

THESIS

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**THE EMERGENCE OF THE HUNGARIAN BLOCKCHAIN
ECOSYSTEM: DEVELOPMENT TRAJECTORY, SUCCESS
FACTORS AND INNOVATIVE SOLUTIONS.**

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EXECUTIVE SUMMARY

As with every disruptive technology, the technology of blockchain comes with several advantages and challenges while helping different industries and even entire countries improve their economy through initializing the fourth industrial revolution. The technology of blockchain proved its ability to improve currently used systems and solve many of their issues through reduction of unneeded steps, productivity improvement and security improvement. No real disadvantages but rather some challenges were encountered upon the implementation of this technology as it is still relatively new and its various applications are not yet thoroughly tested where financial and technical challenges are faced upon scaling businesses that are based on this technology in addition to other technical challenges including privacy leakage and selfish mining. Concerning the ecosystem of this technology and its maturity, different countries were proven to have reached varying degrees of maturity from the perspectives of both, business and regulation.

Since the global enterprise blockchain ecosystem is growing rapidly all around the world including the European region, this research aims to explore the Hungarian blockchain-related start-ups, competitive advantages, practical implementation while identifying the development stages that the Hungarian blockchain ecosystem has reached through assessing a sample of successful start-up companies from different industries within Hungary where the problems that were solved and/or the services that were provided through this technology are identified and related competitive advantages are highlighted.

This research adopted a qualitative, explorative research design which utilized a constructed semi-structured interview for data collections as it helps in acquiring in-depth information regarding the technology of blockchain in the business fields. The targeted population of this research was startup companies that have successfully implemented the blockchain technology and their management team members in Hungary where a sample of six companies covering different industries was selected and

interviews were held with the managing directors and CEOs of the selected companies, noting that this research also depended on secondary data sources such as archives, websites, reports, news sources, and white papers. The sampling techniques that were utilized within this research were purposeful sampling to choose successful companies in the field of blockchain technology in Hungary and stratified sampling to target management team members within the selected companies.

Through holding interviews with the management team members of the selected companies (Bedrock.farm, Enerhash, InsurWiz Technology, Medditive Ltd., Solidity Services and WarrantIQ), different business problems in different areas were identified along with appropriate blockchain solutions. Public offering of consultancy and training was made possible through blockchain to overcome the inability to provide professional educational and consultancy provision to different stakeholders whereas transparency issues and traceability of digital transactions were also solved by making everything visible to everybody using the blockchain technology. Operability of applications with blockchain backend was also solved through developing distributed applications and smart contracts whereas significant value was added to energy producers in terms of profitability and efficiency through the employment of Bitcoin and other cryptocurrencies' mining. Dishonesty of cryptocurrency exchanges was overcome by installing Bitcoin ATM's in public places among other solutions whereas Ponzi schemes and scandals was also overcome by bringing technology-driven transparency to the asset management industry. Last but not least, difficulty in selling or receiving ownership of illiquid assets was overcome by representing real-world assets as digital tokens on a distributed digital ledgers using this technology.

The main findings of this research evidently concludes that the Blockchain ecosystem in Hungary is between the initial and development stages where business players are expected to witness an improvement in the level of knowledge exchange, relations between ecosystem participants, innovation, and employment rates whereas policymakers are expected to work on enhancing the sophistication of its regulations

to strengthen the blockchain field and protect business players and investors in Hungary.

Future research is needed to cover a larger sample since this research was conducted on a limited number of blockchain-based companies in a limited number of industries within Hungary. Future research is also needed to cover other European countries to allow benchmarking of Hungary progress in comparison with other nearby countries. It is also essential that future research employs other research designs and approaches where a quantitative approach can be used and results compared versus the ones made by this research. Last but not least, it is worth to highlight that future research can be conducted under more stable conditions after COVID'19 is over.

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LIST OF ABBREVIATIONS

Symbol	Description
PoW	Proof of Work
PoS	Proof of Stake
EMR	Electronic Medical Record
IoT	Internet of Things
IPR	Intellectual Property Rights
GDPR	General Data Protection Regulation
GPT	General-Purpose Technology
DC	Dynamic Capabilities

CHAPTER ONE: INTRODUCTION

1.1. Overview

This chapter presents an introduction to blockchain technology where its history is showcased, its structure of multiple layers is explained. Different types of blockchain technology along with the advantages and disadvantages of this technology are mentioned. The various uses of blockchain across different industries such as cryptocurrencies, smart contracts, and anti-counterfeiting are also explained. Additionally, this chapter proceeds to state the problem this research aims to solve, to outline related research questions, and highlight the rich addition this research contributes to the currently published body of literature.

1.2. Introduction

1.2.1. Blockchain Technology

Blockchain History

Blockchain is a technology that records information on blocks that are connected through cryptography that makes it difficult or impossible to cheat, hack or change. The first blockchain-like protocol was proposed back in 1982 by the American computer scientist and cryptographer, David Chaum, followed by a more developed system of a secured chain of blocks established in 1991 by Stuart Haber and W. Scott Stornetta which was further enhanced in terms of efficiency in 1992 as several document certificates were allowed to be collected in one block.

Almost 12 years later, a person or a group of anonymous people known as Satoshi Nakamoto established the first blockchain in 2008 which was used as a main component of Bitcoin - a decentralized digital currency - in the following year, 2009 (Nakamoto, 2008). The Bitcoin blockchain grew exponentially during the following years with its file size reaching 20GB in 2014, 30GB in 2015, 50GB in 2016, 100GB in 2017, and exceeded 200 GB in early 2020.

Blockchain Definition and Structure

Different definitions of blockchain were proposed by many researchers and professionals but the most popular one was made by Don and Alex Tapscott who defined blockchain as “an incorruptible digital ledger of economic transaction that can be programmed to record not just financial transactions but virtually everything of value” (Strebko and Romanovs, 2018).

The structure of blockchain is protected against any retrospective alteration of recorded transactions as the change of anyone block mandates the change of all following blocks which hinders any attempts of cheating the system. Blockchain is normally comprised of several architectural components which are Nodes (a computer that has a copy of the entire blockchain ledger on its own), Transaction (records/information), Block (data structure), Chain (sequence of blocks), Miners (verification nodes) and Consensus Protocol (set of rules). Once a new entry or transaction is made within Blockchain, a new block is built and the new record is verified by the majority of nodes then it is added to the network. Each newly built block contains the automatically generated cryptographic hash of the previous block which makes it impossible to alter the hash information where each block reinforces the verification made by the previous block, meaning that the more blocks a Blockchain have, the more secure and reliable it becomes (Strebko and Romanovs, 2018).

Blockchain Types

Based on the different levels of access to blockchain data, there are several types of blockchain networks which are public blockchain, private blockchain, permission-less blockchain, and permissioned blockchain. The public blockchain allows anyone with an internet connection to read the blocks and send transactions as it has no access restrictions, unlike the private blockchain that is limited to a predefined list of users that has access to the blocks and the ability to send transactions, noting that the public blockchain offers economic incentives through securing them and utilizing algorithms such as Proof of Stake (PoS) or Proof of Work (PoW). The permission-less blockchain allows anyone to create the blocks of transactions whereas the permission blockchain is limited to a predefined list of users that are authorized to process the transactions (Strebko and Romanovs, 2018).

The two types of consensus algorithms used to mine or validate block transactions are Proof of Stake (PoS) which is the ability to mine or validate blocks of transactions depending on the number of coins the miner has which can act as an alternative for the Proof of Work where PoS protocols split stake blocks in proportions to the existing wealth of the miner, and Proof of Work (PoW) which can be defined as the base of the block generation for the Bitcoin protocol where it requires huge amounts of energy to mine or validate block transactions through special computational capacities (Pilkington, 2016).

Blockchain Advantages and Disadvantages

Blockchain technology is one of the crucial emerging technologies that underpin the fourth industrial revolution and has a major impact on businesses because blockchain as a foundational technology facilitates other technologies' convergence (artificial intelligence, the Internet of things, machine learning) and can aid companies in providing their maximum capabilities (Iansiti & Lakhani, 2017). According to Deloitte's 2020 Blockchain Survey, business leaders see blockchain technology as a connecting platform enabling many business processes and thereby as integral to organizational innovation (Pawczuk et al., 2020).

As with every disruptive technology, which is an innovation that affects the usual operation of an industry or a market by creating a new market, product, or value, there are several advantages and disadvantages of Blockchain technology. The technology of blockchain has solved many of the issues centralized systems had, by eliminating the need for middlemen during transactions, reducing transaction time, preventing intentional and unintentional deletion or alteration of data, increasing trust and transparency while minimizing fraud and deception as multiple copies of the same transaction are available in different computers/nodes, which made blockchain an indestructible reliable technology that is multipurpose and have a lot of applications in different areas, sectors and in different countries. Blockchain technology does not have disadvantages but challenges of implementation as it is still a relatively new technology and its implementation is not yet thoroughly studied through practical application into the currently used systems in the main industries (Strebko and Romanovs, 2018). Two of the main challenges blockchain startups encounter are financial, especially when scaling their businesses as additional investments are usually needed

for new servers and new customer service staff, and new market penetration due to lack of distribution channels (Jáki et al., 2019). Additionally, there are three challenges from a technical point of views such as scalability since blockchain networks normally have a limited number of transactions per second, privacy leakage as all transactions and balances are publicly viewed on the blockchain and selfish mining where selfish miners refrain from broadcasting their mined blocks to reap more revenues and eventually more power to reverse Blockchain network and performed transactions (Zheng et al., 2018).

Since Blockchain technology has way more benefits than challenges, it is advised that blockchain development and application is thoroughly explored in different industrial areas to overcome current challenges and reap potential benefits (Strebko and Romanovs, 2018).

Blockchain Use & Utilization in Different Industries

Initially designated for facilitating transactions, the technology has spread across different industries as it applies to diverse businesses and organizations and it has many practical capabilities and potentially realized benefits such as increased security, traceability, and transparency in addition to reduced costs, blockchain technology has recently caught the attention and interest of many industrial domains.

One of the very first industries blockchain technology has been utilized by is the financial industry where not only multiple cryptocurrencies were created using the technology, but also the technology was utilized to avoid duplication of financial transactions and validate activities within the financial system. The technology is used in multiple areas within the financial industry such as stock trading, insurance marketplace, financial settlements, food, and peer-to-peer financial transactions (Al-Jaroodi, 2019).

Blockchain technology has also been utilized by several other industries such as healthcare, logistics, manufacturing, energy, agriculture, and food, robotics, and entertainment industries. The technology was used in the healthcare sector to secure and facilitate sharing of patient data among different healthcare providers through digitizing patient information into EMR's (electronic medical records). The technology is also used in logistics as it can reduce delays, costs, and human errors in addition to eliminating counterfeit throughout the entire supply chain from the delivery

of raw materials to the manufacturer up till the delivery of the finished product to the final consumer through the use of its distributed ledgers to record, verify and audit all logistics transactions. Additionally, the technology can be used to facilitate the business relationships between different parties throughout the supply chain through the use of smart contracts (Al-Jaroodi and Mohamed, 2019).

The technology of blockchain can also be used in the manufacturing sector in supporting cloud manufacturing operations, which utilizes cloud computing, Internet of Things (IoT), virtualization, and service-oriented computing where knowledge sharing is secured through a decentralized manufacturing system. The technology can also be applied to improve the industry of entertainment where video games are enhanced through offering better control over virtual assets across multiple gaming platforms while protecting the ownership of virtual assets and preventing any hacking. The technology also has the potential to be used in e-agriculture systems where knowledge sharing is made more secure through blockchain, trust among participants is enhanced and farming operations are made more efficient (Al-Jaroodi and Mohamed, 2019).

1.2.2. Blockchain Technology Ecosystem

Innovation and Technology Ecosystems

Since the approach of innovation systems failed to differentiate between events and structure, the use of innovation ecosystems emerged where economic agents, economic relations, and non-economic parts such as culture, technology, and sociological interactions are included. A well-orchestrated innovation ecosystem facilitates operation beyond the boundaries of the firm where knowledge is transformed into innovation whereby leaders need to understand their importance in creating innovative ecosystem strategies that promote the implementation of such technologies. (Chen, et. al., 2019)

According to Deloitte's 2020 Blockchain Survey, business leaders see blockchain technology as a connecting platform enabling many business processes and thereby as integral to organizational innovation (Pawczuk et al., 2020) whereby creating

innovative ecosystems for business models using blockchain-based infrastructure to demolish the traditional ones are sought to be evolving and increasing in the past years.

It is worth highlighting that the term “ecosystem” comes from biology where it refers to the environment consisting of all living organisms in a certain area and all non-living physical components such as water, air, sunlight, and soil with which the living organisms interact; the term was repeatedly used in business and management to describe different enterprises and businesses and the interaction among them along with the social-cultural environment they conduct business in (Mercan and Gotas, 2011). Due to the complexity of technological systems, as they involve different parties who interoperate with each other, it was evident that the use of technological ecosystems is more appropriate as it reorganizes these different technological systems into components that offer different services while interacting with other components within the same ecosystem (including users) and improving in different ways (García-Peñalvo, 2016). An unbalanced focus on actors, collaboration, and complementary were noticed among the different definitions of “innovation ecosystem”, leading to a new improved definition that goes as “the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors” (Granstrand and Holgersson, 2020).

Blockchain Technology Ecosystems

Blockchain, like any other technology or innovation, has its ecosystem which consists of eleven generic roles; Consumer, Blockchain Infrastructure Provider, Blockchain Platform Provider, Blockchain Application Provider, Token-Based Community Platform Provider, Miner/ Mining Pool, Mining Solution and Equipment Provider, Blockchain Ancillary Service Provider, Blockchain Alliances, Blockchain Community and Blockchain Consulting Services, noting that Blockchain ecosystem differs from other traditional technological ecosystems in terms of governance, openness and trust (Riasanow, 2018). The ecosystem of blockchain, which comprises producers, suppliers, customers, stakeholders, and competitors, is the source of many of its dynamics, development, and vulnerabilities (Hammer, 2018).

Countries in different areas of Europe are in different states of development in regards to blockchain technology, its applications, and its overall ecosystem, on multiple dimensions such as regulations, policy, and business activities. Austria, for example, has limited itself to only monitoring advances in the decentralized finance area and issuing warnings to investors upon need where no crypto-specific legislations are issued but only generic regulations. Bulgaria is decently catching up with the technology as there is an emerging base of enthusiasts, investors, and startup programs in the country, noting that there are also no specific regulations for crypto assets. Ireland has a permissible and flexible regulatory approach towards blockchain and its applications and it also shows a relatively mature blockchain ecosystem with both locally operated companies and internationally operating subsidiaries. Hungary, which is the country of interest in this study, has shown a more structured approach in regards to the blockchain as it created a team of members from different ministries to work on creating an overview of this technology and its potential applications while publishing-related warnings and statements, noting that the country shows early signs of success in capital raising although the business and startup scene is relatively small in the country in comparison with other European countries whereby there are provisions in the Hungarian law by the National Authority for Data Protection and Freedom of Information whereby those

were published in their official website highlighting their opinion with regards to Blockchain Technology in the Context of Data Protection (Péterfalvi,2017). On the other hand, some European countries have adopted a stricter approach towards blockchain such as Poland where taxing profits from crypto trading while financing several pilot projects in the arena in cooperation with the industry.

1.2.3. Maturity Phases of Technology

The maturity of blockchain technology in any country is mainly judged through the maturity in two main areas, regulatory maturity and business/ ecosystem maturity. A useful maturity curve with different stages has been utilized by EU Blockchain Observatory & Forum where maturity is categorized into stage I, stage II, and stage III depending on where the country stands in regards to regulatory maturity and business/ ecosystem maturity.

The regulatory maturity curve measures the degree of governmental support blockchain technology has in a country where stage I is when the country does not have any crypto-specific regulations but only investor protection statements, stage II is when the country shows involvement through wider regulatory schemes or through other specific measures where the country sponsors related studies and pilot projects while establishing a framework for taxing digital currencies and assets, stage III is when the country has crypto-specific regulations (published or voted) and related national vision/ strategy where the country has innovation hubs and regulatory sandboxes among other initiatives to allow novel implementation of this technology within the country.

The ecosystem maturity curve measures the local ecosystem development in a country through three main measures which are: the presence of local startup ecosystems (business), number of user-driven communities (communities), and number of related academic research and formal education initiatives (academia). Stage I is when a country has dynamic initiatives in none or one of the previously mentioned measures (business, communities, academia), stage II is when a country

has dynamic initiatives in at least two of these measures, and stage III is when a country has dynamic initiatives in all three measures.

Blockchain maturity level was described according to (Wang et.al., 2016) to have five stages of maturity: initial, repeatable, defined, managed, and optimizing according to the figure below. From a purely technical point of view, technology maturity is mainly judged by four measures which are information systems, networks, security and privacy, and computing methodologies where maturity stages are categorized as initial, repeatable, defined, managed, and optimizing. “Initial” is when the service is new and chaotic, “repeatable” is when some experience is present from other similar services, “defined” is when the service becomes documented and standardized, “managed” is when the standard service is qualitatively evaluated and “optimizing” is when the service is continuously improved (Wang et al, 2016). KPMG developed a similar model in 2018 with slightly different sequence and descriptions of maturity stages which are initial, managed, defined, quantitatively managed, and optimizing where “initial” is when processes are unpredictable, reactive, and poorly controlled, “managed” is when processes are project-categorized but still reactive, “defined” is when processes are organization-categorized and proactive, “quantitatively managed” is when processes are properly measured and controlled and “optimizing” is when the focus is placed on process improvement. KPMG highlighted some of the risk areas within the Blockchain maturity model which are access and user management, authorization management, data management, interoperability, scalability, and performance, change management, privacy, and security.

Table 2 Blockchain maturity model

	Initial (stage 1)	Repeatable (stage 2)	Defined (stage 3)	Managed (stage 4)	Optimizing (stage 5)
Networks		Network load	Reliability		
Information Systems	Architecture Upgrading Integration	Maintenance Storage Scalability		Business efficiency	
Computing Methodologies	Standardization	Computational complexity			
Security and Privacy			Privacy	Data security Transaction security	

Figure 1: Blockchain Maturity Model

Source: Wang et.al., 2016

1.3. Problem Statement

Due to the newness of blockchain technology, and despite the multiple attempts of researchers to conduct research studies that will help both, researchers and industry practitioners, industries in many countries are still struggling to figure out ways that will help them reap the most benefits from this technology. Hence, this study attempts to investigate the Hungarian startup companies that succeeded at employing this technology into their operations, the different Dynamic Capabilities (DC) including managerial skills and organizational routines that helped facilitate the transition into this technology, the problems they have solved, the benefits and the competitive advantages they have reaped upon the successful implementation of this disruptive technology.

1.4. Aim of the Study and Research Questions

The global enterprise blockchain ecosystem is growing rapidly with the US leading role in blockchain start-ups funding while Europe is catching up as its early stage blockchain ecosystem is increasing with more than 500 new ventures created each year and with existing B2B start-ups deploying blockchain to add value to their product offerings (Puel et al., 2020). Contrary to large companies, start-ups are faster to adopt novel technologies

as they serve as the engine of innovative activity in certain industries, especially in the ICT sector (Audretsch, 2002). Since startup firms are the ones who have innovative business models and play a dynamic role in the economy (Audretsch, 2002), the purpose of this study is to explore the Hungarian blockchain-related start-ups, key issues of their business models and value propositions as well as competitive advantages while shedding light on this technology and its practical implementation in different industries across Hungary. This study aims to assess a sample of successful start-up companies from different industries within the country where the problems that were solved and/or the services that were provided through this technology are identified and related competitive advantages are highlighted.

The study utilized the following questions to achieve its aim:

1. Which industries/sectors do these companies operate in?
2. What problems do these companies try to solve?
3. Which products, services, and solutions do these companies develop based on blockchain technology?
4. Which innovative solutions on blockchain do these companies offer?
5. At what level of development is now Blockchain ecosystem in Hungary?

These research questions aim to address the knowledge gap in comprehending how organizations can harness the technology (Chong et al., 2019) and in identifying the current development stages of the Hungarian blockchain ecosystem.

1.5. Significance of the Study

Due to the unprecedented potential benefits many industries can reap out of Blockchain technology, researchers and practitioners have set to research different aspects as an attempt to better understand the technology, how it operates and how it can help the industries overcome challenges faced in the currently used systems.

Since Blockchain technology is still considered new in the field, researchers have frequently concluded that related body of literature still needs more studies with more

practical applications and implications in different industries. To this end and since, to our best knowledge, there are no research papers that address Blockchain technology, its ecosystem and its contribution to creating a competitive advantage in different industries across Hungary, this research study (The emergence of the Hungarian blockchain ecosystem: Development trajectory, success factors and innovative solutions) is thought to make a rich addition to the body of literature as well as the practical application of blockchain technology as it addresses how utilizing the technology of blockchain can improve the operations of many industries as shown by evidence from the Hungarian industry, noting that this study complements the research results on the local ecosystem (Fehér, 2018; Jáki et al., 2019; Kuti & Bedő, 2018; Szerb et al., 2020) and start-ups (Csákné et al., 2020) while meeting the call of Frizzo-Barker et al. (2020) for empirical research on Blockchain to be given a sound theoretical background.

1.6. Tools

To obtain a proper and thorough overview regarding the questions of this research, an interview was constructed of several sections such as the background of the participant, background of the company, company operations, company market, and sales, company innovation, and blockchain technology. The obtained responses from participants were transcribed and analyzed to reveal answers to the research questions.

1.7. Summary of Chapter One

This chapter provided an introduction to Blockchain technology by discussing its history, definitions, structure, the different available types of this technology while highlighting related advantages and disadvantages. The chapter discussed the various uses of this technology and highlighted its potential benefits across different industries. The chapter also discussed the Blockchain ecosystem and related maturity levels while proceeding to state the problem this research aims to solve while outlining related research questions, and then highlighting the rich addition this research contributes to both, literature and practical application of blockchain technology.

CHAPTER TWO: LITERATURE REVIEW

Some theoretical literature along with previous studies which were performed in the fields of ecosystem and blockchain technology are presented in this chapter.

2.1. Overview

Since the innovation of Blockchain Technology, it has been situated as the principal point for the attention of many researchers and various range of industries. Blockchain; defined as a decentralized ledger, for storing all transactions that have been made, securely, and in a very transparent way (Iansiti & Lakhani, 2017). From another perspective, blockchain is “a chronological chain of blocks where each block contains a record of valid network activity since the last block was added to the chain” (Abeyratne & Monfared, 2016). These blocks contain encrypted information that is reviewed by the network, preventing one or a group of members of the network to change it without authorization. This results in blockchain technology being “a complete and immutable history of network activities, which are shared among all nodes of a distributed network” (Abeyratne & Monfared, 2016). The architecture of Blockchain is differentiated from the traditional architecture as per the figure below (Lacity, 2018; Ølnes et al., 2017)

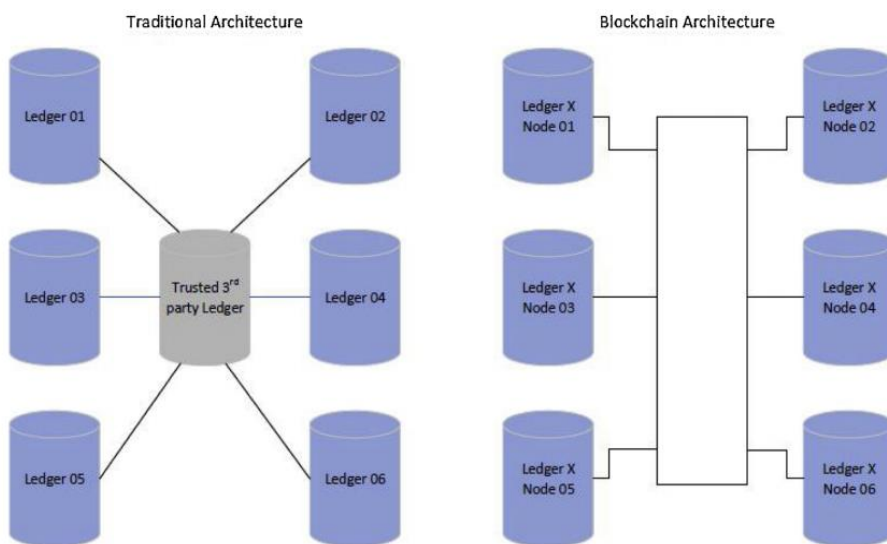


Figure 2: Traditional versus Blockchain Architecture

Source: Lacity, 2018; Ølnes et al., 2017

And since knowledge and information sharing are important to achieve efficient cooperation among different organizations and departments, Blockchain Technology was aimed to provide an induced mechanism to improve organizational synergy and efficiency. Moreover, integrating business functions and introducing collaborations can be defined as the primary responsibility for Blockchain Technology as linking business functions into a cohesive and high-performing business model, while supporting a positive impact on enterprise operational capabilities (Wu & Chiu, 2018).

Additionally, this top-of-the-notch technology was able to compete over existing technologies in enabling two parties to conduct transactions over the Internet without the interference of any intermediary party. This gives Blockchain the lead of removing the third party can decrease the processing cost while enhancing the security and efficiency of transactions. And since there are many benefits that Blockchain can bring in every industry, its significance level, and implementation have been rising in a lot of industries.

As platforms for building customized economic coordination, blockchains utilize distributed ledgers which are supplemented with such computationally embedded features as programmable money (i.e., cryptocurrencies), smart contracts, and organizations made of software such as decentralized autonomous organizations (DAOs) (Davidson et al., 2018). One usage of programmable contracts is to increase trust between managers and clients by the concept of decentralized portfolio management.

The first cryptocurrency Bitcoin is a form of digital cash that can be sent directly without the interference of a financial institution using a peer-to-peer network (Nakamoto, 2008). Using blockchain technology several other cryptocurrencies or tokens can be created, which provide an alternative for start-ups over venture capitalists (VCs), because they can offer their tokens, that can be bought by investors, and this way they can raise funds through initial coin offerings (ICOs); however, many critics consider this a speculative bubble (Zetzsche et al., 2019). Security token

offerings (STOs) are similar to ICOs, but they were created with the purpose to bring regulation to this field and offer more guarantees to the investors (Miglo, 2019).

2.2. Blockchain in the global and the EU context

Blockchain first created a buzz by its financial applications, but the impact of blockchain technology goes way beyond the financial sector. It has the potential to transform industrial sectors and the public sector as well. Blockchain is among the ten technologies believed to have the biggest influence and to be the most disruptive in the next 10-15 years (OECD, 2016). From 2009 to 2018 blockchain start-ups received over 13.1 billion euro in investments on a global level. In 2018, the amount of funding reached 7.4 billion euro owing to the ICO boom (Nascimento et al., 2019). The rapid increase in the volume of funding from VCs and the number of start-ups shows the growing maturity of blockchain projects and further ecosystem development.

The importance of blockchain has also caught the attention of policymakers in the European Union. The European Commission considers blockchain “one of the breakthrough technologies which can have a huge potential impact in the financial sector, but also far beyond” (European Commission, 2017). Although the EU has realized the importance of the technology, it is still catching up to the USA and China in the global blockchain ecosystem. So, the UK is by far the most dominant player within the Union in terms of the number of blockchain start-ups (Nascimento et al., 2019).

As a more thorough look into Blockchain technology where it provides an innovative resource of fostering alliance, especially in cross-organizational systems. Blockchain technology permits the establishments to get involved in workflow and maintain control over their respective activities but, at the same time, enables them to establish a “communal and insistent truth” on the state of the workflow at any time.

However, as blockchain projects are progressing further from the conceptual phase, there can be some regulations and legal barriers that need to be taken into consideration. Foremost among these is the European Union (EU) General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679). The GDPR is a legal structure that sets guidelines and regulations to guard and

protect the collection and processing of personal data or any other transactions related to information for people living in the EU. Accordingly, compliance to the regulations set by GDPR can be challenging for Blockchain projects whereby some of the main challenges can be attributed to the need to establish clear responsibility for compliance, bases for processing personal data, and to comply with the rights to rectification and erasure which may not be achieved. Additionally, GDPR states that data subjects can be requested for change by Data controllers to rectify errors as deemed necessary. This suggests that modifications to data on a blockchain must be made on each copy of Blockchain which ought to as burdensome (Rieger et. al. 2019).

2.3. Conceptualization of blockchain technology and its significance for business

Iansiti & Lakhani (2017) believe that blockchain is a foundational technology that can create new foundations for economic and social systems (p. 4) and gradually reshape the economy by the replacement of traditional businesses and the emergence of new technology companies. This is the same path as adopting the other foundational technologies like transmission control protocol/ internet protocol (TCP/IP), which provided the basis for internet development (Iansiti & Lakhani, 2017).

In the framework of the Schumpeterian paradigm, blockchain is a radical disruptive innovation that has general-purpose technology (GPT) characteristics (Kane, 2017; Pilkington, 2016). The Schumpeterian model can be categorized into three main ideas: (a) innovations can be the source of Long-run development (b) entrepreneurial investments can be the source of innovations whereby such investments are driven by predictions of monopoly rents (c) Old technologies can be replaced by innovations. In different wordings, the development comprises inspired obliteration (Aghion, et.al., 2015). Firstly, its radicalism is identified with the high level of the transformations of the technologies, infrastructures, and markets. Secondly, Blockchain bearing the features of GPT is applicable in many fields and compatible with other technologies like AI and IoT, and technology is expected to economize production costs and improve on the productive efficiency

of some economic operations (Davidson et al., 2018) and thereby lead to “waves of growth” (Kane, 2017).

From an economic view, blockchains are understood as a public database or ledger technology. Following the definition of the ledger as a foundational technology of market capitalism, Allen et al. (2020) and Davidson et al. (2018) define blockchains as a new institutional technology that supports novel forms of economic organizations including DAOs and ICOs. Blockchain is also used to compete with the incumbent institutions of payments, identity, asset registration, and transfer, contracting, and other administrative and economic infrastructure.

Through the lens of transaction costs economics (Williamson, 1979), blockchain’s primary effect is on lowering transaction costs of economic coordination and governance between a network of economic agents. The technology affects two types of transaction costs – verification and networking ones – through transparency and consensus; and blockchain can limit opportunistic behavior with the elimination of the need for trust by using crypto-enforced execution of contracts (Allen et al., 2020; Catalini & Gans, 2016; Davidson et al., 2018). According to Tapscott & Tapscott (2016), blockchain is expected to create new portfolios of value. Angelis & Ribeiro (2019) also believe that the associated value propositions change since blockchain technologies provide new functionalities (p. 307). Moreover, maturing technology ordinarily enables new manners of service and product offerings and includes modifications in the pursued and derived benefits (Angelis & Ribeiro, 2019, p. 308). Consequently, Blockchain-based solutions help authenticate traded goods, facilitate disintermediation, enhance operational efficiency in different ways and diverse industries, for instance, via reduction of time for transaction execution or the decline in operational costs (Nowiński & Kozma, 2017, pp. 183-184 sorting allows companies to reduce friction and information asymmetries (Tapscott & Tapscott, 2016) and ensure more efficiency at a much greater scale than current paradigms (Swan, 2015, p. 27).

To date, blockchain’s sophisticated ledger system is widely used by companies, start-ups, non-governmental organizations, and governments for multiple applications including payments, smart contracts, property rights, insurance, certification, logistics platforms, wallets, and many others (Davidson et al., 2018; Kher et al., 2020); however, blockchain research lacks empirical

investigations. The outcomes of Frizzo-Barker et al.'s (2020) review of blockchain research in the business literature reveal that blockchain technology remains an early-stage area of research in terms of theoretical basis, methodological diversity, and empirically grounded work. Frizzo-Barker et al. (2020) call for a need to generate empirical case studies about specific blockchain solutions for new businesses. Thus, this study attempts to fill this gap and alleviate a dearth of empirical research by investigating the existing Hungarian blockchain-related start-ups and Blockchain-enabled applications.

2.4. Theoretical lenses to analyze blockchain technology

2.4.1. The embeddedness of blockchain technology into the innovation ecosystem research

Blockchain, as an institutional technology, requires groups to adopt (Allen et al., 2020), so due to its functionality blockchain only works at its full potential in a network to achieve cost reduction, transparency, security, and credibility. According to Nasdaq Vice President, “a complete ecosystem on Blockchain is required for it to offer maximum value to all its participants.” (Nasdaq, 2016). This statement is in line with the main purpose of the ecosystem that is the generation of value by all participants’ mutual efforts (Adner, 2006).

Within an ecosystem, multiple actors can collectively create value from innovations that are unlikely to be done by any of them acting on their own (Adner, 2006; Iansiti & Levien, 2004). (Moore, 1993). Moore’s contribution to the emergence of the business ecosystem has boosted the elaboration of the ecosystem interpretation. Subsequently, Iansiti & Levien (2004) describe the ecosystem as “a large number of loosely interconnected participants who depend on each other for their mutual effectiveness and survival” (p. 76). Adner’s (2017) definition of ecosystem construct states that it is “the alignment structure of the multilateral set of partners that need to interact for a focal value proposition to materialize” (p. 42). Adner’s ecosystem-as-structure view places the value proposition at the foundation of the ecosystem consisting of four basic ecosystem elements – activities, actors, positions, links – that contribute to the value creation. The ecosystem can generate opportunities and niches for firms (Iansiti & Levien, 2004) by bringing such benefits as open

innovation, value network, platform leadership, keystone strategies, hyperlinked organizations, and organizational culture interchange (Adner, 2006; Kuti & Bedő, 2018). Besides, accurate problem recognition by actors is crucial for dynamic collaboration and knowledge distribution among organizations as well as between humans and AI (Fehér, 2018).

Jacobides et al. (2018) define ecosystems as distinct forms of organizing economic activities that are characterized by specific types of complementarities (p. 2256). In the context of the platform ecosystem, there are hub-and-spoke networks where a set of peripheral firms link to the central platform through open-source technologies and technical standards (Jacobides et al., 2018, pp. 2256-2257). A platform leader is responsible for managing the technological evolution of the system to maintain competitiveness against rival ecosystems (Kay et al., 2018, p. 633). For example, Corda is the open-source blockchain/distributed ledger platform built for multiple business applications and services in finance, trade, healthcare, and other fields. Developed by an enterprise blockchain software firm R3 in collaboration with over 200 technology and industry partners, the platform is currently supported by a community of blockchain developers that continuously add new functionality and features. The success of the Corda network depends on a vibrant ecosystem of participants on the network including designers, users, governors and operators of the business network, application developers, infrastructure providers, and others (Brown, 2018). Corda is one of the examples, but there are many other platforms like Ethereum, Hyperledger, Ripple, and Hedera, developed by technology companies for faster and easier application development, and they are widely used by enterprises and start-ups across industries.

A multiplicity of platforms indicates that there is no dominant design in the Blockchain industry and homogeneity among the ventures. Meanwhile, Frolov (2019) points out that a multi-level environment with a continuous self-development potential will be established on a Blockchain basis. Therefore, blockchain with its ability to generate different complements is forming

the ecosystem for platform leaders and developers where ecosystem stakeholders can form competitive and cooperative relationships with blockchain platform leaders (Ku, 2020, p. 305). Blockchain as decentralized network technology relies on the network effect for its proliferation and growth (Ku, 2020). Gawer (2014) notes that the existence of network effect is essential to the economic definitions of multisided platforms because it reflects exogenous interdependence of demand between consumer groups and incites platform competition (p. 1240).

Thus, Jacobides et al. (2018) emphasize the importance of ecosystem formation for emerging areas and the necessity to study the dynamics in nascent sectors and understand the attitudes and approaches enabling ecosystem identification. Kapoor (2018) suggests that the ecosystem research can be conducted at the level of the focal offer (innovation and technology), the keystone firm, and the ecosystem. Insofar as new technology can trigger the formation of the ecosystem, this study explores the main activities that constitute different offers, the actors undertaking these activities and producing those offers, and the blockchain that connect offers and actors.

Riasanow et. al. (2018) investigated the generic Blockchain ecosystem and its implications from a strategic point of view whereby analysis was done 479 Blockchain companies in the Crunchbase database. The proposed model employed e3-value by visualizing the current blockchain projects and identifying strategic implications that can be fundamentally different from previous approaches: governance, trust, and openness. A three-step research approach was used based on Riasanow et al. (2017) to get the generic ecosystem of Blockchain Technology. Accordingly, roles of the actors in the industry were identified, the generic ecosystem based on their previous roles and value stream, last, validation model was utilized for five semi-structured expert interviews. The below figure shows the proposed method of e3-value as a generic blockchain ecosystem, where roles and value stream are identified.

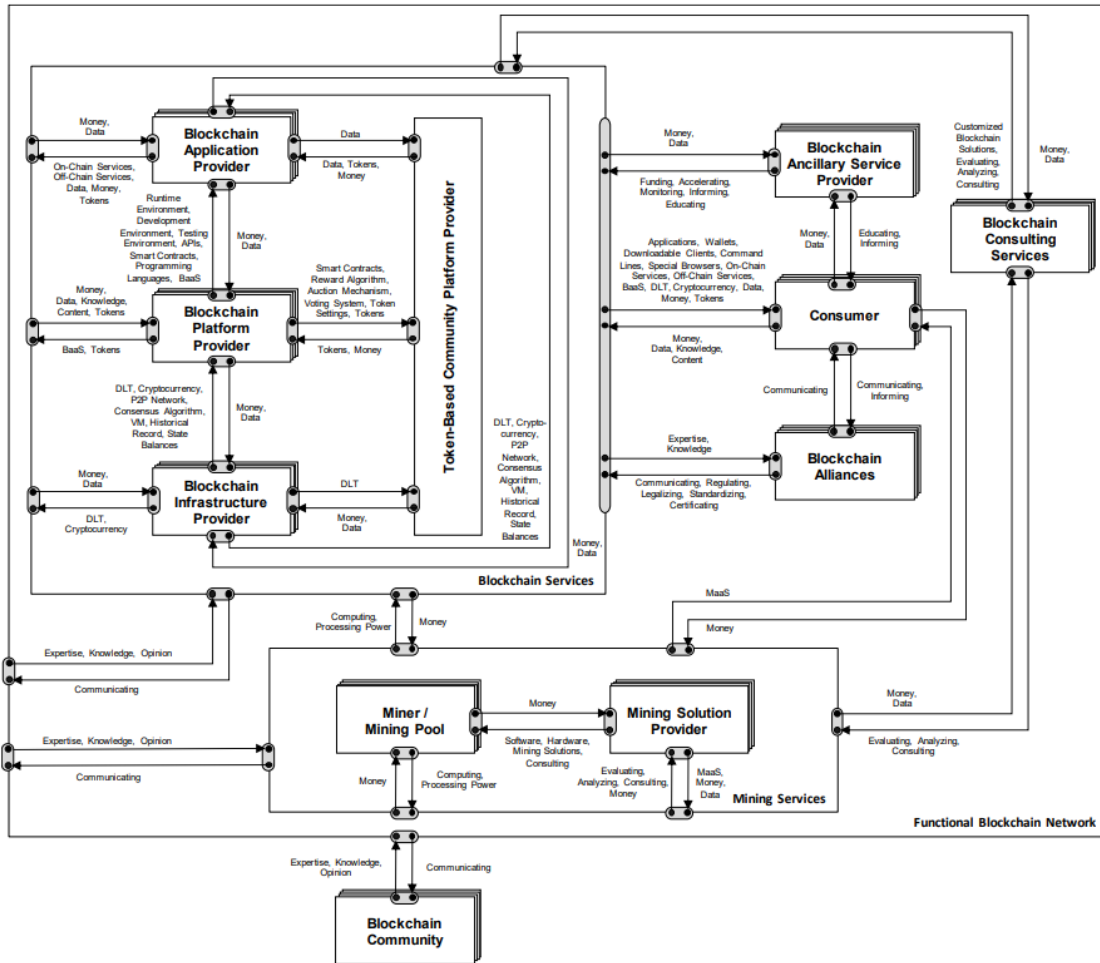


Figure 3: Generic Blockchain Ecosystem

Source: Riasanow et al., 2017

2.4.2. Dynamic capabilities perspective for studying the ecosystem formation

Like any form of organization, the business ecosystem also changes with time, and the success of the ecosystem performance depends on its co-evolution with technologies and the market (Heaton et al., 2019). Hence, the DC theory can be the appropriate paradigm to explore sensing of business opportunities from the environment and understand technology management (Cetindamar et al., 2009) as the effective management of technology can facilitate the conversion of the opportunities into value. Moreover, there is a positive interrelation between the dynamic capabilities,

operational (technological) capabilities, and firm performance (Wilden & Gudergan, 2015). Insofar as technologies are identified as DC (Franco et al., 2009; Kosztyán et al., 2018), blockchain positively impacts the performance of economic actors.

DCs are defined as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments” (Teece et al., 1997, p. 516). Teece (2007) classified DCs into three categories including the capacity to sense and shape opportunities (e.g., technology development), seize them by creating new products, services, processes, and the capacity to improve competitiveness through transformation.

Referring to Teece’s (2007) theoretical framework on dynamic capabilities, the core of strategy encompasses the selection and development of technologies and business models. According to Teece (2014), strong DCs and strategy are the basis for sustained competitive advantage. Enterprises with such capabilities are capable to adapt to business ecosystems and shape them through innovation and cooperation with other enterprises and entities (Teece, 2007, p. 1319). Those strong capabilities include entrepreneurial ability to discover emerging areas, invest in research around them, and build partnerships for creating and maintaining ecosystem infrastructure (Heaton et al., 2019). Kay et al. (2018) noted that the main benefits of participating in ecosystems are access to proprietary knowledge, participation in setting common standards, and coordination of capabilities development. Due to possessing different learning mechanisms, the ecosystem has a collective dynamic capability (Zollo & Winter, 2002); therefore, the stronger the organization’s DCs the more resilient the network would be.

Thus, blockchain technology creates vast opportunities to research the formation of Blockchain innovation ecosystem globally or in a given country. The DC framework can be applied to analyze how various participants adapt to the current technological changes and contribute to blockchain ecosystem formation.

2.4.3. Approach to study new ventures creation (SMEs/ Start-ups)

The formation of innovative ecosystems is typically characterized by market changes and the growing number of new ventures. To analyze new firms' creation, the guidelines are proposed by Gartner (1985) and Giarratana (2004). According to the results of their works, three main areas are required to assess among them the environment, the entrepreneurs, and the new product or process, as well as their connection with each other. First, the organizational forms of start-ups make them critical in opening new markets as they are better adapted to young turbulent environments (Giarratana, 2004, p. 791). However, Jáki et al. (2019) state that all start-ups need a supportive ecosystem for rapid development and easy access to global markets. Entrepreneur-friendly ecosystems also have a huge positive influence on firm entry and growth (Gartner, 1985).

Secondly, the rising demand in the digital sphere causes an increase in the complexity and the spectrum of different products. This process provides an opportunity for smaller companies and start-ups to exploit these specific needs and challenge market leaders in well-defined niche areas by creating new products and processes. Thirdly, in the earlier periods of the firm existence, its survival primarily depends on the founder's abilities and competencies. In exploiting the same business opportunities, entrepreneurs follow different approaches. As a result, there is a massive degree of heterogeneity among the firms (Gartner, 1985; Giarratana, 2004) whose most important drivers of growth are specialization in a particular niche, the introduction of a distinguished innovative product, and international expansion. Thus, this paper gives a short description of Blockchain-based start-ups' entrepreneurs, their offers, and the environment in which they operate.

Finally, in its function as a trusted application for many industries and services, Blockchain Technology facilitates highly specialized purposes for multiple areas through the utilization of end-to-end functionality. Such trusted and secure technology is expected to be implemented in many sectors. In this context, an application refers to "a program designed to perform a function or a suite of related functions of benefit to an end-user" (Horak, 2008), while a service is "a transport of data and/or applications" (Horak, 2008). The figure below illustrated the mapping of

services that can be provided by Blockchain Technology (Sultan, et. al., 2018) whereby the mapping was proposed based on the Access: Primary function for data transformation (application) or to present data (service) and Scope: global/Public use or enterprise permissioned (private)

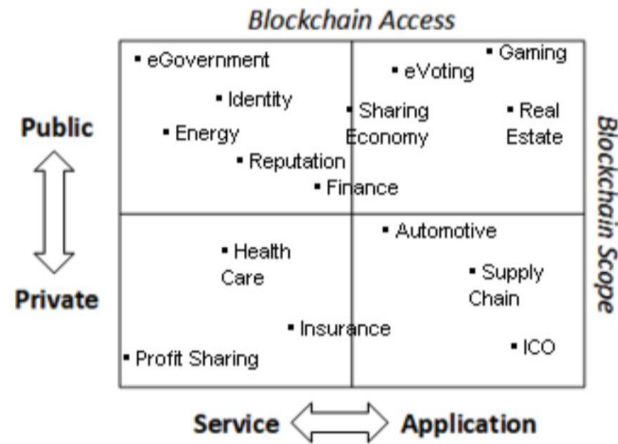


Figure 4: Blockchain Access vs. Scope Matrix

Source: Horak, 2008

2.4.4. The ecosystem lifecycle from the dynamic capabilities 'perspective

Successful sensing and seizing activities lead to product, service, or process development, hence economic growth, which will require the manager and the company to reconfigure and recombine organizational assets to sustain continuous growth. The table exhibits two major cases of reconfiguring activity, responding to organic growth and uncertain events. Examples for organic growth required changes include Rollet whose system monitoring had to be reengineered as the number of implemented hardware grew, as well as Tresorit where the company grew from an agile 20-person company to one with 100+ employees and the founders needed to completely rethink the way they contribute to the operation of the company. From the beginning, György was involved in creating financial models, market research, and competitor analyses, but he had to understand that after a while he could make an impact via the people who were hired to work on these tasks. He participated in leadership training and reconfigured his skills and abilities to adapt to his new responsibilities accordingly (Zhang, 2020; Szilágyi, 2020)

The theoretical research proved that the utilization of dynamic managerial capabilities, namely sensing, seizing, and reconfiguring are positively linked to innovation performance, hence to the competitiveness of a firm. Therefore, overviewing the ways of processing and using our gathered knowledge could be helpful in the long run. However, even more importantly, according to Dyer et al. (2009), around 70% of an individual's capacity to innovate comes from learning, therefore, investing time in practicing self-awareness with prioritized focus on emotional intelligence and understanding our own and others' emotions could result in significantly increased efficiency. Having a people-centric view also embraces the idea of opening up and collaborating with other actors within the ecosystem. This is key, as several studies point out that the future is about interconnected systems and intensive knowledge sharing.

While powerful top management and entrepreneurial leadership are key factors for every actor, in large enterprises, sensing, seizing, and reconfiguring are more deeply embedded into the organization by routinized procedures, hence these enterprises will not be as dependent on the cognitive capacities of a few individuals like in SMEs. As mentioned in previous chapters, in smaller companies, sensing, creative functions, interpretation, and learning is more dependent on the owner and their entrepreneurial leadership (Teece, 2012).

According to Heaton et al. (2019), ecosystems pass through the stages of growth, decline, and rebirth. The evolutionary fitness of the ecosystem's stakeholders is shaped by the specificities of the regional innovation system in which it is embedded. Similar to the study of Heaton et al. (2019), we assume that the ecosystem evolves through three main phases: an initial stage, development and stability, and eventually decline and renewal. As Table 1 shows, each stage requires different DCs, although in practice organizations are simultaneously engaged in sensing, seizing, and transforming activities most of the time (Heaton et al. (2019) and Teece (2007)).

Table 1: Stages of innovation ecosystems and dynamic capabilities

Initial stage	Development stage	Renewal stage
Innovation ecosystem characteristics		
– Few enterprises – Rare interactions between ecosystem members – Limited identity – Low density	– Supporting agencies and organizations become active participants – Communication channels formed for exchanging knowledge – Inter-firm and professional networks become well established – A high level of innovation	– Stagnation of established sectors – Shifts toward new domains
Key dynamic capabilities		
Sensing	Seizing	Transforming
– Recognition of opportunities – Filtering and interpreting information about evolving blockchain technologies and marketplaces – Selecting and developing technologies and business models – Identifying niche markets and fields of blockchain application	– Investments in development and commercialization activity – Implementation of new organizational forms and business models – Creation of new blockchain-backed products and processes – Enhanced level of communication and cooperation among ecosystem participants – Built linkages between local and international participants	– Renewal or redesign of business models – Asset-realignment activities – Developed a strategy that transforms its external environment – Reoriented its culture

Initial stage. According to Heaton et al. (2019), the first stage of an innovation ecosystem is the emergence of an industry that has no technological antecedent in the regional economy. A high degree of uncertainty characterizes the business environment at this stage. Firms and other actors start to realize opportunities derived from the development of blockchain technologies. Formal and informal systems and norms of collaboration are establishing between members. During the initial stage, market players start engaging in sensing activities by assessing the external environment, identifying the potential application of blockchain, and attracting skilled blockchain professionals.

Development stage. This stage exhibits an increasing number of start-ups, an expanding number of linkages, a rise in employment, accelerating the knowledge exchange, and strengthening relations between complementors outside and inside the ecosystem. The free flow of information throughout the ecosystem can be facilitated through conferences, special events, and blockchain courses offered by universities. The shaping activities envisage the creation of blockchain-enabled customized solutions and more deliberate efforts by ecosystem leaders. Non-profit organizations dedicated to blockchain education, lobbying, and advocacy can take a direct role in connecting different ecosystem members and orchestrating local assets.

Renewal stage. Innovative ecosystems need to evolve and adapt to changing circumstances over time. To perform well, ecosystems must co-evolve with technologies and markets. The resources and capabilities of ecosystem members must be updated. A new growth path can be fostered by a renewal of the ecosystem through identifying promising fields, developing a shared strategy, and assembling the necessary human resources (Heaton et al., 2019).

Conclusion

Based on the above discussion, a consensus was found among researchers around the importance of Blockchain Technology and its ecosystem environment in multiple sectors and applications whereby it is a disruptive innovation underlying many projects and cryptocurrencies such as Bitcoin and Ethereum. This evolutionary technology is expected to aim at high profits in entrepreneurial ecosystems. And since it is still in its initial stage, Blockchain scholars and researchers are still thriving for the actual results from the implementation of such technology whereby the literature still lacks the actual implementation results from such project.

Based on the literature reviewed and since, to our best knowledge, the availability of research regarding the implementation of Blockchain ecosystem in Hungarian Markets is still deficient, the model and arguments in this study are conceptual and are expected to have an addition to the literature in analyzing Blockchain Technology in some of the Hungarian Companies.

CHAPTER THREE: RESEARCH METHODOLOGY

This chapter explains the adopted research design where the study population and samples are mentioned, the data collection tool is thoroughly explained, and the processes used to analyze the collected data are discussed.

3.1. Research Design

To best serve the aim of this study in assessing a sample of successful start-up companies from different industries within Hungary through highlighting the problems that were solved, the services that they were able to provide through blockchain technology, and the competitive advantage they acquired while shedding a light on related DC that played a major role in their successful implementation of this technology, a qualitative, explorative research design that depends on a constructed interview was adopted as it is thought to help the research in acquiring in-depth information from participants regarding their view points in the field of blockchain in their companies (Turner, 2010).

Given the exploratory nature of this research, empirical research is based on multiple case studies (Stake, 1994; Yin, 2003) where several cases are jointly analyzed (e.g., Bingham & Eisenhardt, 2011). According to the definition by Yin (2003), a case study “investigates a contemporary phenomenon within its real-life context”. There are three main goals that case studies may accomplish including exploration, testing, or building theory (Eisenhardt, 1989, p. 535). Therefore, it is an appropriate research method to examine a process of the new technology adoption and provide a description of the actors and their activities in the emerging ecosystem, noting that case studies on blockchain applications have been widely used in recent papers as they are considered a suitable approach to systematically and theoretically study industry experience and develop the research design and theories or models, as found by Kouhizadeh et al. (2019). To gain insight into the uptake of the nascent blockchain technology in Hungary and the value this technology brings for organizations, the authors of this paper have chosen to engage with the innovative entrepreneurs that are developing blockchain-based solutions to the existing problems.

3.2. Delimitation of the Study

The perspectives, opinions, and inputs represented in this study are from participants, mainly occupying management positions, from a diverse range of industries within the country of Hungary.

3.3. The population of the Study

The target population of this study includes the management team members of startup companies that were successful in implementing the technology of blockchain within their systems in Hungary as startup companies are usually the first movers in adopting new technologies and innovative solutions, aspiring to seize profitable opportunities and provide high-value products and services.

3.4. Sample of the Population

Since the target population of this research is relatively large, it is not feasible to sample the entire population. Therefore, a sample consisting of six companies derived from various industries such as agriculture and food, energy, insurance, health, finance, and warranty industries, noting that the sample also included a professor teaching a blockchain course at the Budapest University of Technology and Economics (BME) to better understand the technical and scientific aspects of this technology. The number of sampled companies is enough to provide accurate findings in this empirical research since its purpose is mainly explorative. According to Eisenhardt (1989), 4-10 cases are considered a sufficient amount (p. 545). The chosen cases have been selected as they provide a representative sample of different types of companies.

The semi-structured interviews (ranging in length between 46-88 minutes) were conducted during April-July 2020 by at least three members of the research group because, as

Eisenhardt (1989) advised, multiple investigators, increase the creative potential of the study by adding novel insights which complement the data (p. 538).

3.5. Sampling Techniques

Two sampling techniques were utilized in this research; one was at the level of the entire country of Hungary and the other was at the level of the selected companies. Purposeful sampling technique was used at the level of the country to identify and select easily accessible startup companies from different industries that are still active, profitable, in their early and mature phases in regards to the implementation of blockchain technology and can easily share experiences and information whereas stratified sampling technique was used at the level of the selected companies to target managing directors and CEO's who are thought to have the required background and experience to provide needed inputs regarding the selected companies.

3.6. The instrument for Data Collection

A semi-structured interview (see Appendix A) was constructed and utilized in this study. The questions within this interview were formed in a manner to help the researcher assess some successful start-up companies and highlight the solved problems and the provided services through blockchain technology in different industries.

The semi-structured interview has six different sections as follows:

1. Questions on background information about the participant
2. Questions on background information about the firm
3. Questions on the company's operations
4. Questions on markets and sales
5. Questions on Innovation
6. Questions related to Blockchain Technology

Some questions were constructed as yes/no questions while others were formulated as open-end questions to grant participants the space to express their views and opinions freely regarding the companies where they work.

3.7. Validation and Reliability

To ensure the validity of our qualitative research, the appropriateness of the tools, processes, and data should be verified as follows:

1. The research questions adequately measure the desired phenomena
2. The utilized methodology is appropriate to answer the research questions
3. The sampling and utilized data collection tool (semi-structured interview) are appropriate and serve the purpose of this research
4. The data analysis and resultant conclusions are valid for the selected sample within the considered context

To serve this purpose, research questions, research methodology, sampling techniques, data collection tool, data analysis methods were reviewed with some SME's (Subject Matter Experts) where suggested improvements for the data collection tool were taken into consideration to better serve the purpose of this study as follows:

1. Some of the interview questions were rephrased or omitted
2. The interview was formatted in a semi-structured manner rather than a fully structured manner which allowed the interviewees to openly express things from their perspective

To ensure the reliability of our qualitative research, consistency of results should be ensured where only a certain level of variability is tolerated, noting that the utilized methodology should consistently yield data that are essentially similar but might be different in richness and ambiance within similar dimensions (Leung L., 2015). Reliability of processes and results was enhanced using different approaches where data collected through interviews were triangulated along with data extracted from archives, websites, reports, news sources, and white papers and verified for accuracy in terms of form and context through continuous comparison.

Additionally, pilot interviews were conducted with two companies from our sample - bedrock, and Solidity Services — where feedback regarding the used questions was requested and no major changes were needed as the semi-structured interview was already reviewed and assessed by some SMEs.

3.8. Method of Data Collection and Data Analysis

The study employed multiple methods of data collection. Following Horváth & Mitev (2015), qualitative data gathering and analysis have proceeded simultaneously. Due to the nature of the study, the startup companies in their early and mature development stages were examined. The main sources of data about these companies were collected from their official websites, online news, and the semi-structured interviews conducted with start-up management (see Table 2). As noted by Füzes et al. (2018), in-depth interviews enable researchers to grasp the informants' viewpoints about the given topic.

According to Giarratana (2004), it is important to assess the firm founders' characteristics, their incentives and capabilities they brought inside the company, the business ideas they fitted in the organizations, and how they shaped the firm in the initial stages (p. 796). Regarding the backgrounds of our interviewees, two informants (the CEOs of bedrock.farm, and Meddictive) were former founders of the other start-ups, the CEOs of WarrantIQ and InsurWiz were former government servants, and four founders out of six were employees or managers of large companies. For instance, the CEO of *Meddictive* has multi-industrial managerial working experience in developing business in the CEE markets and Germany, and he is currently lecturing at Semmelweis and Edutus Universities. In general, most start-ups are established by entrepreneurs who were previously employed in the same industry and left their current employment to take advantage of a recognized opportunity.

Table 2: Interviews with start-ups founders

Interviewee	Position	Company	Industry	Website
Szűcs Endre	Managing director	bed-rock.farm	Agriculture	http://bedrock.farm/
Jogg Dániel	CEO	Enerhash	Energy	https://www.enerhash.com/
Urbán Viktor	CEO	InsurWiz Technology	Insurance	https://insurwiz.io/
Czeplédi Tamás	CEO	Meddictive	Health	https://meddictive.com/
Brezovszki Máté	CEO	Solidity Services	Consultation	https://solidity.services/
Kalocsai Kornél	CEO	WarrantIQ	Smart Contracts /Warranties	https://www.warrantiq.com/

To select the potential Hungarian companies for interviews, the material about these companies was collected from publicly available sources: websites of Blockchain Hungary Association (BHA, 2020) and the B-Day 3.0 conference (Blockchain Budapest, 2020) which is one of the CEE's largest blockchain events organized since 2018.

The majority of the companies can be found on the map of the Blockchain landscape of Hungary prepared by the BHA (Kalocsai & Kalocsai, 2019). This landscape shows the active participants in the field of blockchain technologies, connects them and convinces potential clients and partners to trust those companies. The map consists of three key groups including implementation, service, and knowledge sharing (Kalocsai & Kalocsai, 2019). Start-ups, developments, research sites, crypto trading, and miners make up the first category that offers products and services based on blockchain and forms the basis for further projects. The second category encompasses the activities and organizations that help implement this technology such as legal, consulting, public

administrations, accelerators, and incubators. The last knowledge-sharing category is composed of universities and conferences, media, and news portals.

All founders were interviewed through the Zoom platform due to its convenience and ease of use. All interviews were audio- and video recorded and transcribed, and participants reaffirmed consent verbally before the interviews. The questions for interviews were aggregated into three main groups, corresponding to the major sections of the interview protocol including the background of the interviewee, key activities of the company, and Blockchain application in its processes. In data analysis, it was utilized to triangulate observed data by combining the material from the interviews, both firms' and different organizations' official websites.

3.9. Summary of Chapter Three

This chapter presented the research design, delimitation of the study, population, sample, sampling technique, data collection tool, reliability and validity, and data collection and analysis methods. Six interviews were held in total with managing directors and CEOs of the selected companies. Secondary data included information from archives, websites, reports, news sources, and white papers. The data collected through the semi-structured interviews was sufficient to serve the aims of this research in exploring the Hungarian blockchain-related start-ups, key issues of their business models and value propositions as well as competitive advantages.

CHAPTER FOUR: RESEARCH FINDINGS AND RESULTS

This chapter concludes with the main findings of this research where the success factors of sampled companies are presented along with some business problems that were encountered in these companies and their respective blockchain solutions that were employed to overcome these problems.

4.1. Success Factors of Sampled Companies

Details of sampled companies are shown in Table 3 where their business names, locations, business innovation, services, and products that are based on blockchain solutions, signals of success, and distinctive capabilities along with some exceptional excerpts are tabulated. One common factor that unites the selected companies is that they are all considered first movers in the Hungarian market that have started employing the technology of blockchain into their business processes in an attempt to solve different types of business problems where some operations were streamlined such as the operations used for data tracking and transaction registration. The selected companies are considered very successful in implementing the technology of blockchain although one of them went out of this business (e.g., *WarrantIQ*) due to personal circumstances whereas another one decided to replace one blockchain platform with another (e.g., *Meddictive*) as some bottlenecks were found in the capabilities of Blockchain architecture, noting that all selected companies have demonstrated how blockchain technology was utilized and tested within their operations as made evident by quotations extracted from conducted interviews.

Table 3: Overview of Examined Companies*

Company / Location	Business Innovation/ Services/Products	Signals of success & distinctive capabilities	Interview excerpts / Blockchain application
<i>bedrock.farm</i> - Hungary	- Production of microgreens, herbs, leafy greens with the exploitation of indoor and control environmental technologies - Selling the information about how to grow plants and the recipes to greenhouses and all other customers - Creating a platform where everybody can build their businesses	- Production of local and high-quality food year-round - No fluctuation in price and quality - Blockchain application for certification and validation - Willingness to be more transparent than other agricultural companies and thereby build trust with its clients - Closeness to their customers (located in the city center of Budapest) - Intention of creating a decentralized network for food production in the future	<i>“Our mission is to decentralize the production of food”.</i> <i>“We are building a platform where everybody else can build their businesses... We are measuring all the environmental data, we are giving our products to labs to check the quality of the food..., we are certifying those kinds of recipes because these recipes can be used in greenhouses...It is the core information that they can use every growth cycle and we need to validate that. This is where we use blockchain for the second part. It is more like a transparency method and certification, certification is the biggest part”.</i>
<i>Enerhash</i> - Hungary - Slovakia - Russia - Hong Kong	- Selling databox (containers) to power plants; building the data centers and renting out the places inside it - Selling computers/ servers to companies and individuals	- First mover in the Hungarian market - Diverse set of partners ranging from small to large power plants and other various unnamed clients - Decentralized data centers and special software - Cryptocurrency mining - Use of cryptocurrencies for international payments	<i>“There was one point where we were involved in blockchain as the crypto-currencies because we are mining bitcoins”.</i> <i>“We realized these cryptocurrencies take a few minutes and it's there and it's completely transparent and much better and faster to make</i>

			payments through these transactions than in the banking system”.
InsurWiz Technology - Hungary	- Digital insurance - Blockchain-based weather insurance	- One of the first tangible blockchain-based solutions - Partnership with AEGON - Interest from other insurance providers	“Pont így működik, hogy van egy kódrendszerünk, ami rendelkezik egy saját pénztárcával, és elvégzi a szükséges műveletet az Ethereum blokkláncon, oda rögzít, és mi vissza tudjuk követni, tehát le tudjuk kérdezni a saját tranzakcióinkat az Ethereum keresőjén”.
Meddictive Ltd. - Hungary - Bulgaria	- Blockchain-based tissue tracking and trading platform for healthcare professionals - Consultancy services on many complementary technologies, mainly, medical equipment - Teaching specialized courses at the medical universities	- First mover in the Hungarian market - Cooperation with 5 universities - Development of mobile application with QR code and crypto wallet - Tissue banking platform operating as a marketplace to connect tissue banks, universities, and hospitals - Participation in Blockchain development unofficial consulting board for the government and the tissue restructuring consulting board	“We would like to set up a platform which is a marketplace for human tissues, for registered and then listed parties”. “The technology we bring to the market is the blockchain for registering transactions and also to make sure the identity, the IDs are not fake”.
Solidity Services (franchise system) - Hungary - Denmark - the UK Subsidiaries: Galaxis Network	- Consulting (pre-sales activity) - Provide blockchain and business training courses - Software development services (building blockchain-based web applications with new functionality) - A blockchain-based digital asset management platform	- First mover in the Hungarian market - Franchise system/agency business model - International strategy, outsourcing tasks from the Western market - Creation of a strong brand - Diverse interrelated set of partners/subsidiaries in Denmark and the UK besides the Hungarian branches	“We use the existing blockchain networks and we build different use cases upon them”. “We are mainly looking at Ethereum because that is the most secured one. I think the technical support and development environment is the most advanced on that network”.

- Hungary Inventory platform - Hungary Defactory.io - Denmark	powered by smart contracts on Ethereum - A blockchain-based product tracking and chain of custody solution - Creating digital twins of the real-world assets based on a new generation of token standards	- A variety of clients ranging from banks to legal offices and start-ups - Pioneering platforms applying blockchain and smart contracts - A set of services covering both the technical and business sides	<i>“For consortium side, sometimes it doesn’t even matter which platform we are using. We have to use the one which is used by most people”.</i> <i>“I was always around banking solutions. I recognized that with blockchain technology we could build much more secured and transparent processes around the financial world compared to the current traditional architecture, there are a lot of pains which can be mitigated by utilizing blockchain technology”.</i>
WarrantIQ - Hungary	- Managing warranties - Issuance of online warranty - Saving and earning money	- Blockchain-based solution to manage and trace warranty documents - Make warranty data accessible for subsequent services: Warranty Voucher Platform - Simplification of the warranty process - Diverse clients from the B2C to B2B markets - Strong management background of the founders	<i>“We are using blockchain because of the tracking function of blockchain and also the recording function. There's another feature like verification for the seller or the producer from the seller, from any intermediary bodies. So it can track all the activities”.</i>

*Table is created by authors based on the interviews and companies’ websites

4.2. Business problems and Related Blockchain Solutions

Different business problems for which the sampled companies aim to offer their innovative blockchain-based solutions are showcased in this section while identifying the role these companies play in the discussed ecosystem as follows, noting that the interviewed companies perform as the complementors to the focal offerings and the open-source platforms in the context of companies' functions.

Problem and innovative solution 1

P1: Providing professional education and consultancy services to various stakeholders.

IS1: Consultancy, offering services on software development and training course packages on public blockchain programming and consortium technologies.

Solidity Services is a Europe-based professional blockchain services network that has started its operations in 2018. It assists in technology implementation and supports global adaptation across different industries by using the existing blockchain networks and delivering blockchain solutions that are tailored specifically to the requirements of individual organizations. With its services and products, *Solidity Services* serves as a complementor to the offerings of its clients among them banks and financial institutions, legal offices, logistics, and supply chain traceability organizations, start-ups, and real estate agencies. For instance, the company provides a particular blockchain-based solution for *bedrock.farm*. The example of *Solidity Services* demonstrates the high degree of interconnectedness between ecosystem members: except for creating a loyal customer base, the founders have built partnerships with Western companies by establishing a franchise system. As a result, *Solidity Services* manages several spin-offs including *Galaxis Network*, *Defactory.io*, *the Inventori platform*.

Problem and innovative solution 2

P2: Identification, traceability, and registration of transactions in a digital manner.

IS2: Addressing problems related to transparency, trust, immutability in various industries.

Meddictive Ltd. is the first Hungarian business entity with tissue bank registration. It is also a registered tissue bank in Bulgaria and the other three countries already under registration. At this time, this startup company is in a mature development phase while it was set up in 2017 due to

sensing activities of Blockchaineum consultancy agency that identified blockchain potential in the health sector. The objective of the company is to improve the cross-border tissue flow within the member states of the European Union by involving all the interested actors of the tissue market to increase the available supply and quality as well as to make scientific and clinical data accessible. To achieve this goal, the company operates as a marketplace through its tissue banking platform to link tissue banks, medical institutions, and universities. The company utilizes the distributed ledger to check the authenticity of the IDs and to register and track transactions of tissues. The technology of blockchain helps address the issues of transparency, trust, and immutability in the tissue industry. Table 3 outlines the Meddictive's services including the provision of consultancy services on the fitting product and the cutting-edge technologies. *Meddictive* involves its clients in an open innovation and R&D process through its activity as the external source of innovation and its partnerships with the leading universities such as the Academic Centre for Dentistry Amsterdam, Manchester, Plovdiv, and Semmelweis Universities.

The Inventori platform is the Hungarian spin-off company of *Solidity Services Group*. The company creates value by building a transparent and easy to access supply chain traceability platform to optimize the process of inventory management certificate registry and product origin validation that is operating across countries. *The Inventori platform* is built on decentralized distributed ledger technology: public smart contracts verify and govern the flow of assets and related information. This platform unites different participants that can digitally track the goods on the same infrastructure network with an unlimited number of stakeholders, the tamper-proof blockchain infrastructure and cryptographic principles reduce the fraud attempts and protect confidential business information while the open-source network provides free access to origin validation for the public.

bedrock.farm is a startup that works in the urban agriculture industry. They exploit blockchain technology to certify and validate data about the production, harvestation, and delivery of the product to be more transparent than other agricultural firms. *bedrock.farm* considers trust as the main value and creates a new method of service through the decentralization of food production. By sharing sensitive and inner information, such as the know-how, with greenhouses and other farmers and by building a platform, *bedrock.farm* is helping other companies to start their businesses. In this sense, the main mission of *bedrock.farm* is to serve as the external source of

knowledge for other actors and at the same time, it benefits from the cooperation with the technology providers (e.g., *Solidity Services* and its *Inventori platform*). *bedrock.farm* actively engages in both closed and open innovation activities.

Problem and innovative solution 3

P3: Building, testing, and operating applications with a blockchain backend.

IS3: Developing distributed applications and smart contracts.

Meddictive Ltd. is developing a mobile application with QR code and crypto wallet to track time and all the movements and the changes of the tissues and manage the payments and everything through the system and thereby decrease the administrative burden of the dental and medical professionals.

Solidity Services develops software and builds blockchain-based web applications, mainly on Ethereum that is an open-source and decentralized software platform; therefore, the company complements the platform providers. Based on specific requirements *Solidity Services* develops smart contracts covering the architecture development, the front-end interface, and the contract deployment.

WarrantIQ was an early-stage startup initiation that operated from 2018 and was closed in March 2020 due to personal circumstances. They were developing new e-warranty solutions for users and enterprises that were required to provide outdated paper-based warranty services. The main function of this start-up was to store and secure warranty documents on blockchain where participants such as consumers, retailers, carriers, banks, and insurance providers were involved. Such services as managing warranties and issuance of automatic online guarantee vouchers for SMEs through a warranty voucher platform save users time and money. *WarrantIQ* complements the existing blockchain-based platforms and also connects multiple stakeholders on its designed platform.

Insurwiz Technology focuses on product development and provides software to insurance companies that can be incorporated into products. They partnered with AEGON to develop blockchain-based weather insurance called Mowi. Smart contracts on the Ethereum blockchain are used for traceability and automation. *Insurwiz* is one of the Ethereum platform's complementors.

Problem and innovative solution 4

P4: Volatility of power generation and the need for power plants to optimize their production under difficult market conditions and high system usage fees.

IS4: Providing significant added value for energy producers in terms of profitability and efficiency by doing Bitcoin mining and hosting cryptocurrency mining companies.

Enerhash offers a new solution for energy companies to maximize the value of energy production via implementing decentralized data centers to use power plant excessive capacity for Bitcoin mining and other similar blockchain technologies. The company connects different stakeholders: it sells the Enerhash databox to power plants and builds the data centers and rents out the places inside it for cryptocurrency mining companies. So, the company provides hosting services for miners by operating their assets on low energy prices and cost-effective operations. As *Enerhash* is involved in global operations, the company also uses cryptocurrencies to make payments quickly and avoid high overseas transaction fees.

Problem and innovative solution 5

P5: The presence of dishonest cryptocurrency exchanges and the need for a convenient and trusted player on the market where one can buy or sell cryptocurrencies for fiat currency.

IS5: Providing easy access to cryptocurrencies, accepting local cash or offering exchange by fast and cheap bank transfer; installation of Bitcoin ATMs in public places.

With its motto “Bitcoin made simple” CoinCash.eu positions itself as the most trusted brand in terms of cryptocurrencies in Hungary. CoinCash.eu offers two types of services: one is transferring money online and another is the access to the largest network of Bitcoin ATMs (16 ATMs) which offer bi-directional functionality, by running nodes and using smart contracts CoinCash enables the customers both to purchase Bitcoin, Litecoin, and Ethereum and sell cryptocurrencies for local currency. The company’s mission is to serve as a “gateway between traditional finance and crypto economy” by transferring value between both worlds. The creation of a fundraiser wallet for hospitals together with MrCoin and INLOCK.io during the pandemic indicates and participation of CoinCash in Blockchain Working Party indicates interconnectivity between ecosystem members.

Problem and innovative solution 6

P6: Ponzi schemes and scandals, human errors, fraud and misbehavior, centralized control in the portfolio management industry and crypto asset management industry.

IS6: Bringing technology-driven transparency to the asset management industry by using smart contracts and blockchain and creating a secure framework and environment for hedge funds and crypto-assets.

Galaxis Network is the Hungarian spin-off company of *Solidity Services Group* and it is a blockchain-based digital asset management platform powered by smart contracts on Ethereum, that is, the *Galaxis* project is a layer upon the existing decentralized finance protocol. The purpose of the platform is to improve the security of the investors and create a trustless environment for portfolio management where the predetermined smart contracts control all processes and connect different stakeholders. Therefore, *Galaxis Network* acts as the complementors for other players in the asset industry and Ethereum platform.

b-cube.ai developed the first completely automatic trading bot on the market intending to make cryptocurrency trading more profitable by eliminating human errors and using AI, mathematics, very complex models, NLP (Natural Language Processing) technique, and machine learning tools such as sentiment analysis. Instead of holding the clients' money, the company asks for their API (Application Program Interface) key and permission to trade in the account of the client. They use a blockchain application software uPort to securely store and encrypt the API keys. *b-cube.ai* uses an Ethereum-based smart contract to collect their shares of the profit at the end of every month. The revenue stream of the company consists of 3% entry fees and 20% profit sharing on a month-to-month basis. Among the company's key partners are the AMF (Autorité des Marchés Financiers), Bitmax exchange, IDEX, Binance cryptocurrency exchange, and other partners. The company is actively engaged in R&D activity both in-house and external, being incubated at CentraleSupélec, the second-best engineering school in France, and at K&H bank incubator in Győr.

Problem and innovative solution 7

P7: Difficulties in selling or receiving ownership of such illiquid assets as real estate and land records.

IS7: Representation of real-world assets as digital tokens on a distributed digital ledger or blockchain.

Defactory.io is the spin-off company of Solidity Services Group operating in Denmark. It is a blockchain-based digital asset issuance platform offering an automated solution for the rapidly emerging digital asset industry and offers a way for anybody to create digital twins of physical assets according to the use case they are searching for. For example, the integration of the specific features of unique assets and fractionalization enables people to have an opportunity to own some portion of artworks or any kind of property like skyscrapers.

4.3. Summary of Chapter Four

This chapter presented details of the six sampled companies including their business names, locations, the different blockchain-based innovative solutions, services, and products in addition to signals of success and distinctive capabilities. From the six sampled companies (Bedrock.farm, Enerhash, InsurWiz Technology, Meddictive Ltd., Solidity Services and WarrantIQ), seven different business problems were identified such as providing professional educational and consultancy services to various stakeholders, identification, traceability, and registration of transactions in a digital manner, building, testing, and operating applications with a blockchain backend, volatility of power generation and the need for power plants to optimize their production under difficult market conditions and high system usage fees, the presence of dishonest cryptocurrency exchanges and the need for a convenient and trusted player on the market where one can buy or sell cryptocurrencies for fiat currency, Ponzi schemes and scandals, human errors, fraud and misbehavior, centralized control in the portfolio management industry and crypto asset management industry and difficulty in selling or receiving ownership of illiquid assets such as real estate and land records where appropriate blockchain-based solutions were found and applied.

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter discusses the main findings of this research while conducting a comparison against findings made by previously conducted research and national papers and drawing the main conclusions of the research findings. The chapter proceeds to outline business and policy implications of the conducted research while highlighting related limitations and suggestions for the potential of future research.

5.1. Main Conclusions

The reviewed case studies on Hungarian companies demonstrate that blockchain facilitates innovation creation across multiple industries, namely, information technology, agriculture, health, warranty, insurance, finance, and energy industries. In line with the literature (Angelis & Ribeiro, 2019; Iansiti & Lakhani, 2017), the presented companies show how blockchain contributes to reshaping traditional businesses and changing existing value propositions. For example, the innovative offerings encompass certifying and validating data on production and inventory (*bedrock.farm* and *Inventory platform*), providing services for storing warranty documents on the blockchain (*WarrantIQ*), developing a blockchain-based weather insurance application (*Insurwiz*), and building completely new business model through selling data centers to energy companies and renting out these facilities for cryptominers (*Enerhash*).

By applying the theoretical lenses of the ecosystem and dynamic capabilities constructs (Heaton et al., 2019; Teece, 2007), it can be stated that the Blockchain ecosystem in Hungary goes through the initial to the development stages which is also in line with the statement that blockchain ecosystem in Hungary is now emerging as it attracts more participants and initiatives (Giaglis et al., 2020). The formation of the Hungarian blockchain ecosystem started to emerge at the end of 2016 and the beginning of 2017 amid the ICO bubble and the sharp rise in cryptocurrencies' prices. The first steps in exploring blockchain technology were made by the incumbent companies before the outset of these events. As explained by the President of the BHA, Mr. Kalocsai: “*Big international companies,*

like Deloitte, have started to deal before 2016, while the small companies and start-ups have begun in 2017, some pioneers might have appeared in 2016”.

Initial stage/sensing: In this stage of the Hungarian blockchain ecosystem formation, entrepreneurs and technology enthusiasts started to discover new opportunities created by blockchain. This corresponds to Overholm’s inference (2015) that an emerging ecosystem may create opportunities for new entrepreneurs by providing a possibility for market entry.

Two of the interviewed companies, Meddictive and Insurwiz Technology, are examples of firms that managed to identify the economy’s needs and the potential of blockchain technology in creating new business solutions, where the initial stage of ecosystem development was characterized by few firms with limited identity and rare interactions with other members of the ecosystem.

The CEO of the Meddictive company explained the process of their involvement in sensing activities (Teece, 2007) where the company started to research blockchain within the Mensa Hungarian Association, then Blockchaineum consulting agency was founded, as explained by Mr. Czeglédi: *“We actually started doing everything from Bitcoin mining to the potentials of the technology and we started to share knowledge within this small group. After two years we realized that we were not experts in this field, but it seemed that we knew the most in the Hungarian market, so we started to teach what we know and share our knowledge”.* To promote the spread of this technology and bring various stakeholders together, Blockchaineum team successfully organized the first Blockchain Summit with around 600 participants in 2017.

Insofar as the Blockchain ecosystem is mainly represented by several startup companies, they are considered ecosystem pioneers on the Hungarian market. The Meddictive company can be considered a pioneer firm that discovered how blockchain could add value in the health industry, as clarified by the CEO: *“We [the founders of Blockchaineum] were looking for a field where blockchain can add value. This was one point of decision. On the*

other hand, we realized that what the tissue industry is missing is transparency, trust, immutability, and so on. It was a strategic match”.

In the case of Insurwiz Technology, the search for blockchain application started at Blockchain Competence Center (BCC), a consulting company specialized in the Blockchain industry. As explained by the founder of Insurwiz: *“We already had the BCC. We’ve been looking for blockchains use-cases. I met Szabolcs Szota and he was interested in insurance innovation then. He used to work for insurance companies...He said what could be done with blockchain. And that was a very strong point”.*

Development stage/shaping: After detecting opportunities, businesses have created new products, services, and processes (see Table 3) by following niche strategies (Iansiti & Levien, 2004). In an ecosystem, value creation is enabled by the presence of complementarities and interdependencies between participants (Kapoor, 2018). The construct of interdependency is crucial in the technology-based ecosystem, as the reduction of dependence isolates the organization (Santos & Eisenhardt, 2005). In this sense, companies create value by cooperating with third parties to develop customized business applications. The CEO of bedrock.farm noted: *“We got a partnership with companies [Inventori platform and Solidity Services] that develops blockchain for inventory and supply chain certification. So, we are designing it, it is based on blockchain, not the whole system but the certification part”.* The CEO of Solidity Services introduced the company’s international development strategy aiming at establishing contacts with partners that can assist them in sales and specific geographical regions. In explaining its partnership with Aegon, the global insurance company, the founder of Insurwiz Technology noted: *“AEGON would like to appear as an innovative insurance company, and they said that no matter how many customers it would be, it’s not about generating revenue, it’s about establishing that AEGON is an innovative insurance company, and if someone asks why you’re making this claim, they can show that they have blockchain-based ski insurance”.*

Collaborative ties with other participants and involvement in the open innovation process can also help companies to figure out how to implement blockchain technology. As explained by Czeglédi Tamás, they are working together with IOTA Foundation and Zebra Technologies to create use cases when RFID sensors can work to have communication between the real world and blockchain. The case of Meddictive demonstrates how the company sensed the development of blockchain and other innovative technologies, seized the new opportunity by optimizing processes in the tissue industry, and profited from consulting various stakeholders in the health industry on the transformation of their outdated practices and coordination of their capabilities development. The Meddictive's intermediary functions were confirmed by its CEO: *"We are the first Hungarian business entity with the tissue bank registration. We were able to sign contracts with 5 universities in 6 months, and our focus was to help them with the tissue banks and now we are focusing on their tissue banks to be upgraded and bringing new technologies"*.

Even though the Hungarian Blockchain ecosystem has not reached the development/stability stage as well as the renewal stage, sensing, shaping, and transforming are simultaneously exploited by its members. For example, Meddictive shows some traits of transformative activities, as indicated by the CEO: *"After six months we decided to shut down the whole system because we realized that what is the value in blockchain if you cannot change anything...So, we decided to stop everything and restart the situation that we make sure we understand fully everything"*.

A significant contribution to shaping the Hungarian blockchain ecosystem is made by the BHA led by President Kalocsai, where the association stimulates the information flow among the Hungarian and international participants and it facilitates knowledge transfer from the US and other countries while helping sell the Hungarian knowledge abroad. The BHA has taken steps to enhance the level of communication and cooperation as well as knowledge transfer among established companies and start-ups, as acknowledged by Mr. Kalocsai: *"Our association is connecting big companies with start-ups, and we are promoting start-ups to the big companies"*. This adopted approach goes in line with the view of Bogers et al. (2019) which states that the focus in the ecosystem study should not be

exclusive on companies but also should include non-profit actors (e.g., universities) and individuals.

Realizing the significant efforts made by local stakeholders of the Blockchain environment to enrich the ecosystem resources, higher education actors such as BME, Corvinus, and Edutus offered several blockchain courses, and targeted conferences (e.g., Blockchain Budapest) are annually organized. The above findings correspond to the results of Jáki et al. (2019) on identifying the Hungarian startup ecosystem's strongest characteristics such as social events (e.g., meetups and networking) and international relations.

Thus, Mr. Kalocsai acknowledges that the Blockchain ecosystem in Hungary is in a good condition and there are successful projects and startup firms with a solid knowledge base. The leaders of our sampled start-ups are actively involved in internationalizing their activities that predict the companies' competitive advantage and good performance (Csákné et al., 2020). The examined start-ups contribute to the realization of the European agenda on accelerating blockchain innovation and developing the ecosystem within Europe. Although Hungary possesses the necessary characteristics of the successful ecosystem (Heaton et al., 2019), further development of the Hungarian blockchain ecosystem depends on progress in the European regulation and the action of Hungarian authorities. A clear legal framework will accelerate the commercial and business activity in the local and European markets (Nascimento et al., 2019).

5.2. Business Implications

Since the Blockchain ecosystem in Hungary is currently going through a transition between the initial and the development stages and following the study of Enkela and Sagmeister (2020), it is advised that established companies should enhance the level of communication, cooperation, and collaboration with blockchain start-ups and other ecosystem participants locally and internationally to boost dynamic capabilities by utilizing their expertise in the fast-evolving technology of blockchain and related distributed ledger technologies. To help facilitate the transition into the development stage, it is recommended

that more investments are made into development and commercialization activities where organizational forms and business models are upgraded and new blockchain-based innovative solutions, products, and services are developed and commercialized.

As a result of developing the ecosystem of blockchain in different industries and among different participants within and outside the country, it is expected to witness an improvement in the level of knowledge exchange, relations between ecosystem participants, innovation, and employment rates in Hungary.

5.3. Policy Implications

To facilitate the transition of the blockchain ecosystem from the initial stage to the development stage in Hungary, it is advised that policymakers enhance the sophistication of its related legal regulations to strengthen the Blockchain field which belongs to the high value-added ICT services branch of diversified economies while protecting the investors and businesses against any possible downturns (Szerb et. al. 2020; Zsoldos, 2020). Additionally, the Hungarian authorities are advised to establish formal working groups from different ministries across the country to better assess the potential of blockchain technology while funding more pilot projects at the country level.

5.4. Research Limitations and Future Work

A few limitations were encountered upon conducting this research where some of them were inevitable. The first limitation is that the research was conducted on a limited number of blockchain-based companies in a limited number of industries within Hungary which hinders the ability to generalize the findings to all companies in all industries; future work is recommended to cover a larger number of companies in a larger number of industries.

The second limitation is that the research adopted a qualitative approach using interviews for data collection where future work is recommended to adopt a quantitative approach and compare findings against the findings of this research.

The third limitation is that this research lacks the inclusion of other European countries which hindered the facilitation of benchmarking the performance of Hungary against other European countries where future research is recommended to construct a European sample of blockchain firms (including over 100 Hungarian players) to facilitate benchmarking while studying survival patterns in terms of covered niches, VRIN criteria, and DCs, technology management, open innovation, and proprietary technologies.

The fourth limitation is that this research was conducted under extreme conditions of the global pandemic – COVID'19 where future research can be conducted under more stable circumstances after the pandemic is over.

5.5. Summary of Chapter Five

This chapter discussed the main findings of this research while comparing them against findings made by previously conducted research whereby the Blockchain ecosystem in Hungary was found to be between the initial and development stages where business and policy implications were highlighted. Business players are expected to witness an improvement in the level of knowledge exchange, relations between ecosystem participants, innovation, and employment rates whereas policymakers are still expected to work on enhancing the sophistication of its regulations to strengthen the blockchain field and protect business players and investors in Hungary. The chapter proceeded to suggest some fruitful tips for future research while highlighting some of its limitations.

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APPENDIX A: Semi-Structured Interview

Date: _____
 Interview length: _____
 Name: _____
 Job title/ Position: _____
 Employability period: _____
 Company: _____
 Phone: _____
 E-mail: _____

Interview Questions
I. Questions on background information about the firm
1.1 How did the idea for your business come about? 1.2 Could you tell me more about yourself, your educational background and working experiences? 1.3 What level of entry barriers did your firm experience in the beginning? 1.4 How did you raise funding for your venture? / How much does it cost to start a startup? 1.5 Did your company receive any public financial support? 1.6 What are the resources and competences of the company? 1.7 What are the threshold and distinctive capabilities of your company? 1.8 How does your company recreate/reconfigure the (DC) capabilities? 1.9 How do you renew the company from time to time? 1.10 How do you learn from your partners (university, foreign partners) concerning the whole blockchain ecosystem?
II. Questions on Employees
2.1 How many employees in your company? 2.2 Do you have HRD at your company/ training department? 2.3 What training do your employees receive? Do you and your employees attend conferences, workshops? 2.4 Is there a lot of collaboration within teams and across different ones? 2.5 Do you have a budget for training? 2.6 Do you evaluate training? 2.7 Is your training connected to strategy? 2.8 How do you as a manager - or your manager- support and motivate your team? 2.9 How do managers and employees share feedback? 2.10 Is risk taking encouraged and what happens when people fail?

2.11 What kind of people seem to be the most successful here? What are their achievements? What were their achievements in the last time? 2.12 How do people at the company unwind and recharge after working hard?
III. Questions on company's operations
3.1 What problems are you trying to solve? 3.2 What value do you deliver to the customer? 3.3 Who are the most important clients? And how do you build a customer base? 3.4 What product or service do you offer for your customers? 3.5 Who are your key partners? 3.6 Which key activities do your partners perform? 3.7 What are your revenue streams? 3.8 What key resources do your value propositions require? 3.9 What are the most important costs inherent in your business model? 3.10 What are the constant and changing costs? Can you tell us about the companies cost structure ? 3.11 What does the company do to improve organizational processes? 3.12 Do you have SOPs? standard operating procedures (identification of processes, how they relate to the whole ecosystem)? 3.13 Are there any cost saving projects in the pipeline? If so, did you study the impact on the processes/ Output? 3.14 Do you have a product development department (R&D)?
VI. Questions on markets and sales
4.1 What are the main markets? What are the characteristics of these markets? 4.2 In which geographic markets does your enterprise sell goods and/or services? 4.3 Which of these geographic areas was your largest market in terms of turnover? 4.4 What do your customers currently pay for? How would they prefer to pay? 4.5 Could you tell in more detail about the B2C healthcare trading platform and B2C payment system? 4.6 What is the size of the market you are aiming for? And how many customers will you be able to sell to? 4.7 Do you use any tools (surveys) to measure your performance in the market? profit, Customer satisfaction and new customer needs. 4.8 How do you plan your Marketing campaigns? 4.9 Are your marketing plans aligned with your strategy? 4.10 Do you have an E-commerce team in your department?
V. Questions on Innovation
5.1 Did your enterprise introduce new products or new business practices to the market?

5.2 Which innovation activities do your enterprise engage in? (*In-house R&D, External R&D, Acquisition of machinery, equipment, software & buildings, Acquisition of existing knowledge from other enterprises or organisations, Training for innovative activities, Market introduction of innovations, Design, others*)

5.3 How much did your enterprise spend on each of the following innovation activities?

5.4 Could you indicate the type of innovation co-operation partner and their location? (*types of partners from the Community Innovation Survey (CIS): Other enterprises within your enterprise group; Suppliers of equipment, materials, components, or software; Clients or customers from the private sector; Clients or customers from the public sector*; Competitors or other enterprises in your sector; Consultants or commercial labs; Universities or other higher education institutes; Government, public or private research institutes*)

5.5 Which type of co-operation partner was the most valuable for your enterprise's innovation activities?

5.6 How does your innovation culture look like?

5.7 Are there specific people assigned to innovation activities?

5.8 Does the company reward innovative ideas?

5.9 Do you focus on internal innovation?

5.10 Are employees from different segments able to connect with ones from other segments to mutually brainstorm? Is there a platform for that?

VI. Questions related to Blockchain technology

6.1 Why did you select Blockchain technology?

6.2 Which blockchain platform did you choose for this company? What advantages and disadvantages does it have in comparison to other platforms?

6.3 What are the benefits of Blockchain? How can technology be used to build trust between partners?

6.4 What are the main limitations of Blockchain?

6.5 What is a security policy?

6.6 When did you start using Blockchain technology?

6.7 How do you improve your knowledge in blockchain updates?

6.8 Do you measure your employees' knowledge related to this field? If so, how?

6.9 How crucial is blockchain technology? What is the added value?