real Estate database	Circumvention, Enclosing, Resource substitution	"In 2021, we decided to move our application to focus on the private sector. That is where people in the real estate companies in Nigeria are focusing more on. Now we can store this land data in a way that it cannot be changed. Basically, we're protecting the data. So, that's the idea of Blockchain." **[C1.1]**	"So after we built that, we didn't go to the market, we did go to the land registry. Going through all the bureaucracy, we realize that we can actually do these things ourselves. So, you can just move forward with that and see where they go later." **[C1.2]**
Sytemap	Circumvention, Legitimation, Resource substitution, Uncertainty reduction	"So, I can't talk about [BCT] when a lot of people don't even understand what they can do with it. So, I focus more on telling them what they can do. People in Nigeria want to live the experience, the map helps with trust." [**C1.1**]	"You just go to the map and you can see all the different estates. We also give you a dashboard where you can manage all the lands that you own. Also, we make sure that you get the documents shipped to you." **[C1.1]**
NFT	Resource substitution, Uncertainty reduction	"We are using NFT's but don't even talk about it! It's not because of the bad reputation, it is more because a lot of people do not even know what NFT is in Africa." **[C1.1]**	"We leverages on Blockchain & NFT in helping real estate companies issue verifiable certificate of land allocation with ease." **[HouseAfrica, 2021]**
Real Estate transaction platform	Circumvention	"We do that property exchange. But that's why we actually started with Blockchain. And then we realized as well, that Blockchain can do other things, almost all over Africa." **[C1.2]**	"We are ensuring homebuyers that they buy verified properties. Because the government does not have that instrument of ensuring that. So, our system offers that." **[C1.2]**

Ellamediate			
Real Estate database	Circumvention, Enclosing, Resource substitution	"The application of Blockchain in different industries is new to everybody. So, there was there was no prior regulation. The government will just call us to the stakeholders meeting and say, you guys have done this, we appreciate what you guys have done. But we need to put some regulations in place." **[C2.1]**	"We've used Blockchain, making it easy to store all this data and transfer our assets." **[C2.2]**
Tokenization	Demand expansion, Legitimacy Resource substitution	"So, we've tokenized these properties. We've built an ecosystem that tracks all the transaction flow payments from the asset managers because they manage getting the property rented out and all of that. So, they manage the income on its own." **[C2.1]**	"When Blockchain comes in place, this transition comes with tokens. Tokens automatically mean they own the asset. It is just like having your own Bitcoin. So, a Bitcoin equivalent to I own a property in Stockholm." **[C2.2]**
NFT	Resource substitution, Uncertainty reduction	"So, a lot of people just look at NFT and think there is no asset back there, but this time around we are providing a product. So, you're not just buying the image you're actually buying a property." **[C2.1]**	"One of the guys in marketing said let's take out the Blockchain. So, at the moment Blockchain is just in the background. Give the people user experience that they don't even need to know about Blockchain." **[C2.2]**
Real Estate transaction platform	Conservation, Demand expansion	"So Blockchain gives the transaction aspect of real estate more transparency and scalability, so you don't necessarily have to come to Nigeria to hold the property anywhere in the world." **[C2.2]**	"With the adoption of Blockchain, acquisition and transfer of real estate assets and the title are seamless, documentation is quick using the smart contract, and the typical middlemen usually associated with real estate transaction is eliminated." **[Ellamediate; Oluwatoyin, 2022]**

Relsify			
Real Estate database	Circumvention, Enclosing, Resource substitution	"Security is a big part of Blockchain because these records get stored into the ledger and no one can manipulate them. In traditional Real Estate, you can even see a property that has two ownership papers, and you don't know which is the original! But, on Blockchain, you can't have that. They're all unique." **[C3.1]**	"We build a framework around regulations. Just because there's no regulatory framework doesn't mean it shouldn't be built, we shouldn't be done! So we're trying to actually collaborate with the state government. So when you buy on Relsify, you get a contract on Blockchain that shows that you actually got this proof and it's government approved." **[C3.2]**
Own stable coin: RELS token	Circumvention, Demand expansion, Enclosing	"If you're using Blockchain, you can take it to the other marketplaces, and sell your fresh shares or the properties that you have got using our platform, basically. We're using USDC, which is a stablecoin." **[C3.1]**	"The government is trying to find a way to see how we can basically integrate crypto properly, to just set the rules through which people really crowdfund their own properties." **[C3.2]**
Tokenization	Demand expansion, Legitimacy, Resource substitution	"We're doing that through tokenization of the real estate assets. This is also helping real estate developers. You can have an acre of land that you need to develop, but you don't have the millions to structure it right. So now you can ask to get funds from the public. It brings more liquidity to the real estate markets." **[C3.1]**	"That's the reason why our solution is unique. Because people want to buy verifiable properties, but the price of verifiable properties is higher than with no verified properties." **[C3.2]**
Real Estate transaction platform	Conservation, Circumvention, Demand expansion	"What we're doing with Relsify, we are digitizing real estate, so that anybody from any part of the world, including you, can go on the website, see a piece of asset that you like, and then you can just own it." **[C3.1]**	"Deviod of any middlemen whatsoever." **[Relsify Pitch Deck, 2022]**
Property valuation tool	Generation	"In the real estate market across the world a lot of times people don't know the value of their property when they're willing to sell, right. So, we've developed tools that can give insight as to what the value of a property is at the time, based on four different metrics." **[C3.2]**	

Vank			
Real Estate database	Circumvention, Enclosing, Resource substitution	"We digitize real estate and make sure that the ownership is transparent and such records cannot be altered. Blockchain is useful for tracking and tracing the property." **[C4.1]**	"Well, the first thing is that its mostly private sector led. So, you have people that start developments. We work with those developers." **[C4.1]**
Tokenization	Demand expansion, Legitimacy, Resource substitution	"There's a secure wallet that allows people who own real estate either wholly or fractionally, so when they choose to hold real estate, fractionally they coordinate with many other people." **[C4.1]**	"Everyday people can begin the journey to owning real estate, you know, they don't need to wait until they're much older." **[C4.1]**
Real Estate transaction platform	Conservation, Circumvention	"The smart contracts can get rid of a lot of lawyers, accountants, and account managers." **[C4.1]**	"The main reason we've kept away from crypto is because of the rules within Nigeria. We went from the idea of a crypto wallet and exchange to a Real Estate wallet and exchange." **[C4.1]**

Circumvention

The second most common mechanism in the case data is the circumvention mechanism. This is also one of the mechanisms that clearly distinguishes PropTech 3.0 ventures from regular PropTech ventures, as this mechanism was not seen in any regular PropTech ventures. There are two unique things about it: first, it is a mechanism that has not been captured in the entrepreneurship literature, and second, it appears to be both an EE and an ED mechanism.

The circumvention mechanism captures all entrepreneurial initiatives that bypass the consequences leveraged by external changes. It is, therefore, most often seen in combination with regulatory factors, as consequences need to be evaded to create a new venture. This can be an EE mechanism, such as circumventing the consequence of not having a regulated market: *"As Africans, you don't wait for regulations, regulations catch up to innovation. You innovate, you wait for regulation to catch up with your innovation.*

So, I think we're moving forward without actually getting full regulatory compliance done, we want to make sure that everybody's safe on the platform" [C3.2]. For a better illustration, see additional quotes in **Table 10.**

Nevertheless, some circumventions are ED mechanisms. Referring back to the example of HouseAfrica, which moved to the private sector because building a government land registry did not work. *"For us, we will not rely on the politics or the government anymore. So, we don't want to build our business with the government or politics, because we understand the instability in Africa"* [C1.2]. The exact mechanism was leveraged when Vank decided to go with a real estate wallet without crypto due to the regulation of the crypto ban (C4.1) or Relsify with another form of crypto, the stable coin, due to the same external change (C3.1).

The reason why such a mechanism might not be captured is that the EE framework has so far only focused on the Western world and not on a developing country alongside such a new emerging market. In addition to the somewhat unclear and lagging regulations in developing countries, new markets such as the PropTech 3.0 industry have hardly been taken into account in regulations around the world. This mechanism may also be relevant in a broader context, as new technologies are a regular source of market entry.

Table 10 Illustration table of the circumvention mechanism

Circumvention mechanism	
"In 2021, we decided to move our application to focus on the private sector. That is where people in the real estate companies in Nigeria are focusing more on." **[C1.1]**	"So, there was there was no prior constitution or prior regulation before now. [...] So, in this case, make our mistakes, make the errors, put together all those reports and information. And let us now structure the entire industry instead." **[C2.1]**
"We need to feel empowered to be able to work with the government. So, at the moment, we don't feel empowered to work with them." **[C1.1]**	"So, when you build on Blockchain you bypass licensing in a way. So, we believe that blockchain also helps us bypass various regulations in different parts of the world." **[C3.1]**
"For us, we will not we will not rely on the politics or the government anymore. So, we don't want to build our business with the government or politics, because we understand the instability in Africa, especially." **[C1.2]**	"Relsify is part of the startups in the Blockchain real estate space that is helping build a framework around regulations. [...] Just because there's no regulatory framework doesn't mean it shouldn't be built!" **[C3.1]**
"We can work around those policies that are existing, good solution that will solve the problem that we currently have." **[C1.2]**	"As Africans, you don't wait for regulations, regulations catch up to innovation, right? You innovate, you wait for regulation to catch up with your innovation. So, I think we're moving forward without actually getting full regulatory compliance done, we want to make sure that everybody's safe on the platform." **[C3.2]**
"From where we stand, we understand that a lot of things can play out, even if the government's direction is different. But I love the way we are building distribution right now." **[C1.2]**	"Well, the first thing is the way real estate is based in Nigeria is that its mostly private sector led. So, you have people that start developments, they go to the community and acquire their land from the community and then break it into parcels, different plots, right. We work with those developers." **[C4.1]**

Enclosing

Another commonly used mechanism is the enclosing mechanism. According to Davidsson et al. 2020, it is an entrepreneurial initiative that increases the company's ability to capture customer loyalty. Relsify's entrepreneurial initiative to use its own token was an enclosing mechanism. According to the company, by having their own stable coins, *"people then feel like they own a part of the business. So, to see that the business also grows influences them very positively"* [C3.2], which increases the buyer's loyalty immensely.

In particular, the Blockchain-based real estate database that each case venture has is likewise an enclosing mechanism. Due to the lack of regulation in the land registry, inadequate real estate services, and a lack of trust in real estate, a secure database is needed. Such a database brings all the benefits of technology, such as transparency and the ability to view all the necessary information about the property online (C3.2; C4.1). All of this leads to greater buyer loyalty.

Demand expansion

The mechanism of demand expansion is the first mechanism that is discussed more intensively and was not seen in all case ventures. Vank, Relsify, and Ellamediate refer strongly to reaching more people, for example, by saying, *"[...] we want people from all around the world to be able to do this. So, we believe that Blockchain also helps us bypass various regulations in different parts of the world"* [C3.1]. Tokenization increases the reachability within the country as more people can now afford to invest in real estate (C2.2).

Nevertheless, HouseAfrica did not leverage a demand expansion mechanism. The reason for this goes back to the recognition of the external factors. For example, while the other three case ventures identified the housing gap, HouseAfrica did not discuss it. As a result, they did not implement tokenization in their business model because they wanted to focus more on the land registry. Therefore, expanding and reaching more demand has not happened yet. However, this leads HouseAfrica to focus more on the Blockchain-based database. The fact that we found most entrepreneurial initiatives in Relsify could be

precisely due to this. While Relsify responded to multiple external factors and the corresponding mechanisms, the others focused only on a few specific external factors.

5.3.2 Relational qualities

The relational qualities of mechanisms ultimately determine whether mechanisms are recognized and acted upon. Given the paucity of previous research in this area (Davidsson et al., 2020), our study has a comprehensive contribution to make to this part of the EE framework. First, it was found that in such a niche market as PropTech 3.0 ventures, the relational qualities of agency intensity and opacity are relatively high, so mechanisms are not obvious to identify, nor is it easy to act on them. **Table 11** illustrates each entrepreneurial initiative's agency intensity and opacity.

What was interesting, however, was the discovery that two different aspects influenced the agency intensity and opacity. First, the interplay of external factors affected the relational qualities. Depending on which other external factors occurred, a particular mechanism's agency intensity and opacity decreased or increased accordingly. Second, however, not only the external factors had an impact, but also the interplay with the ecosystem around the digital entrepreneurs and their founding team had a significant influence on whether an opportunity and, thus, mechanisms were recognized and acted upon. Therefore, the entrepreneurs themselves, including their environment, play a vital role in the creation of new ventures.

High initial agency intensity and opacity of entrepreneurial initiatives

Entering the nascent PropTech 3.0 market is still something very unique. We are talking about an industry that is just emerging, and very few entrepreneurs have entered. Hence the entrepreneurial initiatives are not well visible or actionable, especially when we are talking about a technology that is relatively new in terms of adaptation to different markets. It was noted that there is a high need for knowledge, both in real estate and Blockchain, to recognize the market opportunities. As a result, the opacity of any entrepreneurial initiatives in this space is relatively very high. *"I realized that the problem is that it's very difficult for someone to be very innovative in this place. And probably the understanding is not going to come very quickly for a lot of people, and even for somebody*

like us who's building it, it's hard, because you probably don't know where all this is going to go when you start" [C1.2].

Table 11 Analysis of relational qualities

Entrepreneurial initiative	Mechanism	Relational quality	HouseAfrica	Ellamediate	Relsify	Vank	Boundary condition
Real Estate database	Circumvention, Enclosing, Resource substitution	Opacity	**Moderate** "[…] somebody forges passports and there you have a database. Just running the information will tell you, this is a wrong passport. And that is what our land registry is designed to do." **[C1.2]**	**Moderate** "First, get started with a basic computer programming, then move to the Blockchain development. But more tech people need to know about business. That's needed to see opportunities." **[C2.2]**	**Moderate** "I needed to research the market a lot, which made me understand the technology and how it should works." **[C3.1]**	**Moderate** "There are a couple of platforms that provided info, then for real estate, same thing. This is where I mainly found about about the adaptation of Blockchain onto real estate." **[C4.1]**	**High** "Maybe if some day more research comes around, I would be open to also look into it. I have done not much research on Blockchain. I really don't see so much in it like the others. Like I said, it's still strange." **[PT4]**
		Agency intensity	**Moderate** "Yes, a lot of risk taking!" **[C1.1]**	**High** "It is expensive. So, we have we have developers in the Ukraine, we have some guys in Russia. So, it is really expensive." **[C2.1]**	**Moderate** "We have people we make use us of. They give us data. And when we get data, we sort of like digitize it." **[C3.2]**	**High** "I don't think it's a big risk. Maybe it's a big risk. Maybe I should reframe, maybe it's a big risk, but it's a worthy risk, right? The worthy risk is that Blockchain is still unproved." **[C4.1]**	**High** "It's very hard to get funding for technology like this, that has no other reference in any part of Africa. So you are almost building with your own funds." **[PT1]**
Real Estate transaction platform	Conservation, Circumvention, Demand expansion	Opacity	**High** "I've done a lot of research where I've also seen some start-ups doing this mapping. But they are not doing land registry. I think that's where I saw this and I picked it up." **[C1.1]**	**High** "I joined online classes, researching and used especially YouTube. YouTube was first yeah. And that's how I noticed how Blockchain can be integrated for selling and buying real estate." **[C2.2]**	**High** "And I have like ample experience with real estate, I've seen firsthand people that have had problems with buying real estate markets but also I see people that have gone into real estate market and come out as billionaires." **[C3.2]**	**High** "You need to have generalist knowledge. So if you have specific knowledge around real estate, it's okay to have general knowledge about Blockchain, but then look for a co founder, who has the technical ability to deliver." **[C4.1]**	**Moderate** "I've definitely watched a couple of the projects, especially in Europe that have used Blockchain as a way of selling real estate digitally." **[PT6]**
		Agency intensity	**Moderate** "We understand that it's a difficult path to work. At the same time, there are low hanging fruit that we can grab quickly, you know, to work and see how we can move with that." **[C1.2]**	**High** "This risk factor is really high. So, the odds are stacked against you." **[C2.1]**	**High** "A lot of money is needed at that section because you need to do research, a market analysis and all of these things. Because you have to talk to people direct one on one, you have to travel to places, go for meetings and all of that." **[C3.2]**	**High** "For the adoption as a producer, there's not enough talent here either. You know, and there's not enough funding either." **[C4.1]**	**High** "Blockchain itself does not introduce risk. But the question for start-ups, especially at this point in time, is funding. So many Blockchain companies that I talk to have struggled to raise capital." **[PT3]**
Tokenization	Demand expansion, Legitimacy, Resource substitution	Opacity		**Low** "It has become the trend of conversations in the business space because of the government and the media, and everyone is doing research on Blockchain." **[C2.1]**	**Moderate** "So, as an entrepreneur, posed by what is happening in the world, it is like the global change, and all that and the opportunity that lies within this gap that I see in markets." **[C3.2]**	**Moderate** "While I was in the UK, I stumbled on Bitcoin, way back in 2012. So I bought a few of them just to experiment. And then I got into it, did a Blockchain project. Through that, I got more information on tokenization and saw the opportunity to solve the housing gap." **[C4.1]**	**Moderate** "This model of fractional ownership is really trendy lately. And as we know, like in Nigeria, there are people that want to buy real estate, particularly now a generation that they cannot afford to have the money to buy the whole estate." **[PT5]**
		Agency intensity		**High** "It is not an option, you need funding to get started because it can't be done alone." **[C2.2]**	**High** "There is a lot of risk in in this space because there are projects, where you never see any real product. That is still happening. So, a lot of scepticism is still there." **[C3.1]**	**Moderate** "So now, what we do is we pick up a plot within an estate, and then make those available for users." **[C4.1]**	**High** "Of course, if we had more funding, we would want to get into Blockchain." **[PT5]**

Entrepreneurial initiative	Mechanism	Relational quality	HouseAfrica	Ellamediate	Relsify
Sytemap	Circumvention, Legitimation, Resource substitution, Uncertainty reduction	Opacity	**High** "I realized that the problem is that it's very difficult for someone to be very innovative in this place, right." **[C1.2]**		
		Agency intensity	**High**: "It is really scary."; "It was personal time for learning and researching and funds." **[C1.1]**		
NFT	Resource substitution, Uncertainty reduction	Opacity	**High** "A lot of people do not even know what NFT is in Africa." **[C1.1]**	**High** "Just by getting started we learned more and understood more what is needed. So, the moment you get started, you know what to do next." **[C2.2]**	
		Agency intensity	**Moderate** "When getting started you probably don't need so much right? At the very beginning, you just need someone who understand how to write the code." **[C1.2]**	**Moderate** "And the beautiful thing about the Blockchain is, once you have the knowledge, the only expensive thing I see in Blockchain is getting the knowledge of how to integrate elements together." **[C2.2]**	
Own stable coin: RELS token	Circumvention, Demand expansion, Enclosing	Opacity			**Low** "The big crypto information is everywhere. And the good thing with crypto is that there's always the community to actually help you with anything you want to do." **[C3.2]**
		Agency intensity			**Low** "[...] it is an easier way for companies to raise capital. Basically, anybody knows that. That as a Blockchain start-up, it is easier to issue tokens. Raising money the risk capital to really run your business properly." **[C3.2]**
Property valuation tool	Generation	Opacity			**Low** "In the real estate market across the world a lot of times people don't know, the value of their property when they're willing to sell, right." **[C3.2]**
		Agency intensity			**Low** "We've developed tools that can give insight as to what the value of a property is at the time, based on four different metrics." **[C3.2]**

This market is highly understudied, which makes it difficult for entrepreneurs to see the opportunities and related mechanisms to start a venture. It has not been easy for the currently active entrepreneurs to enter the market and act on certain mechanisms.

Ellamediate emphasize this by pointing out that it took them over a year to study the technology and the market to find a good opportunity (C2.1). While most cases and regular PropTech companies say the same thing, we see that the level of opacity has changed due to external changes, which will be discussed in the following subsection.

Nevertheless, not only the opacity in this field is relatively high, but also the agency intensity. This is because talking about a new technology comes with high risks, as BCT is rarely used in the real estate context and has no support from the government and society. *"One thing about Blockchain is that it is not fully regulated. There are a lot of risks in this space because there are projects, and you never see a real product. So, there is still a lot of skepticism"* [C3.1].

There is also a lack of knowledge about how to apply the technology properly, which increases the risk and reduces the availability of funding (C3.2). Lack of funding was a point that was mentioned several times, including by several regular PropTech companies who mentioned that this was the reason they were not entering the PropTech 3.0 space: *"Of course, if we had more funding, we would want to get into Blockchain"* [PT5]. In a conversation with a PropTech venture capitalist, it became clear that while there is a lot of interest in investing in PropTech in general, companies that integrate Blockchain are still too risky (N10). In addition, Western venture capitalists are only now starting to look at the African market, and he himself is focusing on Nigeria but has not yet seen anything interesting (N10).

While most initiatives have high agency intensity and opacity, it is interesting to observe the case of Relsify. The case venture has two entrepreneurial initiatives, namely the RELS token and a real estate valuation tool, which according to the co-founder, has relatively low agency intensity and opacity but was only done in this one case. One explanation for the valuation tool could be that it is not Blockchain-based and, therefore could have been done by many entrepreneurs in the PropTech space but in our case, they simply did not want to do it. This underscores the importance of the entrepreneur in this context. Regarding having its own token, Relsify is the only one that has it. However, at least for their fellow PropTech 3.0 entrepreneurs, the opacity and agency intensity are low according to C3.2. This could be related to the fact that this is the entrepreneur's own

perception, and the circumvention mechanism was not apparent to his fellow entrepreneurs. Relsify is also the only case venture where both co-founders have intensive prior experience with crypto.

Influences of relational qualities

Being in an industry with relatively high agency intensity and opacity reflects a typical niche market with only a small number of active players. While the PropTech 3.0 industry is still relatively small (Baum, 2017), more and more players are emerging. This can be explained by the phenomenon observed in our case, where certain influences slowly change the relational qualities. One specific aspect is the interplay of external factors, which already runs through the entire analysis. We found that the interplay of external factors influenced the opacity and agency intensity.

The interplay between BCT, socio-cultural factors, and regulatory factors has led to more people getting educated about the technology itself and tokenization, reducing the opacity of using a tokenization business model and the associated mechanisms such as demand expansion. *"It has become the trend of conversations in the business space because of the government and the media, and everyone is doing research on Blockchain"* [C2.1]. Also, the existing housing gap, which is growing partly because of the current age distribution, leads to less opacity regarding this entrepreneurial initiative (C4.1).

Additionally, the fact that the government is now leveraging BCT solutions positively impacts the opacity of mechanisms in the PropTech 3.0 space (C2.1). In the regular PropTech ventures, it was also clear that there was a reduction in opacity as a result of the interplay between the technology, regulations, and demographics: *"We're definitely going to go more in the direction of greater acceptance. We have a CBDC, Nigerian Central Bank Digital Currency. That just shows the direction, because you see young people are more interested in things like that"* [PT4].

The reaction of different governments worldwide impacts opacity, as governments often wait and see what happens around them. *"Governments in Africa adopt the wait-and-see attitude in terms of new innovations. You wait and see what the US and the EU are gdoing. Then you see most African governments either copying or adopting these regulations"*

[N3]. This shows that the interplay is important in the Nigerian context and can be applied globally.

The interplay of external changes also affects agency intensity. Increasing social acceptance of new technologies and alternative solutions increases funding opportunities. *"Blockchain itself does not introduce risk. But the question for start-ups, especially at this point in time, is funding. It requires a different mindset, also from an investor perspective. And especially the old people don't want to understand it"* [PT3]. This statement by the German PropTech 3.0 entrepreneur underscores that the interplay of external factors influencing relational quality is a universal condition and is not anchored in the Nigerian context. In addition to society's influence on financing, regulations also have an impact. Due to the current regulations, many PropTech companies are not getting funding (C3.2).

While the interplay of external factors strongly influences the relational qualities of the mechanisms, we found in our case data that the ecosystem around the entrepreneurs and their founding teams has also contributed to the recognition of the mechanism and, ultimately, to the use of the mechanism. Talking to and understanding what other entrepreneurs do, even in different industries, is highly effective for mechanism recognition (C1.2). This is also underlined by, for example, Relsify (C3.2).

Similarly effective in reducing opacity is the entrepreneur's team. According to them, venture teams with diverse backgrounds, which all of our case ventures have, reduces the overall opacity. *"I just have basic Blockchain coding skills that I haven't built outside of Ethereum. That's why I have a team for all this, to see what else is possible"* [C4.1].

Not only was opacity influenced by the ecosystem and founding team around the digital entrepreneur, but also the agency intensity. Being in the right environment often makes it easier to access funding or additional resources, such as being part of an accelerator program. HouseAfrica shares how being part of an accelerator program gave them access to many necessary resources, such as free Google credits (C1.2). Relsify was able to raise some funding from family and from members of their community (C3.2).

It also became clear that the most expensive part of such a technology project is getting the skills to exploit the mechanisms. Therefore, having someone on the team who can help with that is very important and can reduce the agency intensity immensely. *"IT skills are very important. I mean, if you hire somebody to build these prototypes, it's going to be expensive. And, these guys are not sharing what motivates us, they are interested in this money"* [C1.2]. For this reason, entrepreneurs also play a vital role in ultimately starting a business or not.

6. Conclusion

In the following chapter, we discuss how our findings and analysis relate to our research aim and question. We elaborate on our theoretical contributions in terms of how the interplay of external factors influences entrepreneurial initiatives, and thus mechanisms and relational qualities. We then outline our practical and policy contributions. Finally, we present our limitations and suggestions for future research.

6.1 Theoretical contribution

Given our aim to deepen our understanding of the emerging PropTech 3.0 start-up phenomenon, and thus our research question of how the interplay of external factors influences entrepreneurial initiatives in the PropTech 3.0 space, our results show that the interplay strongly influences entrepreneurial initiatives, i.e., mechanisms and their relational qualities, and thereby ultimately leads to the emergence of PropTech 3.0 start-ups. How it influences entrepreneurial initiatives extends the EE framework in several ways and is discussed below.

As most researchers have examined only one external enabler leading to venture creation (Chalmers et al., 2021b; Cestino Castilla et al., 2023), Kimjeon and Davidsson (2022) pointed out that the interplay of different factors has not been sufficiently studied. Based on our phenomenon that BCT as an external enabler alone did not lead to venture creation, we were able to find out that the interplay of external enablers is highly important. The interplay runs through the entire venture creation process and greatly influences the mechanism and its relational qualities. It was found that there are second and third-order external factors. Since BCT is the primary external factor, regulatory, socio-cultural, and market environment factors are second-order factors that drive entrepreneurial activities directly in combination with BCT. Third-order factors, such as demographic factors, however, mainly influenced the second-order factors.

In addition to the seven predefined types of external factors, we have identified a significant additional type of external factor for the interplay: the market environment. The external factors captured by Davidsson et al. (2020) did not include any changes in the specific market in which entrepreneurs create new ventures. Market environmental

factors, such as the housing gap, are highly evident in our data, highlighting their importance in terms of venture creation. Market factors have previously been identified in venture creation processes, but more as mechanisms that facilitate the process (Schade & Schuhmacher, 2022). In addition, it has been mentioned that market knowledge contributes significantly to an entrepreneur's subsequent recognition of entrepreneurial opportunities (Bennett, 2019; Siegel & Renko, 2012).

Looking at the interplay of external enablers, their impact on entrepreneurial initiatives became more apparent. Davidsson et al.'s (2020) EE framework focused exclusively on external enablers, with positive - not negative - influences of external changes on entrepreneurs and their ventures. While Bennett (2019) also identified external factors as opportunity disablers in his External Enabler/Disabler model, Cestino Castilla et al. (2023) were the first researchers to examine the negative influences of external changes on organizations. However, the negative influences were only examined by focusing on existing organizations. In our study, looking at start-ups, we identified external detrimental factors (negative influence) on ongoing activities but also on new venture ideas. External detrimental factors, i.e. external factors that interrupt the new business idea of a start-up and make it impossible to continue with this business idea or activity, thus hindering the start-up, can also lead to the emergence of other entrepreneurial initiatives within the venture creation process.

Regarding mechanisms, our study also extends the existing research of Davidsson et al. (2020) EE framework. While most of the mechanisms mentioned in the framework were also identified in our research, the interplay of BCT and regulatory factors led to a new mechanism that clearly distinguishes PropTech 3.0 ventures from regular PropTech ventures. The new mechanism was designated as the circumvention mechanism. Besides it's high importance, especially in developing countries with no secure regulatory system, it can also be important concerning new technologies that disrupt an existing market and lead to an entirely new sector, where structures and regulations are also often not in place.

The circumvention mechanism belongs to the entrepreneurial initiatives that are pursued to circumvent a specific external factor. As a result of an external factor, actions are taken accordingly. While the absence of regulations triggers several mechanisms, it also

triggers the mechanism of building a structure independently, thus not waiting for regulations and circumventing the fact that the government does not set the structure.

In addition, the mechanism is interesting because it can be an EE mechanism and an ED mechanism. While specific ED mechanisms of delegitimation, (resource) contradiction, demand (contradiction), and uncertainty (increase) were identified by Cestino Castilla et al. (2023), the circumvention mechanism has both effects and was the only mechanism seen in our case data to respond to external detrimental factors.

Another important contribution is the influence on relational qualities of Davidsson et al.'s (2020) EE framework. First, the interplay of external factors strongly influences relational qualities, leading to lower or higher qualities depending on the interplay. For example, BCT combined with increased social acceptance of the technology lowered the opacity of tokenization and thus the mechanism demand expansion. In addition, the role of the entrepreneur became critical, showing that the entrepreneur's ecosystem and founding team also influenced relational qualities. For example, participation in an accelerator program provides great access to resources, thus reducing agency intensity.

6.2 Practical and policy implications

Our findings also have implications for practitioners and policymakers. From a practitioner's perspective, we hope that our study can serve as a toolbox for digital entrepreneurs entering the PropTech 3.0 space in Nigeria. One of our findings that supports a PropTech 3.0 venture creation process is the formation of diverse founding teams. These companies are part of the real estate sector, and thereby employees with deep expertise are needed to compete with others in the industry. Equally important, and especially for the early stages of these companies, is the presence of technological knowledge within the company. A team member with technical expertise would give the company a competitive advantage, as competitors have to ‘purchase’ these skills from someone outside the company in times of limited and hard-to-access financial resources.

In addition to the team, the founder himself or herself plays an important role. In Nigeria, many people are solution-oriented and willing to go the extra mile to create better living conditions. A valuable insight from this research is that one should dare to try, even when

external factors such as regulations, the economy, or natural disasters would not allow it in the first place, and thus use the circumvention mechanism. Resilience and creativity are qualities that will pave the way to success and inspire others to follow, leading to a collective transformation of Nigeria in the years to come.

From a policymaker's perspective, there are two ways that government regulations can encourage BCT adaptation, by focusing on either quantity or quality (Block et al., 2018). Quantity-based strategies aim to increase the number of BCT-supported companies using or integrating this new technology into their business model. Policies that focus on quality encourage the creation of a regulatory framework that incentivizes innovation. One outcome of this policy could be the creation of an institution, a BCT ecosystem, that improves the circulation of knowledge and resources among members, reduces transaction costs, and increases awareness, leading to greater acceptance for BCT solutions.

Our research found that ecosystems can reduce mechanism’s opacity and agency intensity. Therefore, we suggest that our research could help local policymakers better understand the potential positive outcomes associated with implementing an ecosystem. This initiative will help boost Nigerian real estate entrepreneurship by removing bottlenecks such as lack of knowledge and resources, facilitating access to the market, and consequently spawning new PropTech 3.0 companies.

6.3 Limitations and future research

There are also limitations to our research that can be subjects of future studies. First, we examined PropTech 3.0 in the context of Nigeria, a developing African country. In order to confirm the generalizability of our findings, we call for future research on BCT-supported emerging ventures in other countries or industries that would help to further our understanding of how the use of BCT technology leads to venture creation. It is also essential for generalizing the importance of the interplay of external enablers and their influence on entrepreneurial initiatives. Second, in this study, we have limited our sample to include only start-ups. However, we recognize that there are established organizations that use BCT. Therefore, it would have been interesting to see how these companies,

which have more experience in the real estate market and more resources, would have been influenced by the interplay of external enablers.

Third, our study was also subject to survivor bias. Although we did not initially plan to exclude from our sample PropTech 3.0 companies whose business model was based on BCT and which had to cease operations, we ultimately did not include any of them in our data collection. Nevertheless, we acknowledge that such cases do exist, especially in a new field that is fraught with much uncertainty and risk, and that their (non-)existence could influence the general perception of other companies entering the Blockchain market.

Fourth, both authors are from European countries and have no previous experience with the Nigerian context. Our results could therefore be considered partially biased, as there is a limit to how much information someone can understand about the specific context of a foreign country with no prior experience within the respected culture. To consider the subjectivity of the results, in line with our post-positivistic epistemology, we tried to include a wide range of experts in our sample who either live in Nigeria or have worked with companies from the country for years. However, we might have reached different conclusions if we had had experience in the country ourselves.

Considering the interplay of external factors as an important dimension in the EE framework opens up many new avenues of research. One research opportunity is to look at a different primary external enabler and how it interacts with additional external factors. Furthermore, BCT is new and transformative; therefore, given the fast pace, there is always a risk that our results could quickly become outdated. As more data becomes available, seeing if our results are still relevant would be interesting. Moreover, with the new innovations in the field, PropTech 3.0 ventures with a different business model than tokenization and digital land registry will emerge, making the comparison between them interesting. Lastly, further research could explore how the interplay affects the role of the entrepreneur more explicitly, considering not only the team and the ecosystem, but also the entrepreneur's motivation.

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YT 9. (2021). *House Africa & NMRC Partnership*. Www.youtube.com. Retrieved April 15, 2023, from: https://www.youtube.com/watch?v=ui5v9whqbkE

Appendix

Appendix 1: Detailed explanation of Blockchain

Types of Blockchain

DLTs and Blockchain can be classified into different categories based on the type of ledger and the involvement of validators, called nodes (Ramadoss, 2022). Based on this data management, the three main types of Blockchain are public/permissionless Blockchain, private/permissioned Blockchain, and hybrid Blockchain, which are variously named in the literature, but most commonly referred to as stated above (Johar et al., 2021).

In a public Blockchain, anyone can join the network, participate in the consensus process, send and read transactions, and perpetuate the shared ledger (Xie et al., 2019). It has no restrictions on anonymous participation and is thus permissionless (Johar et al., 2021). In general, public Blockchains are valuable for applications that demand transparency of transactions (Ramadoss, 2022), for instance, cryptocurrencies such as Bitcoin (Volodymr & Gilles, 2020).

In comparison, private Blockchains are permissioned and limit the number of participants (Johar et al., 2021). The ledger is, therefore, only visible to members, and nodes are a closed group chosen by a governing body (Ramadoss, 2022). Private Blockchains are split into wholly private and consortium networks. Actors can choose between these based on need and cost (Johar et al., 2021). Consortium Blockchains are usually chosen to share costs and data as they record cross-organizational business transactions (Xie et al., 2019). Government and business applications are typically built on private Blockchains such as Hyperledger, as protecting the privacy of users, transactions, and data is crucial (Ramadoss, 2022).

Some networks lie between the transparency and security of public Blockchains and the privacy of private Blockchains (Volodymyr & Gilles, 2020). This flexibility gives the actor different options of what to make public and what to keep private (Johar et al., 2021). For example, the ledger may be visible to the public, while nodes are picked by a

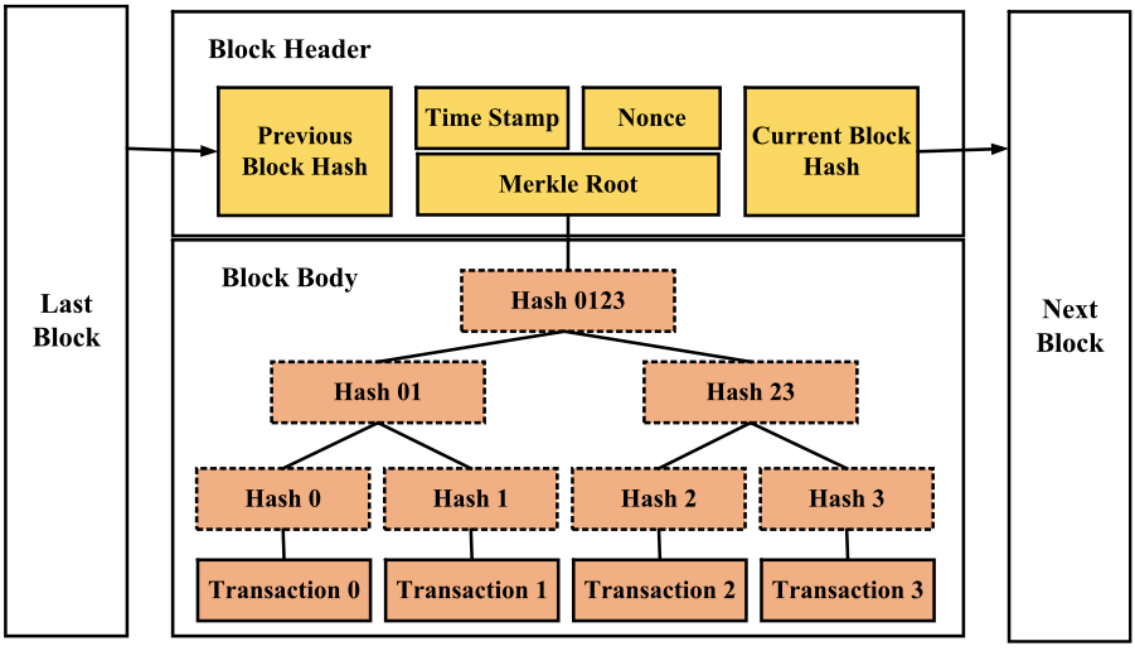
consensus algorithm or governing body (Ramadoss, 2022). An example of a hybrid network is Dragonchain (Johar et al., 2021).

Architecture of Blockchain

A core Blockchain architecture consists of six layers: the data layer, the network layer, the consensus layer, the incentive layer, the contract layer, and the application layer (Xie et al., 2019). Starting from the bottom, the data layer is used to create the Blockchain system in the distributed and shared databases (Agarwal et al., 2022). Each block contains detailed information about different transactions and is chained to the previous block, creating a chain (Xie et al., 2019).

The typical structure of a block is shown in **Figure 5**. The block is divided into two parts, the block header, and the block body. While the block header stores the metadata, the hash of the previous, and current block, the timestamp, the nonce, and the Merkel root, the block body stores all verified transactions (Xie et al., 2019). The Merkel root represents the root of a Merkel tree that adopts a binary hash tree to record all transactions occurring within a certain time period (Xie et al., 2019). Thus, the existence and integrity of these transactions can be confirmed efficiently, quickly, and securely.

Figure 5 A typical block structure



Source: Adapted from Xie et al. (2019, p. 2798)

The network layer consists of a communication mechanism, a distributed network mechanism, and a data verification mechanism (Xie et al., 2019). The main purpose of this layer is to forward, distribute, and verify Blockchain transactions (Xie et al., 2019). Since Blockchain is a peer-to-peer network, when a transaction is generated, it is transmitted to all surrounding neighboring nodes (Xie et al., 2019). Each node must verify the transaction against predefined specifications (Xie et al., 2019). If the transaction is verified, it is transmitted to other nodes; if not, it is discarded. This way, only the verified transactions are recorded in each node of the Blockchain (Xie et al., 2019).

The consensus layer consists of several consensus mechanisms that address how to achieve efficient consensus among untrusted nodes in decentralized networks (Xie et al., 2019). These mechanisms are procedures and rules for reaching agreement on adding new blocks or transactions to the ledger (Ramadoss, 2022). Since one consequence of decentralization is that versions of the database may temporarily differ, these consensus mechanisms are needed to ensure that the different versions converge (Volodymyr & Gilles, 2020). However, depending on the type of Blockchain, different methods are used to achieve this (Volodymyr & Gilles, 2020).

While there are many different consensus mechanisms, the most important and most commonly cited in the literature are Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), and Practical Byzantine Fault Tolerance (PBFT) (Agarwal et al., 2022; Ramadoss, 2022; Volodymyr & Gilles, 2020; Xie et al., 2019). PoW is used in Bitcoin, and nodes in this algorithm repeatedly perform hashing functions to create nonce values, which are ultimately difficult to generate but fairly easy to validate for other nodes (Xie et al., 2019). In contrast to PoW, PoS is a low-energy algorithm that allows the node with the largest stake, for example, currency, to generate blocks (Xie et al., 2019). PBFT is a replication algorithm that tolerates Byzantine errors, and DPoS is much like PoS (Xie et al., 2019). However, a group of elected delegates validates blocks in the name of all nodes in the Blockchain network (Ramadoss, 2022).

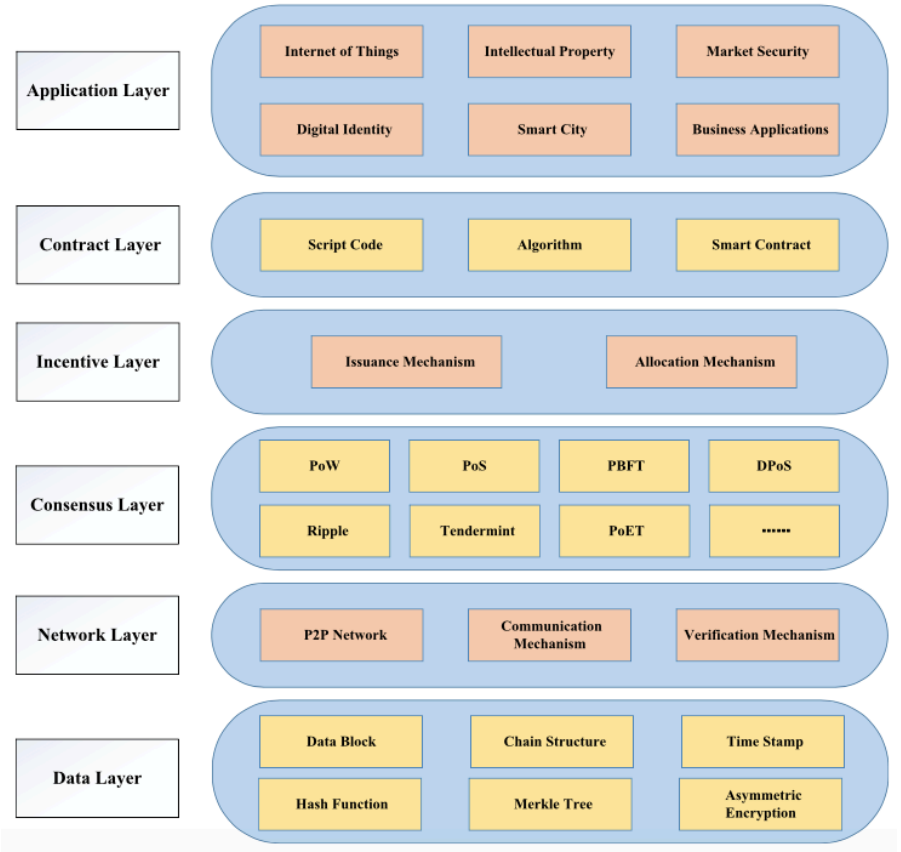
The key driving force of the Blockchain network is the incentive layer, which integrates economic factors such as allocation mechanisms and the issuance of economic incentives into the network to motivate nodes to verify the data (Xie et al., 2019). Especially, when

a block is generated, economic incentives such as cryptocurrencies are issued as rewards to the respected nodes based on their contributions (Xie et al., 2019). The next layer, the contract layer, then brings programmability to the Blockchain (Xie et al., 2019). To enable more sophisticated programmable transactions, algorithms, scripts, and smart contracts are used.

Smart contracts, in particular, have enabled many different programmable transactions. These are computer protocols to verify, facilitate, and enforce the execution and negotiation of a contract (Agrawal et al., 2022; Volodymyr & Gilles, 2020). Unlike regular contracts, smart contracts do not use paperwork but are backed by BCT (Sharma, 2022). To ensure that contracts are executed only when predefined conditions are met, smart contracts are created using a condition-based approach (Sharma, 2022). Technology is used to ensure compliance with predefined terms, while verification is achieved by retrieving data from external sources (Sharma, 2022). The use of smart contracts leads to faster and cheaper transactions and can be performed anonymously if desired (Sharma, 2022). These contracts are still quite simple and not yet legally binding in some countries (Volodymyr & Gilles, 2020).

The top layer is the application layer, which includes business applications such as market security, Internet of Things, intellectual property, smart cities, and more (Xie et al., 2019). BCT can be applied to various areas of our daily lives. The general Blockchain architecture can be seen in **Figure 6**.

Figure 6 General Blockchain architecture

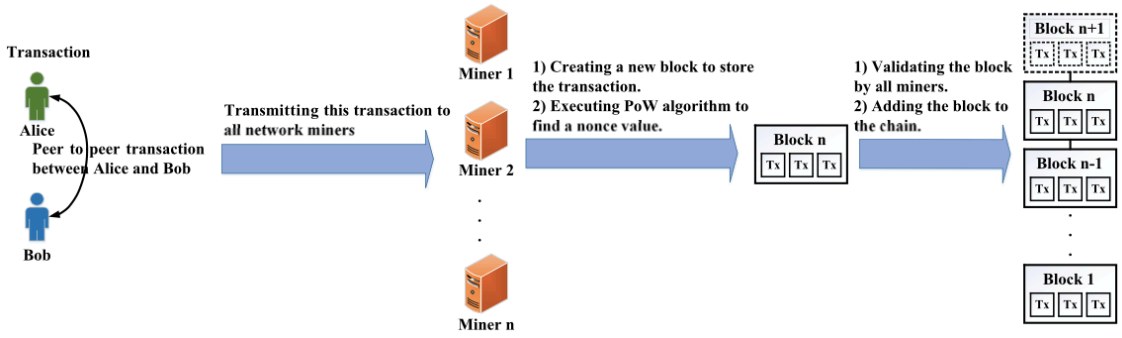


Source: Adapted from Xie et al. (2019, p. 2798)

Working Flow of Blockchain

To better understand the process behind Blockchain, **Figure 7** illustrates it using the example of Alice and Bob. After a successful transaction, the information is added to the Blockchain through a certain consensus mechanism, in this example PoW (Johar et al., 2021). In this system, there are nodes and so-called miners, which can be individuals or organizations that confirm transactions. A miner is a specialized node that validates groups of transactions and receives incentives, such as money, in return (Johar et al., 2021). While nodes validate transactions, miners compete to be the first to find a nonce value. Once found by a miner, the miner attaches a timestamp to the block and sends the timestamped block to the network (Xie et al., 2019). When successfully validated across all miners in the network, that block is added to the chain (Johar et al., 2021). Since the ledger operates on a peer-to-peer network, all participating nodes receive a copy of the initial transactions (Johar et al., 2021).

Figure 7 Blockchain process in a PoW network



Source: Adapted from Xie et al. (2019, p. 2800)

Appendix 2: Detailed explanation of the technology behind PropTech 3.0

So far, there is no universal format for BCT registries (Graglia & Mellon, 2018). For this reason, researchers present many different BCT registry frameworks and the use of Blockchain types (Benette et al., 2019; Saari et al., 2022). Nonetheless, the private or hybrid blockchain type has been the most commonly cited in previous research (Saari et al., 2022). The reasons for using these types over a public Blockchain are primarily because the registrar must be able to customize the ledger (Graglia & Mellon, 2018). This is especially necessary when fraudulent data has been entered, or the digital key has been lost and not communicated prior to death. Public Blockchain information cannot be accessed without the key or edited (Graglia & Mellon, 2018).

Moreover, public Blockchains cannot cope with the amount of data. The registers contain titles, plans, deeds, and maps, which must be stored in a decentralized database. Furthermore, anonymity does not work for real estate registries. It needs to be known who is transferring ownership data or registering. Public Blockchain allows anyone with the right keys to transmit valid transactions, regardless of who they are. In contrast, in a private Blockchain, only agents that have their identity confirmed to the authorities' satisfaction can conduct transactions (Graglia & Mellon, 2018).

Bennett et al. (2021), along with other researchers describe the current Blockchain application in real estate registry using the concept of a hybrid approach, which refers to the combined use of traditional database technologies with integrated BCT (Saari et al.,

2022). Here, a private Blockchain is used to record the information for more security, cost reduction, selective privacy, and efficiency. At the same time the record function itself is still carried out on a public Blockchain. However, the implication is not that all information is private. Selective information about transactions can be shown visibly to a large network, reducing the chances of undesirable behavior, such as fraud. The network can get authorization to propose changes or updates, resulting in a more curated dataset. This scheme can also offer incentives to reward helpful contributions (Graglia & Mellon, 2018).

Smart contracts, Blockchain-based protocols to verify, facilitate, and enforce the execution and negotiation of a contract (Agrawal et al., 2022; Volodymyr & Gilles, 2020), are used for the selling procedure. Instead of sellers, buyers, and banks depositing down payments, deeds, and mortgage payments under professional escrow, they are handled through smart contracts (Graglia & Mellon, 2018). This allows the process to occur online and without intermediaries such as notaries. However, many countries lack laws and interoperability to recognize digital signatures (Kshetri, 2021).

While the lack of technology adaptation also improves the opportunity area for digital entrepreneurs (Baum, 2017), the sector simultaneously represents one of the biggest obstacles for entrepreneurs (Kshetri, 2021). The challenges BCT is trying to overcome in the real estate sector, such as the lack of property rights and documents to prove land ownership, limit access to capital (Kshetri, 2021). Clear property rights allow entrepreneurs to use these assets as collateral, which increases entrepreneurs' ability to obtain loans formally (Kshetri, 2017). However, building a PropTech 3.0 venture involves not only high capital requirements but also other challenges, such as the lack of expertise in Blockchain development, the need to collaborate with the government, political rivalry, and lack of trust from landowners (Thakur et al., 2020).

Appendix 3: Extended BCT literature review table

Article Title	Author(s)	Year	Type of study	Journal	ABS list	Blockchain definition	BCT Real Estate	BCT Application/ challenges	Enablers
The truth about Blockchain	Iansiti & Lakhani	2017	Conceptual	Havard Business Review	3	■			
Will blockchain emerge as a tool to break the poverty chain in the Global South?	Kshetri	2017	Literature Review	Third World Quarterly	2		■	■	■
PropTech 3.0: the future of real estate	Baum	2017	Book	Oxford	-		■		
Blockchain and Property in 2018: At the End of the Beginning	Graglia & Mellon	2018	Conceptual	MIT Press Direct OA Journals	3		■	■	
A Survey of Blockchain Technology Applied to Smart Cities: Research Issues and Challenges	Xie et al.	2019	Literature Review	IEEE Communication surveys and tutorials	3	■	■		■
Blockchain in Industries: A Survey	Jameela & Nader	2019	Literature Review	IEEE Access	3			■	■
Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda	Hughes et al.	2019	Literature Review	International Journal of information Management	2	■		■	■
Transformations, transitions, or tall tales? A global review of the uptake and impact of NoSQL, Blockchain, and big data analytics on the land administration sector	Bennett et al.	2019	Literature Review	Land Use policy	-		■	■	
Bitcoin, Blockchain and Fintech: a systematic review and case studies in the supply chain	Wamba et al.	2019	Literature Review	Production Planning & Control	3	■			
LandLedger: Blockchain-powered Land Property Administration System	Gupta et al.	2019	Conceptual	IEEE	3		■		
The PropTech Revolution: The Imperatives for Nigeria's Estate Surveying and Valuation Professionals to Catch Up or Get Left Behind	Aihie	2020	Literature Review	Journal of African real estate research	-		■		
Demystifying blockchain: A critical analysis of challenges, applications and opportunities	Upadhyay	2020	Literature Review	International Journal of information Management	2			■	
Distributed Ledgers and operations: What operations management researchers should know about Blockchain technology	Volodymyr & Gilles	2020	Qualitative Study	Manufacturing & service operations management	3	■			
How the Pandemic Is Pushing Blockchain Forward	Van Hoek & Lacity	2020	-	Havard Business Review	3				■
The impact of proptech on real estate industry growth	Siniak et al.	2020	Qualitative Study	IOP Conference Series: Materials Science and Engineering	-		■		
The rise of PropTech: emerging industrial technologies and their impact on real estate	Starr et al.	2020	Literature Review	Journal of Property Investment & Finance	-		■		■

Research and Applied Perspective to Blockchain Technology: A Comprehensive Survey	Johar et al.	2021	Literature Review	Applied Sciences-Basel	-				
Query Optimization in a Blockchain-Based Land Registry Management System	Yadav & Kushwaha	2021	Quantitative Study	Ingénierie des systèmes d'information	-				
A Blockchain Solution for Securing Real Property Transactions: A Case Study for Serbia	Sladić et al.	2021	Conceptual	ISPRS International Journal of Geo-Information	-				
Blockchain as a tool to facilitate property rights protection in the Global South: lessons from India's Andhra Pradesh state	Kshetri	2021	Literature Review	Third World Quarterly	3				
Blockchain Technology in maritime supply chains: applications, architecture and challenges	Liu et al.	2021	Literature Review	International Journal of Production Research	-				
A novel Blockchain-based integrity and reliable veterinary clinic information management system using predictive analytics for provisioning of quality health services	Iqbal et al.	2021	Quantitative Study	IEEE Access	3				
Hybrid approaches for smart contracts in land administration: lessons from three Blockchain proofs-of-concept	Bennett et al.	2021	Qualitative Study	Land Use policy	-				
Categorizing and relating implementation challenges for realizing blockchain applications in government	Luthra et al.	2022	Qualitative Study	Information Technology & People	3				
Land records on Blockchain for implementation of Land Titling in India	Thakur et al.	2020	Literature Review	International Journal of information Management	2				
An Extensive Blockchain Based Applications Survey: Tools, Frameworks, Opportunities, Challenges and Solutions	Agrawal et al.	2022	Literature Review	IEEE Access	3				
Blockchain in real estate: Recent developments and empirical applications	Saari et al.	2022	Literature Review	Land Use policy	-				
Improving implementation of the Blockchain technology in real estate registration	Podshivalov	2022	Literature Review	Journal of High Technology Management Research	2				
The New Digital Era: Emerging Risks and Opportunities	Sharma	2022	Book	The New Digital Era: Digitalisation, Emerging Risks and Opportunities	-				
Blockchain Technology: An overview	Ramadoss	2022	Literature Review	IEEE potentials	3				
An Ultra-Scalable Blockchain Platform for Universal Asset Tokenization: Design and Implementation	Buldas et al.	2022	Quantitative Study	IEEE	3				
The Essential Factors of Web 3.0 Affecting 7 Layers of Decentralized Web in Business or Industry	Vernando et al.	2022	Literature Review	IEEE	3				
Web3 Challenges and opportunities for the market	Sheridan et al.	2022	Literature Review	Computers in Industry	-				

Appendix 4: Extended EE literature review table

Article Title	Author(s)	Year	Type of study	Journal	ABS list	Technology	Infrastructure	Socio-cultural	Regulatory	Natural/ Environmental	All EE
The promise of entrepreneurship as a field of research	Shane & Venkataraman	2000	Conceptual	Academy of Mangement Review	4*						
Entrepreneurial opportunities and the entrepreneurship nexus: A re-conceptualization	Davidsson	2015	Conceptual	Journal of Business Venturing	4						■
Entry and technological performance in new technology domains: Technological opportunities, technology competition and technological relatedness	Leten et al.	2016	Quantitative Study	Journal of Management Studies	4	■	■				
Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship	Nambisan	2017	Conceptual	Entrepreneurship Theory and Practice	4	■					
Digital Technologies as External Enablers of New Venture Creation in the IT Hardware Sector	von Briel et al.	2018	Conceptual	Entrepreneurship Theory and Practice	4	■					
Infrastructure Investments and entrepreneurial dynamism in the U.S	Bennett	2019	Quantitative Study	Journal of Business Venturing	4		■				
The emergence of the maker movement: Implications for entrepreneurship research	Browder et al.	2019	Conceptual	Journal of Business Venturing	4	■		■			
Entrepreneurial cognition and the quality of new ventures: An experimental approach to comparing future-oriented cognitive processes	Frederiks et al.	2019	Quantitative Study	Journal of Business Venturing	4			■			
Digital girl: Cyberfeminism and the emancipatory potential of digital entrepreneurship in emerging economies	McAdam et al.	2020	Qualitative Study	Small Business Economics	3	■		■			
Artificial Intelligence and big data in entrepreneurship: A new era has begun	Obschonka & Audretsch	2020	Literature Review	Small Business Economics	3	■					
External Enablement of new venture creation: An exploratory, query-driven assessment of China's high-speed rail expansion	Chen et al.	2020	Quantitative Study	Journal of Business Venturing	4		■				
External enablement of new venture creation: A framework	Davidsson et al.	2020	Conceptual	Academy of Management Perspectives	3						■
Blockchain as an external enabler of new venture ideas: Digital entrepreneurs and the disintermediation of the global music industry	Chalmers et al.	2021	Qualitative Study	Journal of Business Research	3	■					
Local economic freedom and creative destruction in America	Bennett	2021	Quantitative Study	Small Business Economics	3				■		
Artificial Intelligence and entrepreneurship: Implications for venture creation in the fourth industrial revolution	Chalmers et al.	2021	Conceptual	Entrepreneurship Theory and Practice	4	■					
COVID-19 as External Enabler of entrepreneurship practice and research.	Davidsson et al.	2021	Conceptual	BRQ Business Research Quarterly	-					■	
Ditching Discovery Creation for Unified Venture Creation Research	Davidsson	2021	Literature Review	Entrepreneurship Theory and Practice	4						
External Enablers of Entrepreneurship: A Review and Agenda for Accumulation of Strategically Actionable Knowledge	Kimjeon & Davidsson	2022	Literature Review	Entrepreneurship theory and practice	4						■
Digital infrastructure and entrepreneurial action-formation: A multilevel study	Schade & Schuhmacher	2022	Quantitative Study	Journal of Business Venturing	4	■		■			
External Enabler in existing organizations: Emergence, novelty and persistence of entrepreneurial initiatives	Cestino Castilla et al.	2023	Qualitative Study	Strategic Entrepreneurship Journal	4					■	

Appendix 5: Interview guide

PropTech ventures in Nigeria with and without BCT

Part 1 – General information about the entrepreneur and venture

Information about the company

- Can you please give us more information about the company?
    - When was the company founded?
    - What exactly does the company do?
    - How exactly is Blockchain integrated into your business model?
- If no BCT is used
    - How are you integrating technology into your business model?
    - Why not Blockchain?

Information about the entrepreneur

- Tell us about yourself?
- What is your background? (experience in Real Estate, Blockchain, entrepreneurship?)
- What did you do before you started the company?
- How did you get involved in PropTech 3.0, and how were you involved in the founding of the company?

Entrepreneur in PropTech 3.0

- What is your role in the start-up?
- Why were you interested in starting a PropTech 3.0 start-up?
- Why did you choose to do so in Nigeria?
- Can you please tell us more about the real estate industry in Nigeria? And more specifically, Real Estate and Blockchain.
    - What about the land registry in Nigeria?
- Would you advise people to connect BCT and Real Estate?

Part 2 – Information on the role of the entrepreneur in the venture creation process

Relational qualities – Individually

- What resources did you use when starting the venture?
- What skills and knowledge do you think were necessary for starting the venture?
- Where do you learn about Blockchain/ entrepreneurship/ real estate? (offline/ online)
    - Technology and Blockchain are constantly changing. How do you stay up to date?
    - How do you put what you learn into practice?
- How did you decide to take the risk of starting a Blockchain-based business, considering that the technology is new, still in its early stages, and not yet successfully adapted by many companies?
- Can you think of something else that helped you start the business?

Relational qualities – Founding team

- What about your co-founder? Did he/she have qualities that complemented yours and were necessary to start the company?

Relational qualities – Ecosystem

- - Are there other PropTech 3.0 entrepreneurs besides your team with whom you share thoughts and ideas?
- Who do you turn to outside the venture when facing a problem? What industry do they belong to/ background do they have?
- Are you mostly talking to regional experts and like-minded or global?
    - Through what channel is the communication going?
- How helpful would you say is such an exchange with like-minded/ different experts?

Part 3 – Information about venture creation

External enablers for venture creation

- When did you first have the idea of starting a PropTech 3.0 company?
    - What prevented you from acting at that time?
- Can you think of any other external factors/ changes that led you to start the business?
- Do you think each factor, individually or in combination, influenced you to start a PropTech 3.0 venture?
- In your opinion, which external factor had the most significant influence on creating your PropTech 3.0 venture?

Mechanisms

- What exactly did you do as a result of those external changes to build your current business model?
- Were there different responses/ strategies to different external changes?

Part 4 – Closing questions

Closing question

- Do you think there is anything you would have done differently when starting your company? If so, what and why?
- Given our goal of creating a comfortable and respectful environment for our participants, did you experience any feelings of discomfort or distress in any way over the course of this interview?
- Do you have any documents that you could share with us to better understand your business?
- Can we talk to someone else from your company?
- Do you know anyone else that could be useful for our research? PropTech with or without Blockchain? Experts in Real Estate/ Blockchain/ Nigeria?

- Closing the interview and given our goal of creating a comfortable and respectful environment for our participants, did you experience any feelings of discomfort or distress in any way over the course of this interview?

Expert interview guides

Economist in Nigeria

- What are the main economic challenges currently facing Nigeria?
    - What other external factors are affecting the current economic situation in Nigeria?
    - Did Covid-19 have a significant impact on the Nigerian economy?
    - What is the impact of the recent elections on the Nigerian economy?
- What is the situation in the real estate market in Nigeria?
    - Who is currently investing in real estate?
    - Can you tell us more about the land registry situation in Nigeria?
- What is the cryptocurrency situation in Nigeria?
- What is the technological situation in Nigeria?
    - How many people have access to smartphones and the Internet in general?
    - Do you think technology can solve the current problems in Nigeria?
    - What is the government's stance on technology?
    - Have you thought or heard about what Blockchain can do in Nigeria?
    - Have you thought about or heard about what Blockchain can do in real estate? What are your thoughts on it?
- What is the ecosystem like for start-ups in Nigeria?
    - Is it supported by the government?
- What is Nigeria's economic outlook for the next decade?
- Closing the interview and given our goal of creating a comfortable and respectful environment for our participants, did you experience any feelings of discomfort or distress in any way over the course of this interview?

Real Estate experts

- Tell us about yourself. (Background/ past and current work experience).
- What is the real estate industry like in Nigeria in general?
    - Who is currently buying and where?
    - How is Nigeria dealing with rising real estate prices?
- Can you tell us more about the land registration situation in Nigeria?
    - Do you think technology could help?
- What kind of technologies are used in the real estate industry in Nigeria?
- What is the funding situation in the Nigerian PropTech sector?

- Have you thought about or heard about what Blockchain can do in the real estate industry?
    - What are your thoughts on it?
- What are the regulations regarding real estate and Blockchain?
- What type of entrepreneur and knowledge is required to use technology, specifically BCT in real estate?
- Where are you learning about blockchain/entrepreneurship/real estate? (offline/ online)
- What does the ecosystem around Real Estate and PropTech look like?
- If you could, what problem in real estate would you solve first?
- Closing the interview and given our goal of creating a comfortable and respectful environment for our participants, did you experience any feelings of discomfort or distress in any way over the course of this interview?

Blockchain expert

- Tell us about yourself. (Background/ Past and current work experience)
- How do you see Blockchain technology benefiting start-ups in Africa, and what are some current examples of successful Blockchain-based start-ups in the region? (Fintech/ PropTech/ EduTech etc.)
- Why have those adaptations just now become popular? What has changed?
    - Do you think any external factors have influenced how people view this technology today?
- What potential challenges may start-ups in Africa face when implementing Blockchain technology?
- How can Blockchain technology address land registration issues in Nigeria?
    - Is BCT the actual solution to solve this issue in the future?
- In your opinion, what are some key regulatory considerations that start-ups in Africa should be aware of when working with Blockchain technology?
    - Do you think that is a good approach for people working around the regulations?
- Do people know and/or trust Blockchain?
    - Given the young population of Africa, do you think that there is more interest and more opportunities related to technology
- Is there a strong blockchain community in Africa?
- What advice would you give to entrepreneurs and start-ups in Africa who are interested in leveraging Blockchain technology for their businesses?
    - What skills, knowledge, background resources, and character traits do you think entrepreneurs need to adapt the technology successfully?
    - Do you think that people interested in BCT have something specific when it comes to individual characteristics?
- Do you think it is the right timing for companies to integrate BCT or is it still too early to discuss BCT? How do you see this technology in ten years?

- Closing the interview and given our goal of creating a comfortable and respectful environment for our participants, did you experience any feelings of discomfort or distress in any way over the course of this interview?

Appendix 6: GDPR Thesis Study Consent Form

JÖNKÖPING UNIVERSITY
Jönköping International Business School

GDPR Thesis Study Consent Form

Required by European Union General Data Protection Regulation 2016/679

GDPR Consent for [thesis title]

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I consent to JIBS processing my personal data in accordance with current data protection legislation and the data delivered.	☐	☐
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
I consent to audio recordings being made during the interviews using a voice recording program or to audio and video recordings being made during the interview using Microsoft Teams or Zoom. What is said will be immediately transcribed and anonymized to ensure that no identification of the individual can be made.	☐	☐

My signature below indicates that I choose to take part in the thesis study and consent to JIBS treating my personal data in accordance with current data protection legislation and the data delivered.

_____ _____ _____

Name of participant [IN CAPITALS] Signature Date

Thesis contact details for further information

Verna, Melina; +4915787894163; veme21os@student.ju.se

Dragonas, Dionysios; +306983302304; drdi21cv@student.ju.se

Version: January 2020

JÖNKÖPING UNIVERSITY
Jönköping International
Business School

Participant Information Sheet template

Invitation paragraph

You are being invited to take part in a thesis study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully.

What is the purpose of the study collecting personal data?
The research study, which is being conducted as part of the master's program in Strategic Entrepreneurship, will examine the phenomenon of the emergence of Proptech 3.0 ventures and the corresponding role of digital entrepreneurs. For this purpose, semi-structured interviews of approximately 60 minutes duration will be conducted via. Microsoft Teams or Zoom. The research study thus contributes to student learning.

It is entirely up to you to decide whether or not to take part. If you decide to do so, you will be given this information sheet to keep and will be asked to give your consent.' *All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications.*

Under GDPR you have the following rights over your personal data:

- ***The right to be informed**. You must be informed if your personal data is being used.*
- ***The right of access**. You can ask for a copy of your data by making a 'subject access request'.*
- ***The right to rectification.** You can ask for your data held to be corrected.*
- ***The right to erasure**. You can ask for your data to be deleted.*
- ***The right to restrict processing**. You can limit the way an organisation uses your personal data if you are concerned about the accuracy of the data or how it is being used.*
- ***The right to data portability**. You have the right to get your personal data from an organisation in a way that is accessible and machine-readable. You also have the right to ask an organisation to transfer your data to another organisation.*
- ***The right to object**. You have the right to object to the use of your personal data in some circumstances. You have an absolute right to object to an organisation using your data for direct marketing.*
- ***How your data is processed using automated decision making and profiling**. You have the right not to be subject to a decision that is based solely on automated processing if the decision affects your legal rights or other equally important matters; to understand the reasons behind decisions made about you by automated processing and the possible consequences of the decisions, and to object to profiling in certain situations, including for direct marketing purposes.*

***You should also know that you may contact the data protection officer if you are unhappy about the way your data or your participation in this study are being treated at** dpo@ju.se*

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Thank you for reading this information sheet and for considering whether to take part in this research study.'

Contact details for further information

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