

**Dogukan Dizman**

# **BEYOND CRYPTOCURRENCY: THE ROLE OF BLOCKCHAIN IN THE FUTURE**

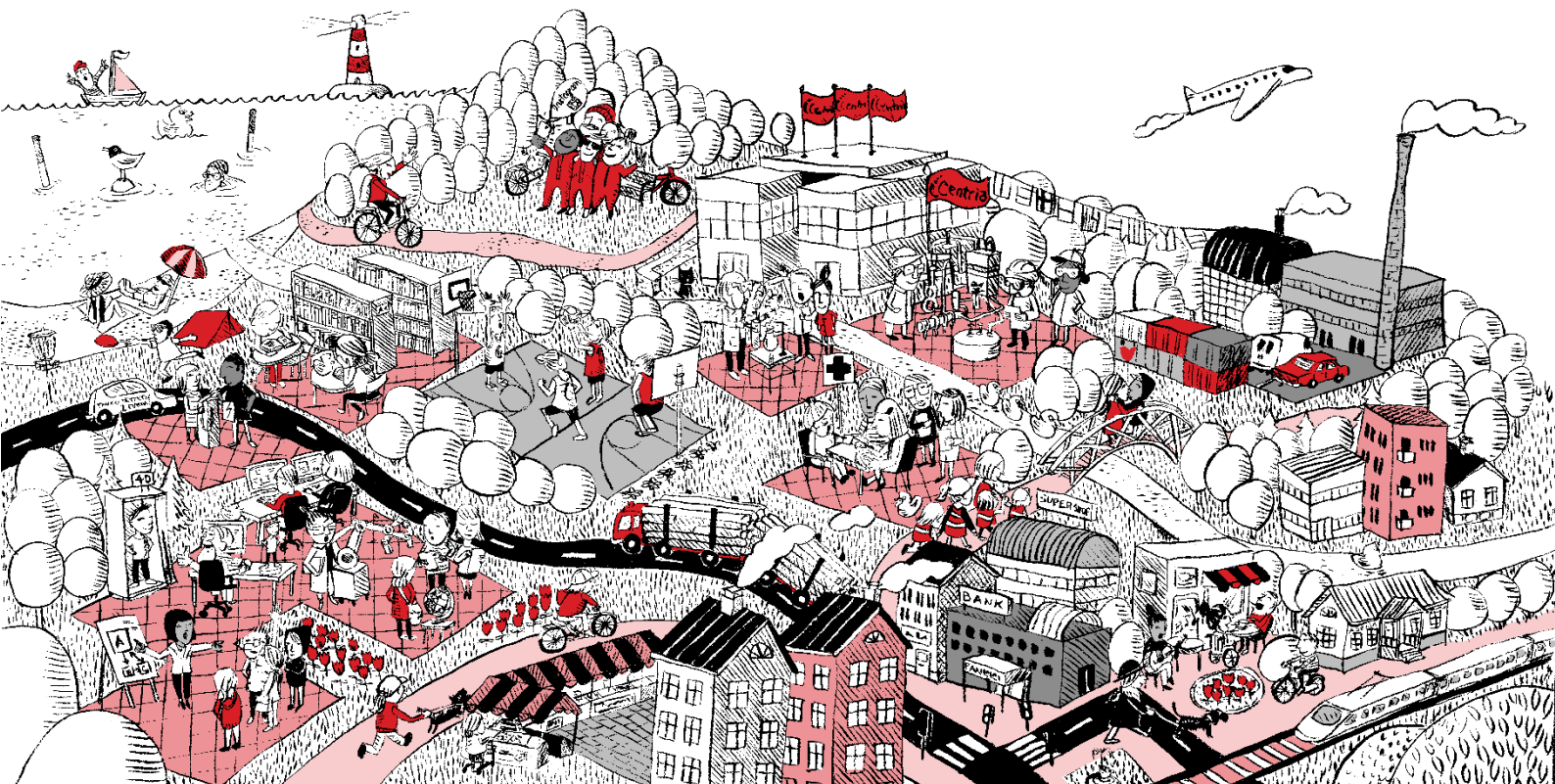
**ERP and Blockchain Integration**

**Thesis**

**CENTRIA UNIVERSITY OF APPLIED SCIENCES**

**Bachelor of Business Administration, Business Management**

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**ABSTRACT**

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<p>The objective of this thesis was to study blockchain technology in the case of Marmara Chain. This thesis looked at the industry uses of blockchain and analysed the future of blockchain technology. The first objective of this thesis was to tell the reader how blockchain works and why it is important. This thesis also examined enterprise resource planning, how to implement ERP, what the modules of ERP are as well as the advantages and the risks about it. However, the main aim of this thesis was to answer the questions such as whether the integration of blockchain and ERP is possible, what the benefits and challenges of such an integration are.</p> <p>To answer the research questions, a literature review was conducted. The books and articles were selected from scientific databases such as Google Scholar, Research Gate, Centria E-Library.</p> <p>Blockchain is a decentralized ledger in which the record of transactions is made. The data on blockchain is unable to be modified, which makes the system secure and suitable for industries such as healthcare, cyber security, voting and banking and payments. On the other hand, enterprise resource planning systems is the core of all business processes in a company: finance, production, HR, supply chain and so on. ERP integrates all business processes in a single system.</p> <p>The main result of this thesis was that blockchain can address to the challenges of ERP. ERP systems most likely require customization to meet organizational issues. These customizations raise issues and solving these issues is expensive. However, as blockchain with its decentralized ledger offers increased visibility and enhanced trust it can address to some challenges of ERP systems.</p>		
<b>Key words</b> Bitcoin, blockchain, economic order quantity, ERP, future technology, Marmarachain, middleman, materials requirement planning, node		

## **CONCEPT DEFINITIONS**

### **B2B**

Business to business

### **BI**

Business intelligence

### **DISTRIBUTED LEDGER**

Meaning that blockchain is not based only single computer, but it is distributed to each computer in the network.

### **ERP**

(Enterprise Resource Planning Systems) is the integrated management of all business processes in an organization.

### **EOQ**

Economic Order Quantity

### **HASH**

It is a function which meets encrypted demands that are used to solve for a blockchain combination.

### **IOT**

Internet of Things refers to network of physical objects.

### **MRP**

Materials Requirement Planning is a system that makes the planning and decisions related to production processes.

### **SAP**

System, applications, products in data processing. Enterprise software to manage business activities and customer relationship management.

**ABSTRACT**  
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## 1 INTRODUCTION

Blockchain is already a big part of our lives. During the recent years, blockchain became so popular that all over the world millions of people keep cryptocurrencies in their online wallets as a way of investment. Yet still all the users of blockchain technology does not know what blockchain is all about, as well as the reason why blockchain itself, and cryptocurrencies are becoming more common over time. In short, blockchain is a decentralized ledger technology, based on peer-to-peer network, and it operates in a way that allows the data to be stored in all users' computers in the network. There is no single person regulating the system, everyone in the in the system is a part of the regulation. Even a single change in the system must be approved by each party. Blockchain hereby provides a safe environment for its users. (Voshmgir 2020.)

Blockchain technology is not only related to cryptocurrencies but also this relatively new technology brings new practices into many different sectors from banking to healthcare. In fact, implementation of blockchain into current technologies is easy. For instance, since the 16th century banking sector has been acting as a middleman to validate transactions. With the advancement of technology, blockchain provides the opportunity to cut the middleman as well as to create a safe and cheaper payment system (Beall 2017). As a technology based on a decentralized ledger, blockchain has potential answers to the questions in our minds related to the growing privacy problems in the digital age. In today's world, few companies such as Google, Apple, Amazon, Facebook, etc. have huge economic power. These powerful companies keep billions of people's personal data in their own records, and from time to time they violate the privacy of their users without any hesitation. (Maleh, Shojafar, Alazab & Romdhani 2020, 75-77.)

For the time being, enterprises must deliver their products to their customers on time and at reasonable prices. Otherwise, it is arduous to survive in such a competitive market for those enterprises. In order to complete the production in a quality and timely manner, those enterprises must plan all the internal and external activities effectively. Considering the developing competitive market conditions today, enterprises need to use Enterprise Resource Planning (ERP) system to be able to present the orders on time and at affordable prices. Simply, the ERP system allows companies to manage and integrate their systems on the way to success, and it covers planning, procurement, sales, marketing, finance, human resources, and many more. (Parthasarathy 2007, 1-2.)

This thesis firstly answers the questions such as: What is blockchain? What is the technology behind blockchain? What are the uses of blockchain technology? What is Marmara Chain? Can blockchain address the privacy issue? How is the reaction of governments towards blockchain? How will the future of blockchain be? What are the advantages and disadvantages of blockchain technology?

In the second part, the thesis examines ERP and its implementation process. This chapter also includes the modules of ERP as well as the benefits and limitations of ERP systems. The third part of the thesis brings out new questions and looks at whether the integration of blockchain technology and ERP is possible. Can blockchain address the challenges of ERP systems? What are the potential applications?

Finally, this thesis was written based on the research method, and electronic sources. The purpose of this thesis is to find out whether the integration of blockchain and ERP is possible.

## 2 BLOCKCHAIN

The term blockchain was first coined by a person or group of people known as Satoshi Nakamoto in the article “Bitcoin: A Peer-to-Peer Electronic Cash System” published in 2008. In the article, the writers described Bitcoin as a new international digital currency, and blockchain is defined as a chain of blocks with a signature. Blockchain technology does not only function as a backbone for cryptocurrencies such as Bitcoin or Dodge coin. Conversely, it stands out as a technology which holds the potential to transform the foundations of social and economic systems. (Vadapalli 2020, 13-14.)

Blockchain, as a chain structure formed by blocks, is a distributed database system that provides encrypted transaction tracking. Each block in the chain holds the hash value of the previous data. All blocks form a chain, with every other block supporting the one preceding it. Consequently, the data is unchangeable and permanent once it is recorded, and the information in the block cannot be adjusted without modifying each subsequent block. In other words, blockchain is a decentralized ledger that records and verify all the transactions across to peer-to-peer network. Hence, rather than relying on a central clearing authority, blockchain allows the operation to continue on a large network of computers and each user authenticates and approves the transactions. No single authority can control the network. The majority of the people in the network must agree to implement a new transaction, additionally, users in the network remain anonymous. (Kasthala 2019.)

Every structure which contains data is named as Blocks. Completed blocks are connected to each other and form the blockchain. Blocks consist of data, the hash value of the previous block, nonce, and Merkle root. When a change is made to any block in the chain, all subsequent blocks also must be changed. Otherwise, the change will not be acceptable.

As it shows in figure 1, blockchain technology allows a limited or unlimited number of participants to add new transactions to a peer-to-peer network, verify transactions, and include the new blocks to the chain.

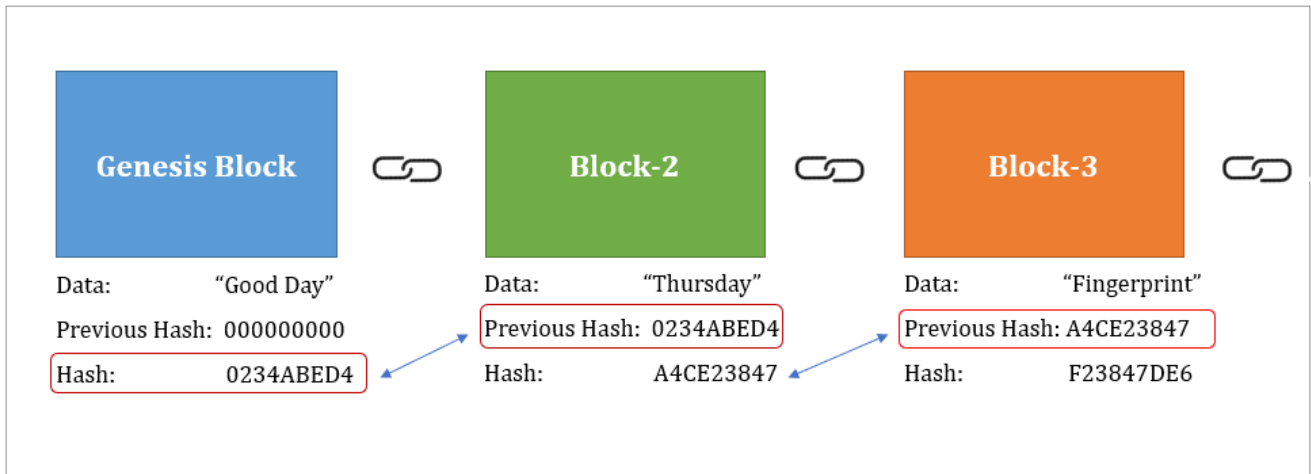


FIGURE 1. Foundation of blockchain technology (Kasthala 2019)

## 2.1 The principles of blockchain technology

First of all, blockchain is a relatively new technology, and it still has many unknowns and benefits. When a person nicknamed Satoshi Nakamoto created the first major and most successful digital currency Bitcoin in 2008, many people were curious about the underlying technology behind it. Ever since this technology evolved massively resulting in many innovations that make up blockchain history. For instance, an innovation developed by Vitalik Buterin, "smart contracts" embodied in the system in 2014, and allowed the technology to go beyond only using the cash-like tokens to work as a stronger financial instrument with loans, and bonds. Since then, many other new applications have appeared, so that nowadays, the use of blockchain technology has become more and more common. (Gupta 2017.)

## BLOCKCHAIN HISTORY

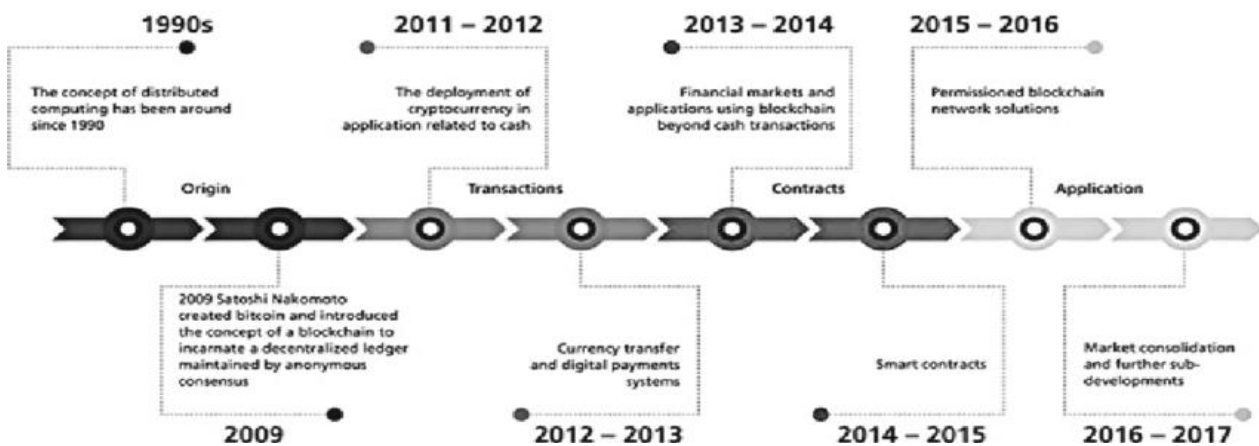


FIGURE 2. The history of blockchain technology (Iyenger 2020)

Blockchain works as a decentralized public ledger of all transactions across to peer-to-peer networks. In simple words, blockchain technology is a distributed network of databases that does not have a central authority to keep control and makes the data unchangeable when it is linked with the blockchain. As a matter of fact, by using blockchain technology, all partners can do transactions without having approval from a central authority. The distributed ledger also lowers the risk of corruption or mistakes. Hence, this robust technology is already playing a great part at revolutionizing many areas in life and specifically, businesses such as voting, banking, cybersecurity, infrastructure, and so on. More importantly, many benefits come along with blockchain technology. For instance, it maximizes transparency, improves security, reduces costs, and provides faster transaction time. Notwithstanding the fact there are many benefits of this relatively new technology, it also has unknown facts. Especially, the fact that it is a complex technology makes it difficult to understand. Not only that but also the regulatory impact is mainly due to the increase in anonymity that keeps some people and companies away from using blockchain technology. (Iyenger 2020, 450-453.)

The distributed ledger makes the whole technology very secure because of the fact that all transactions are done completely in a decentralized way. All partners in the network hold a copy of the transactions through the ledger. A transaction cannot be done without a consensus from all people in the network. During this stage “nodes” have a controller role meaning that they check if everything is according to the rules or not. Once all partners in the network agree on the data, then it joins the block. This block gets timestamped and consists of either data or messages. Later, the block is added to the chain. (Iyenger 2020, 450-453.)

Without a consensus by each participant in the network, it is impossible to make a change in the large blockchain network. For example, in figure 3 below, A wants to send money to B, and this transaction is represented in a block called “transaction block,” and this block is broadcast to everyone in the network. Once every single node on the network approves the transaction, the block then can be added to the chain. When there is a consensus, the distributed ledger has been updated, and each node in the network keeps an identical copy of this transaction. All these blocks in the chain are unique and consist of a timestamp, signature, and some other relative data. To make a change in a block, approval by the network is a must.

## How Blockchain Works

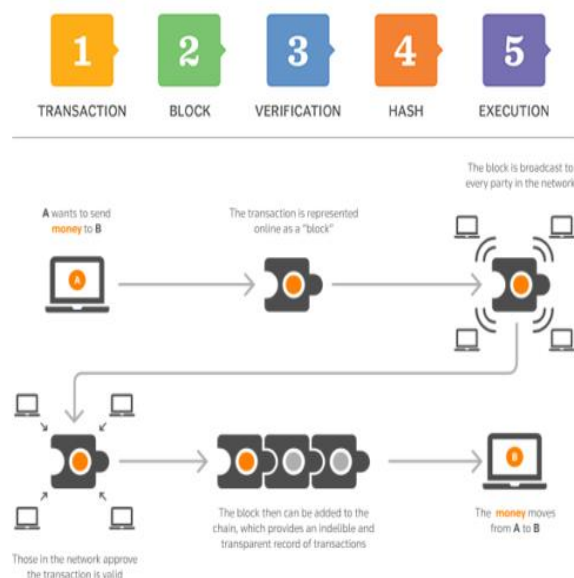


FIGURE 3. How blockchain works infographic (Fox 2017)

Apart from what is said so far, blockchain has five principles. To understand thoroughly how blockchain technology works it is very important to know these principles. The first principle is decentralization. As mentioned above, no single user on the network can have control over any transaction, but the power is distributed among all the participants. This fact makes the system much more secure and free from fraud. The second principle of blockchain technology is cryptography. To ensure security and authenticity cryptography is used. The third principle is security. Since blockchain is a decentralized technology, there is no central authority, which means that no single user can hack the whole

chain. The fourth principle of blockchain technology is inclusiveness. Everyone can join the network no matter what kind of background he or she has. The last but not least principle of blockchain technology is privacy. In today's world, a lot of online transactions are occurring, and keeping the data safe is difficult. Yet, blockchain technology uses an encryption mechanism, and it helps participants to make transactions even more secure and without disclosing their personal information. (McLeod 2018.)

## **2.2 Industries impacted by blockchain technology**

The use of blockchain goes beyond cryptocurrencies. Even though the primary use of blockchain is Bitcoin and other coins now, many industries are becoming much more open to the idea of using blockchain to own higher quality systems. It has the capacity to create a more transparent and fairer environment in many areas ranging from finance to voting. Not only that but also with the advanced technology blockchain provides it removing third parties and do all the interactions within the network becomes possible. Thus, blockchain has created a cheaper and faster way for many industries. For instance, the use of smart contracts is common in today's world. Smart contracts in many ways are very similar to regular contracts, however, unlike regular contracts smart contracts are complied with blockchain and cuts the middleman while providing an even more secure environment for the parties. That helps businesspeople to operate their businesses in a more feasible way. (Holotiuk & Moormann 2017, 13-15.) One of the examples of smart contracts is a company called BurstIQ, which provides blockchain-based data solutions for its customers in the healthcare industry.

Many industries are available for the use of blockchain such as healthcare, finance, infrastructure, banking, cybersecurity, voting, and so on. Though in many industries the use of blockchain is not common yet, it is becoming much more popular.

### **2.2.1 Banking and payments**

Retail banks progressed a lot in the last decade, and with the development in the retail bank industry, millions of people started making use of online banking, and many other new applications. However, the possibility to make higher progress still stands with the help of blockchain. Blockchain has the ability to bring value to core parts of traditional banking. Due to that, it is increasingly becoming vital and popular in the banking industry. To be more precise, blockchain technology can benefit the

banking industry in many ways. By providing a shared electronic ledger, this technology could have benefits on some certain services within the sector. For instance, the financial services can become more transparent and secure. As well as that, blockchain technology has the potential to eliminate middlemen and various back-office processes in order to lower fees and make faster transactions. In addition, using smart contracts on the blockchain can automate many manual processes. (Higginson, Halil & Yugac 2019.)

When it comes to the payments, blockchain technology can play a huge role for a great transformation. Nowadays, when an international transaction takes place, many additional fees which cost around 3 percent of the transaction value come up, and it takes days for the money to land into the other account. However, blockchain technology promises to simplify these processes with the help of distributed ledgers. If the parties decide to exchange cryptocurrencies instead of fiat currencies transactions can be a lot faster through blockchain technology. (Guo & Liang 2016, 3-4.) For example, most Bitcoin transactions take only up to 10 minutes and with almost no additional fees. This also helps banks to save up around \$10 billion annually. There are already some blockchain service providers in the industry. Ripple, as a fintech company providing blockchain service in payments, is actively connecting businesses with their customers. Especially, related to international money transfers the standard fee in Ripple is much lower than the fees charged by the banks in Swift transactions. (Higginson et al. 2019.)

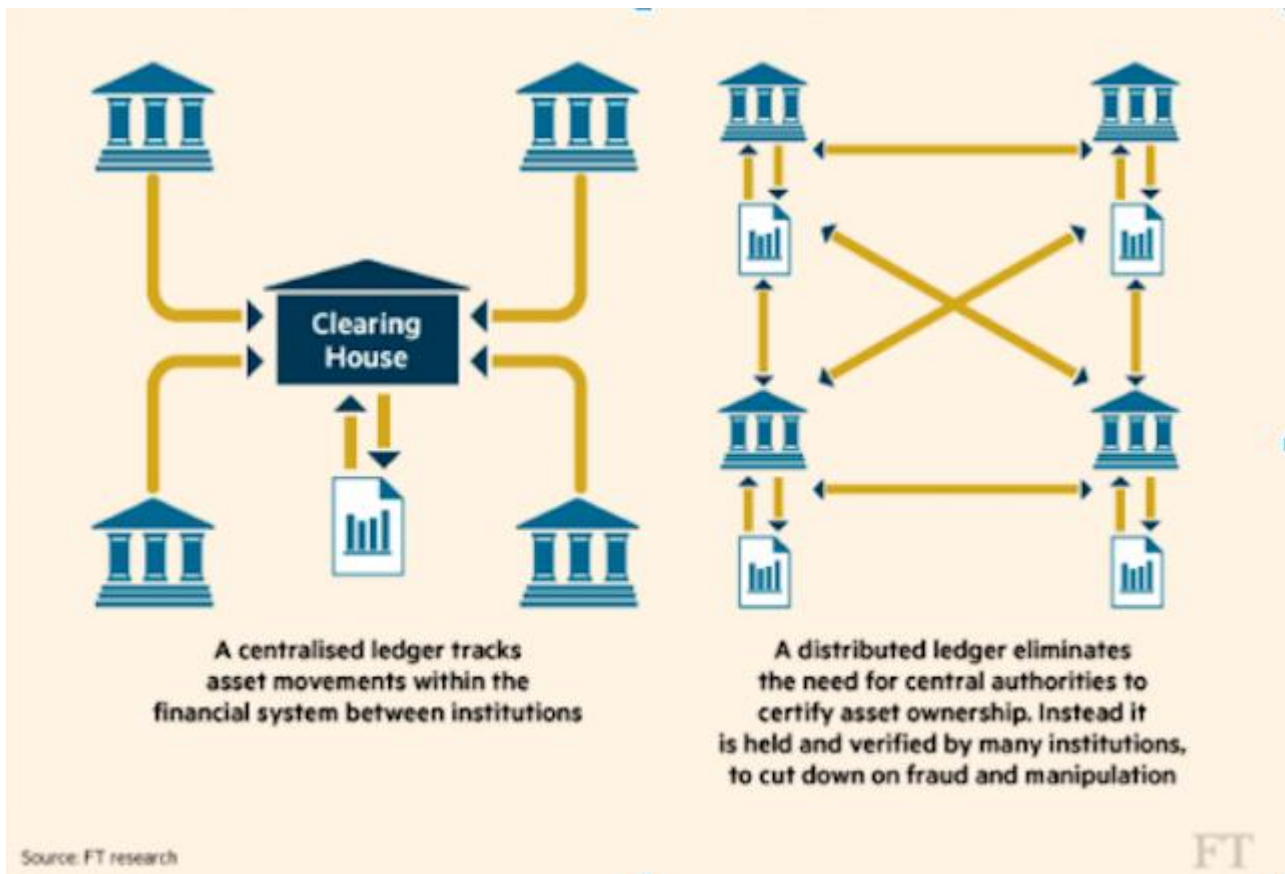


FIGURE 4. How blockchain could disrupt banking (CB Insights 2021)

Not only to the issue about payments, but also Blockchain technology can be the answer for other issues in the banking industry. For instance, it may be possible to prevent money fraud problems via this technology and save banks from a huge amount of operating costs. According to Javelin research, around \$15 to \$20 billion is lost by banks only because of identity fraud every year. Just for this issue, retail banks make huge investments in the know-your-customer protocol, to prevent money fraud, and money laundering as well as protecting their customers' data. Blockchain technology uses digital fingerprints to identify users and this digital print can be stored on a distributed ledger. Digital prints can be utilized to open a new account or to prove the identity around the world. With the help of blockchain technology, banks can save up to \$8 billion annually. (Faden 2017.)

However, even though all the advantages the question of whether blockchain technology is going to make a revolution in the banking and payment industry still remains. Retail banks are cautious to engage with this new relatively new technology. Except for that blockchain technology also faces some issues in terms of high fluctuation in the value of cryptocurrencies, and trust from time to time. However, one thing is clear: blockchain will make a transformation in this sector. (Higginson et al. 2019.)

### 2.2.2 Cyber Security

Cyber security yet is another area where the blockchain technology can play a great role. Nowadays, almost all businesses depend on technology and the internet. This situation has brought new challenges to the industry as cyber attackers have discovered more vulnerabilities that can be exploited. Enterprises have always been the main targets of cyber-attacks. In order to protect their systems, they spend millions of euros on cyber security. However, at times their cyber security systems are not advance enough, and those attacks cause not only massive financial losses but also leads to bad reputation. (Legrand 2020.)

Malware attacks have become more sophisticated, and this puts individuals and companies as well as governments in a tough and dangerous position. For example, in May 2014, Ukrainian presidential election was disrupted due to cyber-attacks. Also, during the United States elections in 2016, Russian hackers hacked Hillary Clinton's election campaign. These incidents show that cybersecurity is undoubtedly an issue even for governments. Security Intelligence Report estimates that the cost of cyber-attacks as of 2019 was \$3.92 million. Yet, these attacks as well as causing huge financial losses also attempt to steal personal information such as bank details, medical records, e-mails and so on. And, worse than this, the tremendous advances in technology have also created more gaps and opportunities for cyber attackers. Especially once the Internet of Things is embedded in our daily lives, almost everything from refrigerators to kitchen utilities will be connected to the Internet. Unfortunately, the security systems of these new technologies are not strong enough yet, so hackers may take advantage of this situation. (Piscini, Dalton & Kehoe 2017, 6-10.)

Some think that the emerge of promising blockchain technology can improve cyber security and address those issues. Ed Powers, Deloitte's U.S. Cyber Risk Lead says that "while still nascent, there is promising innovation in blockchain towards helping enterprises tackle immutable Cyber Risk challenges such as digital identities and maintaining data integrity." One of the most prevalent concerns of organizations is to have utmost confidentiality. To ensure that the data is available to only appropriate people, companies spend a great deal of money, whereas blockchain technology with its decentralized ledger can protect their crucial data in a cheaper and more secure way. Already, some organizations are using the blockchain-based system to protect their customers and insider data. The Founder's Bank is a good example of that, as it aims to be the first decentralized bank in the world.

By utilizing blockchain technology, organizations may guarantee integrity. There are many ways to make sure of integrity thanks to blockchain. For instance, digital signature, hash comparison and encrypted data can provide a higher integrity for organizations. As its key component decentralized ledger, blockchain technology can be regarded as a reliable technology. The encrypted data along with the hashing algorithm makes the system utterly impossible to tamper by the third parties. The only way to hack the system to own the 51% of the chain, however further restrictions can be taken to prevent this risk. (Piscini et al. 2017, 8-11.)

Blockchain can be the most effective technology to prevent cyber-attacks now and also in the future. Nonetheless, also blockchain technology faces with many difficulties as it is relatively new technology, and still growing.

### **2.2.3 Healthcare**

Health is the greatest wealth of all, and foundation of all things in life. Fortunately, there have been huge advances in health sector during the last decades and modern humans are lucky to benefit from all these advances. With the help of these advances, and widespread collection of data it may become possible to solve former problems in the sector. However, there is a need for even more advance technology like blockchain to be able to perform data analysis to arrive at solutions. Also, blockchain technology can be the answer to many other issues which exist in the healthcare sector. Blockchain-based systems are considered to have a great potential to eliminate those problems that plague our health. (Engelhardt 2017, 1-3.)

Blockchain technology can be used in a wide range of areas, including drug prescriptions, data management, supply chain management as well as billing, keeping medical data records, and anti-counterfeiting drugs. For instance, blockchain addresses one of the biggest problems in health data management by putting the patient at the core of healthcare services. To be more accurate, a lot of patients are having help from variety of healthcare providers in their lifespan, and all those healthcare providers generate data related to the patient, which are critically important to make correct decisions. Blockchain-based system consolidates all information related to the patient and enables the exchange of health information across variety of healthcare providers. As well as that, patients themselves can have access to their own medical information history to have a clear vision for their past and future healthcare. This expands the control of patients on their health and enables them to correct the

mistakes. Patients also can share their medical history with new health care providers to ensure that the entire medical history is available to them. Keeping patients' private health information safe is just as crucial as collecting them. Health information data is very sensitive and therefore it must be accessible only by appropriate people. Since blockchain technology uses decentralized ledger, and it provides a stronger defence against cyber-attacks, so it is almost impossible to hack the system. Hence, it can be a decent framework for healthcare services. In figure 5 below how the blockchain-based system works can be seen. (Yaqoob, Sarah, Jayaraman & Al-Hammaddi 2021, 7-10.)

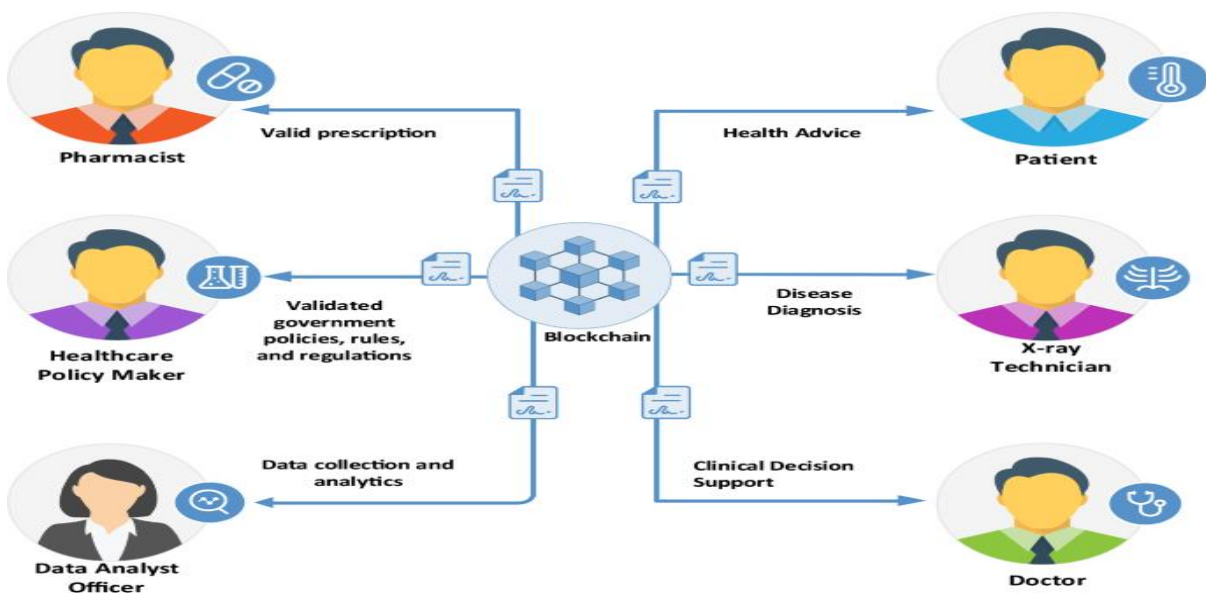


FIGURE 5. Blockchain for healthcare (Yaqoob et al. 2021, 8)

Nowadays the costs at healthcare sector are so high that even in some developed countries people cannot afford to access to crucial health services. A study done recently showed that elder people with crucial healthcare problems face catastrophic expenditure. For instance, the expenditure on health per capita increase 60% during the last decade. The United States spends almost 17% of its GDP on health expenditures and the healthcare system is still worse compared to many other developed countries. Figure 2 shows the expenditure on health of some OECD countries. And if we consider that population in developed countries is aging, it is possible to expect a worse situation in the future. However, blockchain-based systems could save up to more than 50 percent of those high costs as well as the time being spent on it. As it was mentioned above, blockchain technology can provide solution to the issues such as controlling massive amounts of information, answering former health problems, while keeping the customers' data safe. To sum up, blockchain-based systems would make the system more efficient and feasible. (Arsenijevic, Pavlova, Rechel & Groot 2016.)

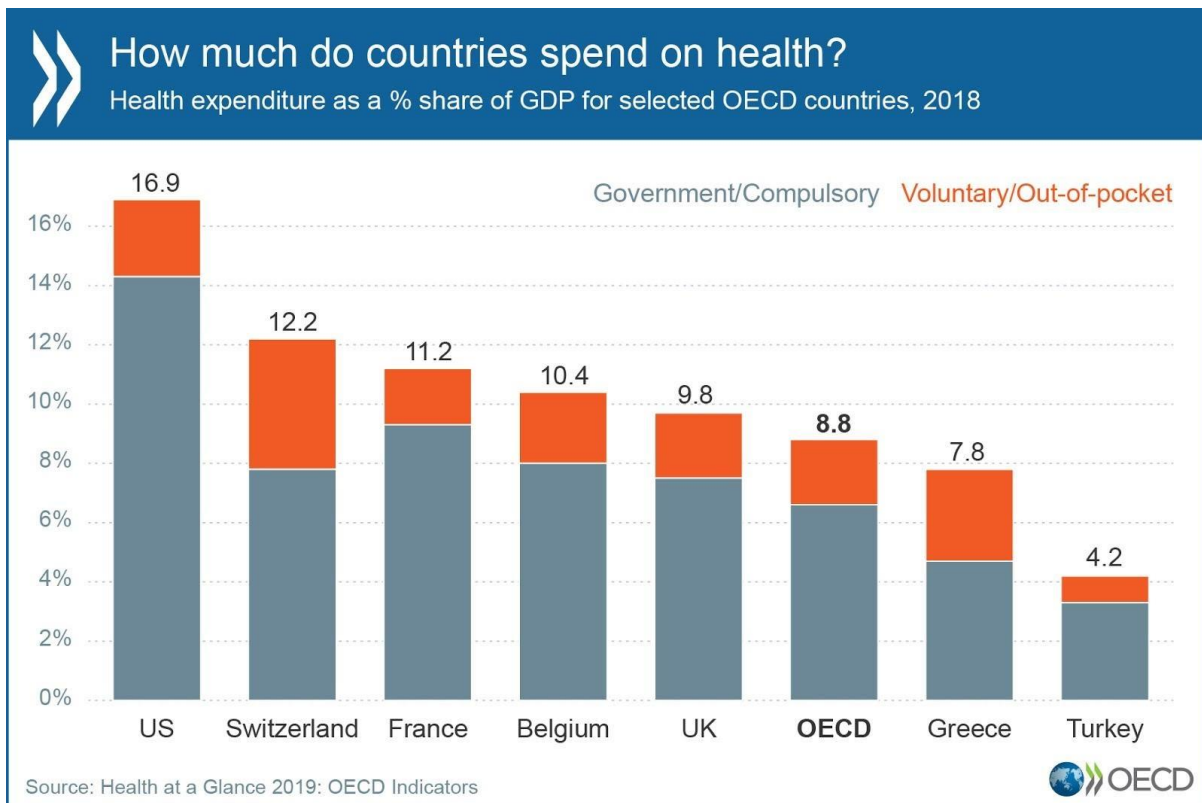


FIGURE 6. How much countries spend on health? (Arsenijevic et al. 2016)

There are also concerns about implementing blockchain technology in healthcare systems due to some risks. Since blockchain can accumulate massive amounts of data and stores them in chains, the scalability is one of the biggest concerns. Using private blockchain that enables users to control the speed may answer this issue.

One other risk comes up if one loses the connection to the authentic key to log in the blockchain. Once the key is lost the data becomes irretrievable. In such an important area of life like healthcare losing the access to all medical history via a key access is totally unacceptable. Yet, developers are already working on some other verification models. The third challenge is that if one company holds 51% access to a chain, then that party becomes able to make changes in the blockchain. However, regulations may address monopolisation issue in blockchain. (Maleh et al. 2020, 202.)

In conclusion, the blockchain-based solutions present a distributed ledger and is regarded as having potential answers to the current healthcare problems. However, there are variety of challenges to face and decisions to be made during the adaptation process. If blockchain technology addresses to these challenges, then a new healthcare system with more advance technology may replace the previous one.

## 2.2.4 Voting

Blockchain can have a great positive impact on many aspects of our lives, and voting is among them. As a solution to the apathy against traditional voting from youngsters e-voting is pushed to attract the voters. However, in order to create a trustworthy e-voting scheme a fair, transparent, and accurate environment must be created. Since blockchain has the ability to distribute the authority among users while they are remaining anonymous it can be a suitable basis for e-voting. Additionally, it can address the two major problems in voting today: access to vote, and fraud. By creating a reliable a voting scheme, blockchain has the potential to prevent many disastrous events related to elections today. Yet, there are opportunities and challenges coming up with this new voting model. One of the main opportunities blockchain creates is that it becomes almost impossible to modify or manipulate votes. Furthermore, blockchain provides greater transparency with help of distributed ledgers, and preserve the right of anonymous voting. (Hardwick, Gioulis, Akram & Markantonakis 2018, 1-3.)

Voters can be identified by their digital ID's. People with those ID cards can vote anonymously from whichever place they are instead of queuing at the vote centre. Blockchain technology also would enable to change the vote before the due date of the election. If a person wants to change the vote during election times, by the help of blockchain it can be done.

Estonia since 2007 allows the citizens of Estonia to vote online, and online voting saved them millions of euros, and loads of unnecessary work. However, many other governments and other stake holders still find online voting suspicious. They need to find solutions to several challenges related to e-voting to build full trust to it. Even though blockchain technology is secure and accurate, public confidence and trust have not been built enough around the technology. Therefore, as some claims it is early to transform voting system completely into blockchain technology. (E-Estonia 2007.)

### 3 THE FUTURE OF BLOCKCHAIN

Just a decade ago, the value of Bitcoin was less than a penny. However, the current value of Bitcoin as of July 2021 is almost U.S.D 27,000 and the people who invest in bitcoin in the early days now are driving super expensive cars. Such a rise in bitcoin price put the technology behind bitcoin and cryptocurrencies into the tech spotlight today. Blockchain as the technology behind cryptocurrencies is already shaping many industries. (Schapkohl 2020.) Moreover, according to David Furlonger, Distinguished Research VP at Gartner, the adoption of blockchain technology will be on the rise in the next three years.

As it is well known, we are experiencing the Fourth Industrial Revolution nowadays. And the use of game-changing blockchain technology is predicted to increase more and transform the industries. One of the predictions about the future is that blockchain networks can provide interconnectivity. Even a single update in the chain will be copied across the network in order to reach all nodes at the same time. Also, the combination of adjacent technologies and blockchain has the potential to revolutionize many industries from supply chain to IT. For example, with Internet of Things the number of interconnected devices will grow, the blockchain technology can address the issues coming up during these processes as well as supporting the entire system. Furthermore, Tapscott in 2016 states, to provide a fully successful implementation of Internet of Things, IOT, blockchain technology needs to be used.

The unique platform MindSphere developed by Siemens uses IoT to optimize operations and meet customers' needs. Thanks to blockchain applications MindSphere digitizes the entire supply chain operation making it easy for users to join and succeed for its users. Besides that, the application also lets the customers to keep private information secret, while sharing the necessary data with the other partners in the chain. A recent analysis showed that with all the benefits counted above IoT solution with the blockchain can save up to 0.6% of revenues for companies. In addition to that, the other benefits of combined IoT and blockchain technology are easier traceability, smart contracts and much more. (Siemens AG 2019, 1-2.)

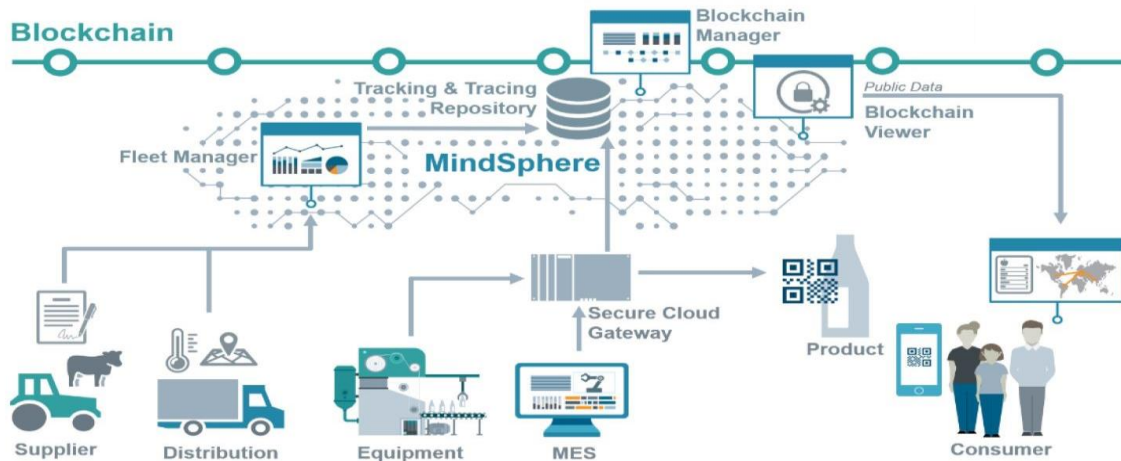


FIGURE 7. Pairing blockchain with IoT to reduce costs (Siemens AG 2019)

Furthermore, combining all the data including feedback from customers, ERP documentation, product information, etc. More in-depth analysis can be performed on the blockchain. So, that the company may arrive to better solutions. The future of blockchain looks exciting. With the emergence of new technologies, it is not difficult to estimate that the scope of application of blockchain technology will become more extensive.

### 3.1 Governments and blockchain

In today's world, a large number of people think that the corruption within government agencies is high in many countries and consequently, people's trust in governments is at an all-time low. When these facts taken into consideration, a need for a solution arises. At this point, blockchain-based system can involve the game, and it can meet the needs of government. Blockchain as a decentralized ledger offers transparency, auditability and tamper-proof ledger, and smart contracts. These functions of the blockchain technology increase the level of security tremendously, and they make sure of the accountability within the organization. That is why this technology is applicable for governmental organizations. (Vadapalli 2020, 27.)

The use of blockchain based solutions in government enables stronger degree of integrity, power, value, privacy, security, and inclusion. In parallel with increased level of these principles the performance of government organizations will also improve, and citizens can feel more participation. Thus,

governments can apply blockchain technology in numerous fields from record-keeping to patent protection. To demonstrate the utility of the blockchain technology in governmental organizations, we can look at one of the most innovative examples related to an employee digital record. In the United States of America, the office of personnel management is responsible for the overall human resources record for officers. The information ties back to the duration of work, the places where the employee have worked, the salary history of the employee and so on. Before implementing blockchain technology, performing a transfer process of an officer from one agency to another was taking long time. However, through the blockchain technology authorized agencies can log in the system and see necessary background information about the employee, so that all that transfer process can be done much faster now. (Tapscott 2016, 75-77.)

Estonia is the country which regarded as the world leader in digital government also shows a great example of how to adopt the blockchain technology in governmental organizations. Whereas the digitalization of Estonian government predates blockchain technology, the integration was done successfully between previous digital systems and the blockchain technology. Today all people residing in Estonia can have access to a variety of government services online by using their digital identity.

As of 2021 98% of Estonians holds most advanced developed digital identity card to access online government services. The chip embedded to card carries all necessary information about the owner of the card. With the encrypted key in the chip one can verify his/her ID online. Estonian residents use this digital identity on many occasions. In 2005, Estonia became the first country using the electronic voting system. Since then, in nine elections i-voting is widely used in Estonia and in addition, the number of people voting online increased in every new election. The voter can log in the system by verifying his/her digital identity and cast the vote easily. I-voting also allows voters to change their votes as many times as they want since each new vote cancels the previous one. Estonia also revolutionized its healthcare system by digital identity cards. The system called Electronic Health Record allows the patient, doctors, hospitals along with authorized healthcare providers to access the medical record of a patient. In case of emergency, a doctor can connect and see all health-related information of a patient including blood type, drugs, and other critical information. Not only in voting and health care areas but also in many other areas the e-identity cards are being used in Estonia. Some of the other examples are:

- As a travel document within the border of European Union
- Banking
- Voting

- Tax claims
- E-Prescriptions
- Parents uses track assignments, and grades of their children. (E-Estonia 2007.)

The digital ID card and all the online services coming along with it would not be acceptable without a strong cybersecurity. To provide solid cybersecurity, the Estonian government uses blockchain and cryptographic keys. Blockchain ensures integrity, transparency as well as security. There are number of ways that government agencies can interact with blockchain. And by this way governments could enhance integrity, accountability, security, and engagement from citizens. (E-Estonia 2008.)

### **3.2 The advantages and disadvantages of blockchain technology**

The arrival of blockchain technology has brought many innovations to variety of industries, and meanwhile it brought some difficulties too. Being a decentralized system is the main benefit that comes with blockchain technology. Each and every action is recorded and all people in the chain can access to records. (Vadapalli 2020, 10.) Those transactions which are connected to the blockchain cannot be changed or modified. Thus, blockchain technology is almost free from fraud, transparent, and secure. It also eliminates the middleman such as bank and provides a cheaper, and faster transaction overall. Eliminating third parties increases the security level.

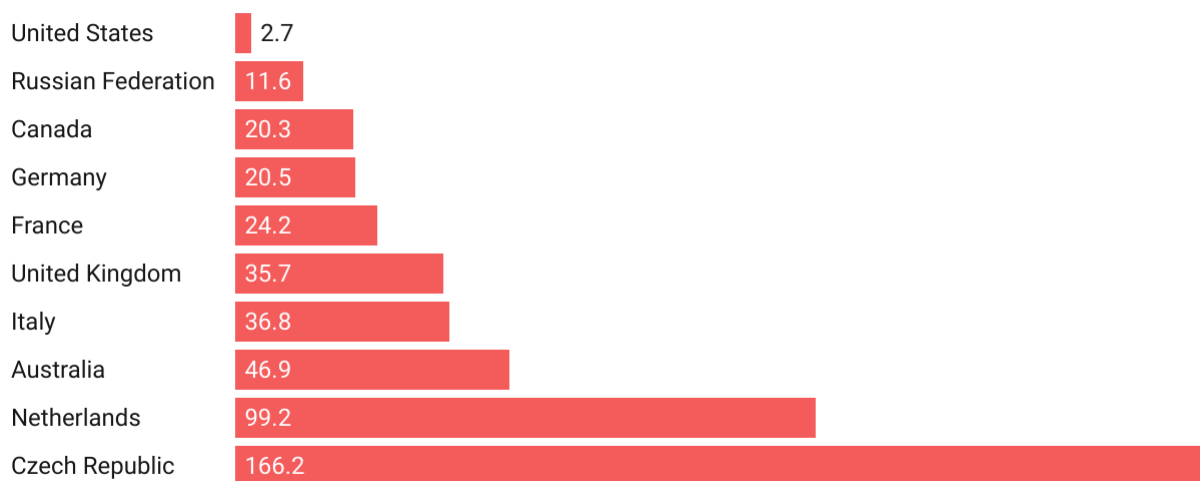
When a transaction is made in the decentralized ledger, the copy of that direction goes to every computer in the chain. All participants in the network can check transactions and the information related to them. This makes blockchain technology safer and effective against viruses. To modify or remove data is only possible when all participants in the chain agree to do so. Therefore, the more computers there are in the chain the more secure the chain is. Blockchain technology also saves a lot of time. In traditional banking when one wants to make international money transfer it may take up to three days for the money to be delivered to the other account, whereas via blockchain technology it takes only minutes. Hence, blockchain technology provides faster processing. (Vadapalli 2020, 10.)

One of the other great benefits of the blockchain technology is the increased stability. Once creating a new cryptographic hash, information should be added into including the value of the previous hash, the ID number of the block, all the data about previous transactions, the time that the hash was created, and so on.

On the other hand, blockchain has some disadvantages too. To begin with, miners consume excessive energy to generate coins. The machines used by miners to generate Bitcoin itself uses a huge amount of energy. The Bitcoin Energy Consumption Index refers that Bitcoin itself uses the equivalent energy of the Netherlands' annual energy consumption. Secondly, scalability is still an issue with blockchain technology. Classic banks still have much more scalability compared to blockchain technology. (Iredale 2020.)

To access blockchain technology users keep private keys that are generated during the wallet opening process, on their hands. However, this gives responsibility users to keep their private keys safe and sound. In case they lose the private key access, they also will lose the access to their wallets. (Iredale 2020.) In traditional banking, central authorities such as banks help users to reach their accounts back even though they lost their log-in credentials. One other disadvantage of blockchain is related to its *raison d'être*. Notwithstanding the fact that decentralization is the best benefit of blockchain technology, it also can be a disadvantage from time to time. (Tapscott 2016, 57-58.)

## Percentage that could be powered by Bitcoin



Source: BitcoinEnergyConsumption.com • Created with Datawrapper

FIGURE 8. Blockchain energy consumption (Digiconomist 2021)

In summary, the technology is developing, and it is bringing newer solutions to existing problems. For instance, Ethereum technology solved some issues related to blockchain using smart contracts, and Proof-of-Stake.

## 4 ENTERPRISE RESOURCE PLANNING

With the advancement of computer and communication technology, companies continue to adapt to updated corporate governance. Before the integration of computer systems, corporate entities used manual methods such as papers and files to track their daily business activities. Besides that, with the integration of computer systems, corporate entities can now carry out their entire business activities more efficiently. Hence, companies started to use Enterprise Resource Planning System to plan their business activities and satisfy their customers' needs in a faster and more secure way. In today's world enterprises must always perform as well as possible to survive in such a competitive business environment. In order to have a timely and quality production process, corporations should inculcate the habit of a continuous effective business planning system. When we consider the business environment today, we can see that companies benefit from software systems more than ever, and these software systems like ERP allow them to meet their customers' needs. (Parthasarathy 2007, 1-7.)

Enterprise Resource Planning (ERP) systems integrate and connect all business processes within a company onto a single computer system. This system operates in fields such as accounting, project management, service maintenance, engineering, risk management, and logistics, and allows various departments to share data among them in an easier way. (Monk, Wagner & Monk 2013, 22-25.)

Braggs in his book named "ERP: The State of Industry" has defined ERP systems as "ERP is a proposal package that replaces the entire enterprise with a single database, a single application and a single user interface, which has recognized that manufacturing, distribution, finance and sales modules are completely different systems." Nowadays, ERP systems are critically important for running numerous businesses from many industries. To those businesses, the use of ERP is inevitable. (Benzer & Akar 2020, 231-235.)

It is no longer enough to only produce in the age of information where the importance of knowledge and efficient management increased and the resistance to change became very challenging. The facts such as speed, quality, offering reasonable prices, and customer satisfaction stand out more than ever. That is why enterprises need to have a system like ERP to have a faster information flow within the organization. In addition to planning, ERP also links all operations within the organization to one software. This system complies with all departments so that it provides companies to have better communication, more quality products, and so on.

From another point of view, ERP systems ensure that all the obtained information is stored on a single database and shared accurately with all authorized departments. ERP functions include minimized inventory, the accuracy of delivery, quality management, production, finance, procurement, and distribution of goods. However, in addition to enterprises, the ERP system also supports patient management in hospitals, student management in universities, or store management in retail businesses.

The origin of ERP can be traced back to 1913 when an American engineer named Ford Whitman Harris introduced the Economic Order Quantity (EQQ) system to achieve more efficient production planning. Before the emergence of a game-changing model for material requirements planning (MRP) in 1964, manufacturers used the EQQ model. However, as the innovations in computer technology sped up manufacturing resource planning (MRP II) was introduced in 1983, only a few years before the emergence of ERP. Later, a need for new software that can allow companies to handle their whole businesses has risen, and by the 1990s, enterprise resource planning was born. After the emergence of ERP, its usage increased rapidly. But at the same time, the implementation cost of the ERP system began to rise. Not only the implementation of the ERP system but also maintaining the system entails additional costs such as consultant and training fees. But the innovations have not stopped, ERP technology evolved over the years and embrace the adjacent technologies. After a decade of the emergence of ERP, the ERP II system developed by the cloud system has helped companies reduce operational and capital expenditures. As time went on, ERP innovations increased, and it started to enable data processing data in real-time, machine learning as well as IoT. (Parthasarathy 2007, 1-7.)

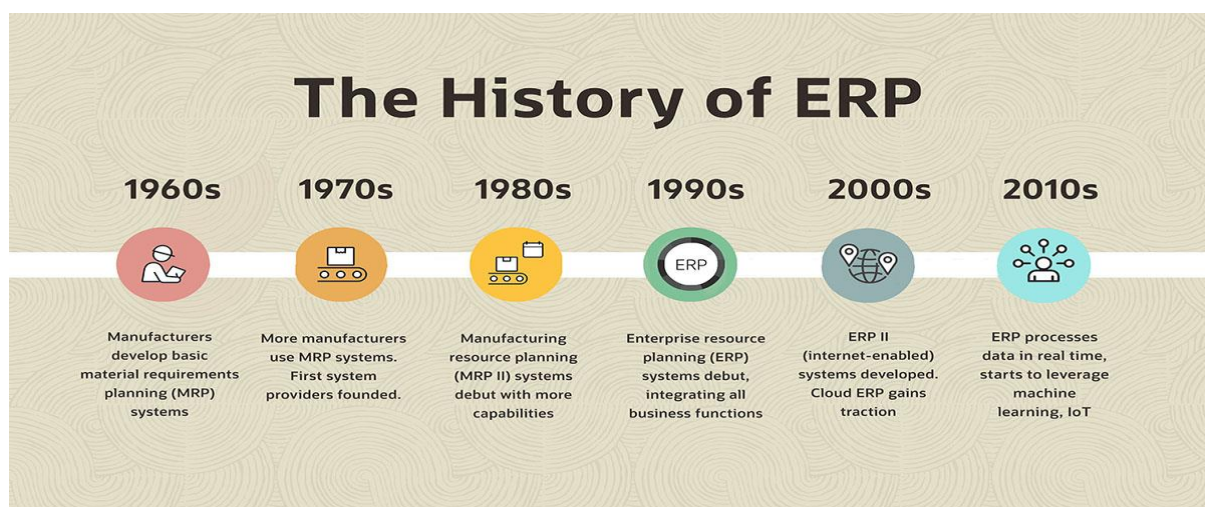


FIGURE 9. The history of ERP (McCue 2020)

## 4.1 Implementation of ERP systems

Even under the most ideal conditions, the implementation of an ERP system can be very complex and costly. It requires rigorous work from all the parties within the company, otherwise, the wrongdoings during the installation can cause huge losses. Most organizations installing ERP face the huge cost and complexity of the system, however even more serious problems may come up if organizations try to implement ERP without a thorough understanding of the system. Implementing ERP systems does not only cause loss of money, and time but also it may change the working culture of a firm, create a need for extensive staff training, and even lead to fewer productions so financial losses. That is why the implementation of ERP must be done very carefully, if not the implementation cannot be on time, within the budget. (Stewart, Milford, Jewels & Hunter 2000, 2-11.)

ERP systems do not only provide back-office functions such as the management of accounting, manufacturing, and project management, but also ERP systems such SAP, and Oracle provide more services involving business intelligence, customer relationship, and logistic operations. A lot of researchers have identified various critical factors for the successful implementation of ERP systems. According to those critical approaches, implementation takes place in three main stages. They are:

1. Big Bang Approach
2. Locations-Wise Approach
3. Module-Wise Approach

In the Bing Bang approach, the company implements the whole system at once. Companies that follow this approach install all the modules coincidentally so that in case of successful implementation they can start to reap all benefits of the ERP system right away. On the other hand, even though this approach brings some important benefits, the risk is also relatively high. As the company embraces a completely new system, the risk is big in case the system does not work properly. (Arguin 2017.)

In the second approach, the company picks one or a few departments to implement the ERP systems. This department can be the head office, production site, human resources department, and so on. Since only one or a few parts of a company will be replaced with the new system the time loss will be less. Also, the Location-Wise approach allows companies to try out the system at reasonable costs and with lower risks. The advantage of this approach is that if implementation works well in one of the branches and on that basis, the company may start making further investments for wider implementation.

In the last approach, companies consider implementing only one or few modules instead of the whole system. The Module-Wise approach enables companies to implement an individual module such as the procurement module, manufacturing module, during the HR module, etc. depending on their needs.

As well as the three critical approaches, there are also three perspectives on the implementation of ERP systems.

1. Organizational Perspective
2. Business Perspective
3. Technological Perspective

Some claim that the installation of an ERP system affects the organizational structure the most. Seeing the implementation from the organizational perspective can increase the adaptation of people to the system. However, there are some issues with this perspective. According to the Business Perspective, the implementation of ERP systems is such a challenging process to do for organizations, and it can change the organizations entirely. For that reason, companies with visions, and well-developed IT strategies can do the implementation smoothly. (Kumar & Thapliyal 2010, 2-4.)

As the last perspective, technological perspective suggests that elaboration of the ERP system should be done for a better configuration. Since the companies face with many difficulties related to infrastructure, customization, etc. elaboration of ERP systems is believed to provide a better understanding of ERP installation.

Prior to implementing ERP system, companies should be careful with choosing the suitable ERP package that meets their needs. The package to be bought should cover all the business processes of the company. The cost is also another important point that must be considered beforehand. The installation of ERP may cost higher than the software itself. Besides, the consultancy firm also must be reliable. While implementing an ERP system, companies should install the system step by step instead of following the big bang approach. Even though it may take up to 2 years to implement the whole system, in general, it gives better results. And to set up the ERP system companies must pass the following stages.

- Project Planning
- Gap Analysis
- Customization
- Testing
- Training

## · Identification and Evaluation of ERP vendor

Project planning is the first and foremost phase of ERP implementation. In the initial meetings, project team identifies the current and upcoming problems as well as potential solutions. The project plan includes the details about the implementation project including information such as the time duration of the project, the cost of the project, necessary training, and consultants. (Parthasarathy 2007, 9-14.)

Gap analysis refers to a method of assessing whether ERP package meets the needs of a business or not. At this phase, companies can invite consultants to analyse the project from a neutral perspective. Therefore, the Gap analysis provides a complete overview of the ERP system. Custom-built or customized ERP application refers to modifying the software on either a micro or macro scale so that the new software fits the organization. Companies apply to customization in order to meet their specific needs. Research done by Panorama Consulting has found out that 90% of ERP systems have customizations. In spite of that, it is not recommended that to make radical changes in the base of the system. Major changes in the system make it harder to benefit from all the advantages of ERP for companies. For instance, the cost of technical changes is higher, and they need more specific testing. Additionally, the customization should be renewed for each new release.

During the training phase, employees get courses about how to use the system. These courses help employees to work effectively and efficiently in the new system. Identifying and choosing the right vendor is a bit challenging in today's crowded market. However, to identify the reliable vendor companies can consider factors such as the ability of the vendor, the reputation of the vendor, and the cost of the total project. By choosing the right vendor and evaluating properly organizations can carry out all the other phases well.

Yet, the ERP systems carry many astonishing facts. Before the implementation of ERP systems companies used to have numerous accounting systems, and bills of material. This situation was making companies incompatible. So that notwithstanding the huge cost of ERP implementation, many companies decided to integrate ERP systems such as SAP in their businesses. Even under the most ideal conditions, the implementation of an ERP system can be very complex and costly. (Kumar & Thapliyal 2010, 6.) It requires rigorous work from all the parties within the company, otherwise, the wrongdoings during the installation can cause huge losses. Most organizations installing ERP face the huge cost and complexity of the system, however even more serious problems may come up if organizations try to implement ERP without a thorough understanding of the system. The implementation of ERP

systems does not only cause loss of money, and time but also it may change the working culture of a firm, create a need for extensive staff training, and even lead to less production so financial loss. That is why the implementation of ERP must be done very carefully, if not the implementation cannot be on time, within the budget.

ERP systems do not only provide back-office functions such as the management of accounting, manufacturing, and project management, but also ERP systems such SAP, and Oracle provide more services involving business intelligence, customer relationship, and logistic operations. (Parthasanthy 2007, 31-43.)

## 4.2 ERP modules

In today's current technology ERP contains numerous of modules to present companies such as finance, procurement, human resources management, customer relationship management, warehouse management, supply chain management and so on. A client can pick up the package including all the modules to completely replace its existing system or only one single module depending on the needs of the client. In case a client decides to pick up only one or few modules instead of the whole package, ERP vendor does the necessary customization to meet with the requirements of the client. Most vendors' have such a software that they allow customers to install ERP system into their existing system in stages, also this way of implementation reduces some risks for companies. For example, if a customer selects a particular module instead of complete ERP system can have some advantages such as:

- A module that meets with the exact requirements of the client
- Less installing time
- Less risk
- Lower resistance to change.
- Chance to try out other vendors 'modules.
- Less time spent in training.
- Less need for maintenance and consultancy

Picture 10 presents fully integrated ERP module across departments, customers and supplier information is exchanged by departments and stored in central database. When one department make an update, the update automatically goes to all other integrated departments. It saves a lot of time and

reduces costs. However, maintenance and updating the system gets tougher when they are many modules linked to each other. (Parthasanthu 2007, 17.)



FIGURE 10. ERP modules (Sternad, Tominc & Bebek 2020)

As one of the most important modules of ERP finance module pervades all areas of businesses, it enables businesses to comprehend thoroughly their financial situations and estimate the future demand. Finance module packages most likely consist of accounting, investment management, tax statements, risk management, forecasting the business expenditure and so on. The module also handles billing, tax calculations, maintenance of accounts, insurance, board reports, planning for future investments etc. automatically.

One of the biggest advantages of finance ERP module is that the outcomes from this module can be compared to department-wise operating results. In this way top management ascertains enterprises' financial status. It provides well-grounded information related to records and processes. Materials management module also plays very important role for companies, and it is the most preferable module by the majority of manufacturing enterprises. The biggest risks faced by manufacturing companies are to running out of the stocks, not delivering the order on time, and being unable to satisfy their customers.

The main goal of this module is to make sure that the inventory is adequate for the orders. Essential functions of MM module consist of management of inventory, purchasing, vendor evaluation, verification of invoices, cost of goods and so on.

Sales and distribution is also an very important module due to the facts that it consists of selling, shipping, master data management, pricing strategies and billing of the goods. Figure 11 shows all the functions of sales and distribution module and its relationship with other modules. (Parthasanthi 2017, 18-25.)

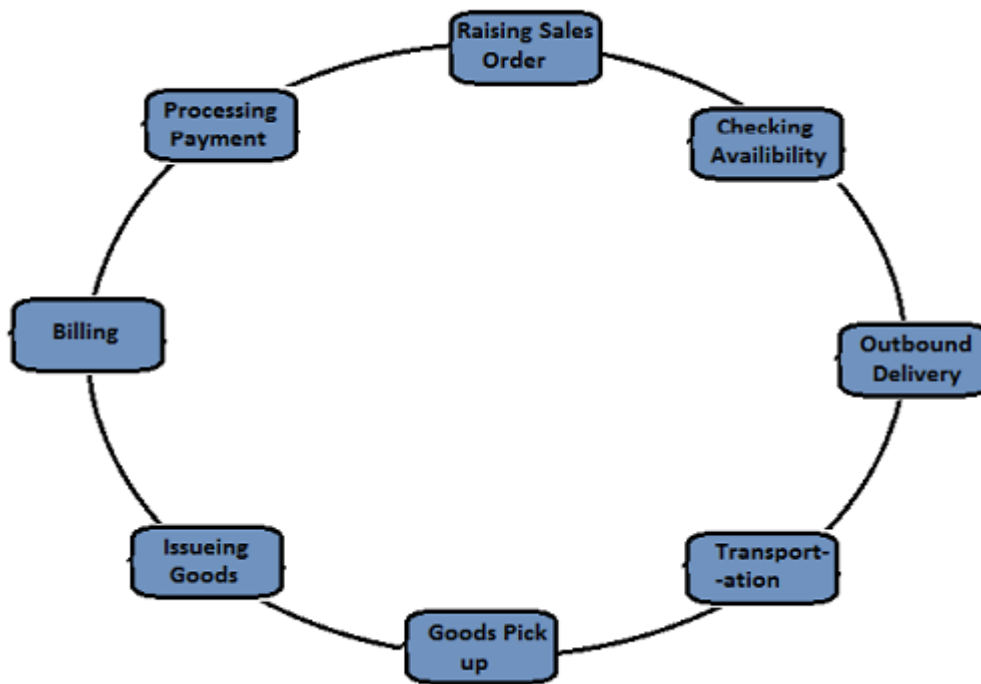


FIGURE 11. SAP sales and distribution cycle (Tutorials point 2013)

In conclusion, ERP is a very complicated software system. Even though it is presented as a single package, implementing ERP in stages is possible and have its own advantages. The ERP modules provides great benefits to the user company and enable head office to make correct decisions.

### 4.3 ERP limitations and benefits

The main goals of ERP systems are shortening the delivery times and reducing overall costs. With a proactive perspective, such systems enable companies to predict the potential problems and finding solutions to them. Also, ERP systems strengthen the structure of management by allowing all the

authorized workers whatever information they want to. Prior to ERP, reaching to all information and decision making were taking longer times and only top management were eligible to do that. That was leading to communication problems and even sometimes wrongly taken decisions. Since ERP removes such problems, it is possible to take correct decisions on time. Additionally, companies, suppliers, and retailers can see stock levels and productions plans through ERP systems, therefore it enhances supply chain operations and increases efficiency. (Azavedo, Romao & Rebelo 2012, 4-7.)

With the globalization of the market, companies grow and participate in the international market. This type of company prioritizes opportunity assessment, protection of strengths, development weaknesses, and anticipation of potential problems. The ERP system aligns with the company and helps them use resources as efficiently and effectively as possible.

Installing an ERP system requires a big budget. However, a study titled "Organizations Prepare for ERP Implementation" found that 60% of the largest US companies have adopted ERP technology. The reason behind such large-scale adoption of ERP systems to companies is that the ERP system brings many benefits. Some benefits of ERP systems will appear directly and quickly. (Azavedo et al. 2012, 6-8.) Those benefits include improved efficiency, integration, lowered costs, enhanced supply chain operations, faster response time, better communication with customers, etc. Whereas some other benefits will impact companies indirectly and the effect of those advantages will be seen after a period of while, especially when the full integration completed. Examples of such include:

- Integrating data from different departments on one shared ERP system.
- Time saving thanks to less data entry and some other processes.
- Allowing companies quickly adapt to the latest technologies.
- Providing flexibility.
- Collective data allowing more detailed analyses for future projects.
- Reducing the vulnerabilities of the system, therefore providing better security.

Integration is one of the most important benefits of ERP system. Before ERP, particularly large-scale companies were facing with problems related to share information, and data across business units. The connection among business departments was weak and this disconnection caused time, and money loss. The emergence of ERP allowed enterprises to use single system for all units, and interlinked people to one another. All business departments became eligible to see the updated information right

away, and it led to better productivity. ERP systems also enable companies to reduce the Lead-Time so that companies can have a better inventory management. (Parthasanthi 2017, 47.)

Thirdly the vendors of ERP shaped the ERP system in order to adapt the companies to the latest technologies before it is too late. Although undertaking modifications of ERP sometimes can be very stressful time for companies, it is likely to have more advantages and usage areas of ERP when it is done.

Another advantage of ERP is the flexibility. International companies most likely are dealing with different languages, currencies and so on. All those functions can be covered on a single system. To run a successful business in a globalized environment companies must be flexible.

Not only the ones counted above but also ERP system includes some other benefits such as providing better corporate image, improving customer satisfaction, obtaining more accurate information and reduction in cycle time. Improving corporate image is crucially important for companies. ERP increases the quality of business processes, and allows them to share information in real-time, thus customer satisfaction increases. Furthermore, with ERP systems, companies can apply to numerous of production methods such as make-to-stock and make-to-order methods. Therefore, they can meet their customers' needs faster and better. (Parthasarathy 2017, 46-49.)

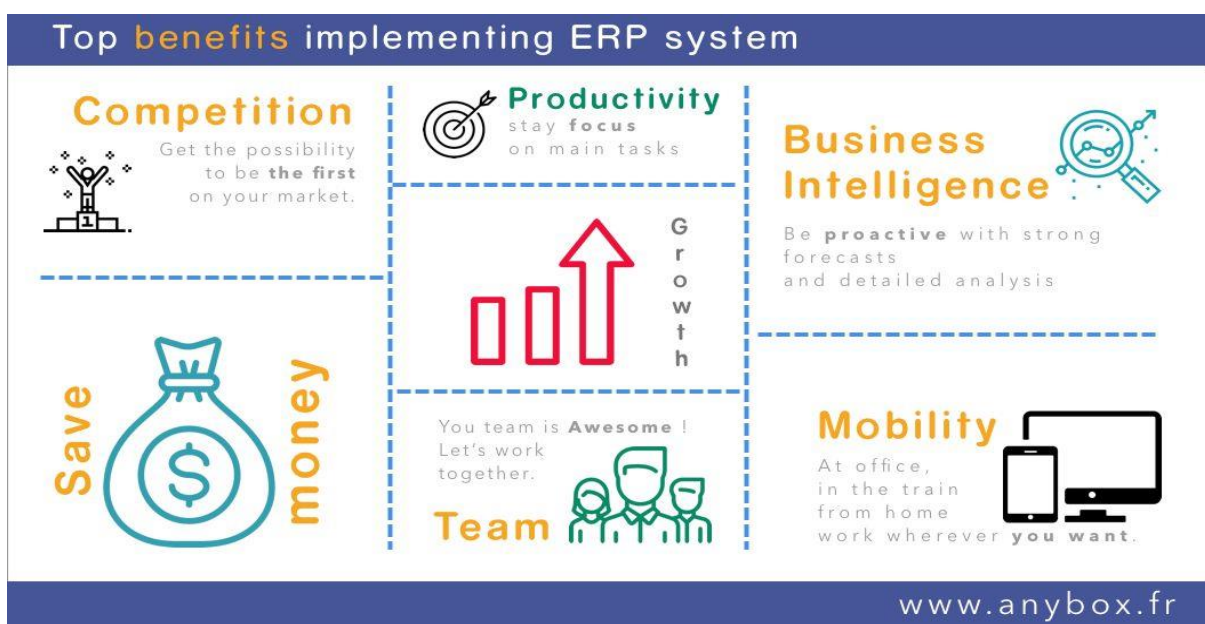


FIGURE 12. Top benefits of ERP system (Wedell 2019)

Nowadays the business environment so competitive that the importance of information is more than ever. If decision-makers within a company cannot obtain right information, the chance for success is very far for that company. That is why ERP is necessary to keep all related information on single software, and to support external businesses. When ERP is used rightfully enterprises can follow the company strategies, assess the result of strategies, can use resources efficiently and effectively, provide reliable service support, have better communication both internally and externally and manage vendors.

On the other hand, even though ERP systems increase the efficiency and remove the time loss, they have some disadvantages and limitations. The big cost of ERP, waiting duration for full implementation, and difficulties to keep up with certain software are some of them.

The prices for ERP packages start from \$500,000. However, in case of purchasing a more advanced module the cost may go up to one million easily. These prices do not include the training and consultant fee. The implementation takes about six months, and various of invisible costs come along during the implementation process. (Menon, Muchnic, Butler & Pizur 2019, 4-7.) Some other limitations of ERP are resistance from users, unmatching technology, concentration of data and complex software.

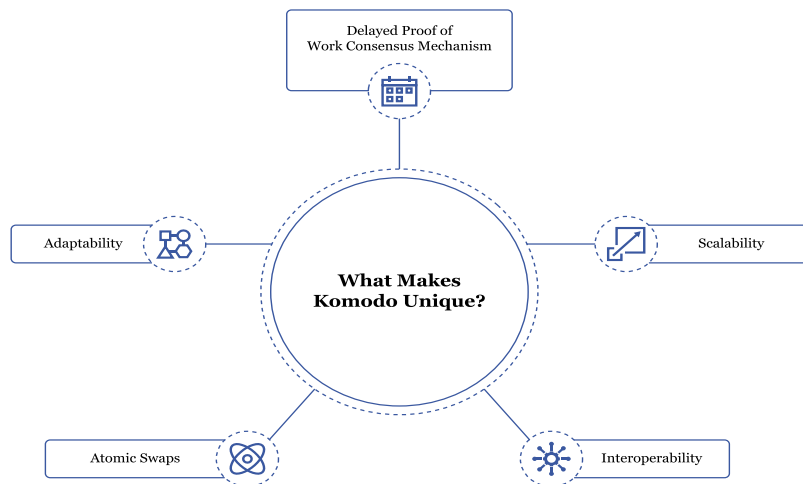
## 5 CASE STUDY MARMARA CHAIN

The most important function of banking sector is generating credit. Banks create new money whenever someone wants to get a loan. This credit circulation occurs between the person who gets the loan and the bank. To the contrary of this belief, banks are not the only institutions that can create money from credit. Individuals in many countries are able to create money, just like banks, through post-dated cheques or promissory notes in the peer-to-peer manner. Marmara Credit Loops, MCL, aims to digitize expired checks while solving the most important issues related to the non-redeemability of tools. The MCL on Marmara Chain represents a guaranteed peer-to-peer credit creation and circulation system based on trust. It is the first of its kind which enables to digitalize post-dated cheques all around the world. The technology behind MCL is based on Komodo blockchain technologies.

There are few reasons why MCL is based on Komodo blockchain technologies. First of all, Komodo allows its users to be hundred percent independent and establish their own blockchain without depending on any central body unlike the other platforms. This gives the opportunity to make transactions for cheaper prices and faster, scale their solutions to its users. Besides those, since in Komodo platform users can create their own chains so it is a multi-chain platform the issues such as crowded network are avoided. Also, Komodo provides a composable framework meaning that the platform does not apply to any restrictions or limitations for the solutions and provides full independency. Lastly Komodo uses an open-source platform where it provides scalable, adjustable, and interoperable solutions to its users. All these facts make Komodo platform unique and real independent compared to other blockchain platforms. Additionally, providing high security is one of the top priorities of Komodo platform, and to do that it uses Delayed Proof of Work consensus mechanism. The Delayed Proof of Work mechanism connects Bitcoin hash power and dPoW mechanism to ensure of the high security. These two mechanisms combinedly give a second layer of security for all kinds of transactions. So that MCL works the best on Komodo platform. (Takyar 2021.)

The source of the idea of Marmara Chain Project comes from a culture of post-dated cheques which were very popular and used in Turkey. These post-dated cheques presently hold a market size of 30% of GDP. The fact that makes them exceptional is that these post-dated cheques are in circulation many times until the post-date. In spite of the fact that these post-dated cheques are initially printed by the banks, the issuers are the ones who can compose any amount of money on slip without having the same amount of money in their hand. The amount on the check must be ready when the post-date is written on

the cheque comes. In certain areas, the post-date time can be up to 2 years. Banks don't have the right to reclaim a cheque before the due date written on the cheque. Until the due date the cheques continue flowing as cash simply by marking and passing to different endorsers in purported credit circles. By this way a peer-to-peer trust-based credit created.



LeewayHertz

FIGURE 13. What makes Komodo unique? (Takyar 2021)

Marmara Chain aims to be an alternative to all peer-to-peer loans such as post-dated cheques and promissory notes etc., which are widely used in the real market especially in countries such as India and Turkey. Most importantly, Marmara Chain Project aims to completely reveal the unrequitedness of these cheques.

As a platform using Komodo Blockchain technologies Marmara Chain targets to completely solve the problem of creating peer-to-peer credit and reciprocity in circulation. It is the first system in the world to solve the problem of universal reciprocity in post-dated cheques and promissory notes which are used in many countries. The system also can easily be used by communities adopting a similar culture and is mainly a system of trust. (Cetiner 2019.)

Credit cycles in the new version are 100% collateral based, i.e., mutual. Therefore, there is no longer a problem of dishonour in loans or cheques. This is achieved by staking coins through so-called activation.

As the first decentralized finance system, Marmara Chain runs in the real economy, and the system rewards both buyers and sellers by giving the opportunity to stake to them. Marmara Chain also protects itself from 51% attacks by the help of Komodo delayed proof of work mechanism.

Furthermore, Marmara Chain thanks to its structure, works with blockchain technology in a unique way. It is the first of its kind in the world that implements blockchain technology in such a way. Since the credit loops are directly applied onto blockchain, it is not possible to intervene or modify or manipulate without a consensus in any ways. The properties of MCL are:

- Works best in the real economy: MCL as a decentralized finance system runs in the real economy without facing any problems.
- Half activated half locked blocks: Half of the blocks found are already activated. Therefore, they are happy to join the staking process.
- 3 times staking in credit loops.
- Non-modifiable, non-intervenable credit loops: The credit cycle cannot be modified during shopping or before the expiration date.

Marmara Chain has two protocols, and first of them collateralized all credits. Hence, it removes the risk of defaulting. Since the system provides 100% assurance an escrow or a third party to hold the money on behalf of other two parties is not needed. Holders of the products in the credit loop also gain the opportunity of 3 times staking until they become buyers. Hence, it is pointless to transfer credit unless it is for shopping. MCL is the only system that uses blockchain technology in such a way.

In order to estimate staking rewards users can follow the formula below. Even though the formula does not give the exact numbers, it gives estimated results. In the second protocol, MCL targets to increase trust by adding the credit which was created in blockchain to the credit loop whereas in real life the credit remains as a contract when it is done by between a bank and borrower.

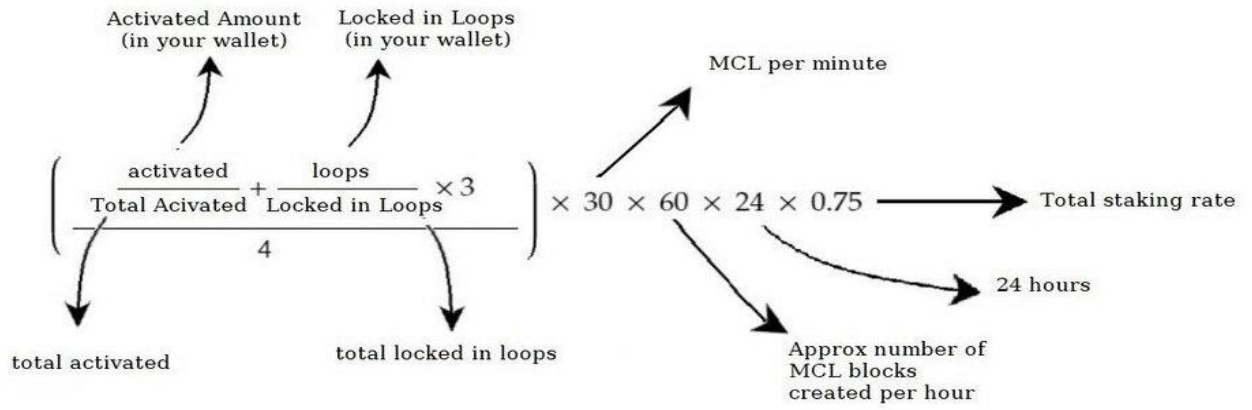


FIGURE 14. Calculation for estimated earnings in the chain (Cetiner 2019)

## 6 INTEGRATION OF BLOCKCHAIN AND ERP

Even though blockchain technology used for cryptocurrencies initially, it is promising for other industries. ERP is one of the areas blockchain can adopt and address to the current issues. Blockchain technology with its immutable and distributed ledger provides safer, more transparent, and trackable records for the areas such as production, supply chain and so on. SAP as one of the leading ERP vendors, is already using blockchain technology in some fields. Based on 2018 SAP insider data, almost 2 in 10 companies are utilizing from blockchain technology. As well as that the findings of the research demonstrates that in the near future the number of the companies will adopt blockchain technology.

Decentralizing function of blockchain gives companies the opportunity to monitor large supply chain network easily. The integration of ERP and blockchain also allows the automation process. So that each business in the supply chain can be a part of big blockchain network while still using their own ERP systems. That function brings some clear advantages. For instance, it increases the trust between supply chain participants. Participants easily can track the journey of products thoroughly from production to the last stop. Integration blockchain technology in ERP systems can also help companies in authenticating and verifying identities. Not only that but also this integration can authenticate who have the access to sensitive information. (Slimov 2019.)

Blockchain is popular mostly due to its functions that provide almost 100% security, especially in the case of money transfers. With the integration of blockchain technology and ERP companies can be confident about that their financial transactions will be safe and sound. That is why even nowadays a lot of banks use blockchain-based services. In addition to what is said so far, companies while making business to business payments have to follow regulatory compliances. The integration of both technologies can fasten those payments and ensures that transactions meet with regularity compliances. Furthermore, blockchain technology removes the need for a middleman to confirm transactions, so that it decreases the time spend on financial transactions drastically. One of the other important benefits of this integration is the increased security. A lot of companies already using blockchain to protect their cloud systems. It prevents data leakage, unauthorized people from access and locates security threads before they harm companies. (Sloboda & Demianyk 2020.)

As we already talked already about how blockchain can influence our lives, it becomes really essential to connect variety of business applications such as enterprise resource planning, customer service

management, manufacturing, etc. with blockchain technology. Only after a successful connection customers will benefit from the technology. There are many benefits comes with such integration including:

- Since business applications manufacture, track, obtain, and ship the products, the integration with blockchain technology will create an exact copy of all transactions, and the paper created by blockchain technology is immutable and unchangeable and can be tracked whenever the businesses need.
- Since ERP systems also creates financial transactions, the integration with blockchain technology will make all financial transactions more transparent and reliable.
- Also, such integration will reduce the number of conflicts over invoices, logistics, returns and purchases.
- All business applications from customer service management to manufacturing execution systems will be more transparent.
- It also can help businesses to prevent sending faulty components in case of a big material and only one component driving all the assembly to failure. By providing better and more transparent tracking blockchain technology may solve this issue.
- Blockchain and customer relationship management also increases the satisfaction of customers by providing them more transparent and trackable transactions, and the chain of ownerships.

The advantage in coordinating the ERP with blockchain is twofold. Initially, it makes all business applications more transparent, and furthermore, it can reduce the costs. (Banerjee 2018.)

The current blockchain abilities need to address the business processes in order to assist them with getting into blockchain network. If we take a look at Finlync's example, the first integrator of blockchain and ERP systems, we can see that Finlync already developed a great integration for SAP and blockchain technology. Also, a company from Norway named Skye has brought more adaptable systems to the table. It has created incorporations of SAP with other blockchains offering joining finance services, HR, and inventory network.

Every year worldwide, foodborne diseases make more than 600 million people sick. Yet, most supply chains still rely on manual processes which makes the tracking more difficult and time-consuming. However, it is very essential for especially food companies to be able to do fast tracking in case of contaminated food spread. It does not only save the reputation of the business but also lives.

We can look at Walmart to see a well-functioning example of blockchain technology and ERP integration. Since 2019 Walmart works with IBM to increase food safety by using blockchain technology. As an early adopter Walmart started to use blockchain technology after the outbreak of Escherichia coli bacteria in some kind of lettuces as well as salmonella virus. They together created a system which allows tracking the food from the origin to the store. Each node on the blockchain represents an organization which hold the food on the way to the store, and this develops transparency and traceability.

At first Walmart and IBM ran two pilot projects to test the system. One project was in US and focused on tracking mangos whereas the other one looked at the pork in China. In two of the cases the system proven its efficiency and effectiveness. It was considered as impossible in Chinese market to prove the authenticity of the pork, but blockchain and ERP combination made it possible. On the other hand, in US market, tracing the origin of mangoes were taking up 7 days but after the successful integration that time has been reduced down to 2.2 seconds. Overall, with the capabilities of blockchain such as trackability, and transparency Walmart strengthened its reaction once some contaminated products came to the shelves. (The Leadership Network 2020.)

## 7 CONCLUSION

Blockchain technology is shaping industries in many ways. Especially the industries such as banking, cyber security, healthcare, and voting are already transforming. Even though many people think that the most precious and important thing related to blockchain technology is Bitcoin, it is not the actual case. The technology underlying crypto currencies is even more important, and it is about to transform business environment for better. The promising blockchain technology offers blockchain-based solutions to the current problems that companies face with by removing third parties, increasing trust and security, as well as lowering the costs. Blockchain impacts industries such as banking, healthcare, voting, cyber security, infrastructure, agriculture, education etc. However, it is expected that the impact of blockchain technology will grow and spread to other industries in the near future.

Additionally, blockchain technology can improve the ERP systems and address to the current issues. Enterprise resource planning (ERP) refers to a sort of software that is used by companies to manage and integrate their businesses activities such as HR, accounting, supply chain, finance and so on. ERP software has numerous of benefits for businesses, yet some setbacks exist in the system. Blockchain technology also offers the opportunity to push ERP systems to another level. ERP vendors including SAP intend to integrate blockchain into their own system to provide a safer and trackable software to their users. Integration of blockchain technology to ERP enables optimizations of all business areas that businesses operate, as well as ensuring security, traceability, and transparency of the data. For instance, blockchain improves supply chain excellently. Similar to that, blockchain in the manufacturing increases the reliability and trust between parties while lowering the costs. By utilizing blockchain technology, businesses can track all the data of transactions within ERP and ascertain that the information cannot be modified or manipulated. Blockchain also allows them to establish an integrated platform where all parties are included.

During my literature review, I realized that the uses of blockchain technology are endless and in the upcoming days we will experience the more use of this exceptional technology. Furthermore, I also saw that blockchain technology meets with the needs of the current ERP system. To conclude, the integration of blockchain and ERP is a great idea and has a big potential to transform business environment for better.

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