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Blockchain-Driven Redesign of Business Processes

Master's Thesis (20 ECTS)

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I have written this master's thesis independently. All attitude of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

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Blockchain-Driven Redesign of Business Processes

Abstract:
Today, blockchain technology has become a platform that could be used to change many processes in many businesses and industries.
The goal of this study is to analyze how Blockchain technology can be used to improve business processes. This thesis aims to investigate the business processes in different companies or institutions to analyze if they have been redesigned by using blockchain in the past five years (2016 to 2022) and how they were able to change. Companies are exploring the use cases of this technology in the hopes of making a profitable change in the business process. However, this technology cannot simply replace some parts of business processes because it may not have the desired result. An analysis of each process is needed to be able to improve the state of the process.
This thesis is based on a systematic literature review (SLR). The main goal of this thesis is to find and measure studies that show how blockchain has been used to improve business processes. Therefore, based on the findings, the measurement of these results was investigated.

Keywords: Blockchain, Business process, Distributed ledger, process, BPM, IoT, Supply chain, Innovation

CERCS: P170 Computer science, numerical analysis, systems, control

Plokiahelapõhiste äriprotsesside ümberkujundamine

Lühikokkuvõte:

Tänapäeval on plokiahela tehnoloogiast saanud platvorm, mida saab kasutada paljude protsesside muutmiseks mitmes ettevõtes ja tööstusharus. Selle uuringu eesmärgiks on analüüsida, kuidas saab plokiahela (Blockchain) tehnoloogiat kasutada äriprotsesside täiustamiseks. Lõputöö sihib uurida äriprotsesse erinevates ettevõtetes või asutustes. Uuritakse, et kas neid on viimase viie aasta jooksul (2016–2022) plokiahelat kasutades ümber kujundatud ja kuidas need on muutunud. Ettevõtted õppivad tundma selle tehnoloogia kasutusjuhtumeid, lootes teha äriprotsessis tulusaid muudatusi. Kuid see tehnoloogia ei saa lihtsalt asendada mõnda äriprotsessi osa, kuna see ei pruugi soovitud tulemust anda. Protsessi oleku parandamiseks on vaja igat protsessi osa analüüsida. See lõputöö põhineb süstemaatilisel kirjanduse ülevaatel (systematic literature review). Käesoleva lõputöö peamine eesmärk on leida ja hinnata uuringuid, mis näitavad, kuidas plokiahelat on kasutatud äriprotsesside täiustamiseks. Seega leidude põhjal uuriti tulemuste mõõtmeid.

Märksõnad: Plokiahel, Äriprotsess, Hajutatud pearaamat, protsess, BPM, IoT, Tarneahel, Innovatsioon

1 Introduction

Technologies are developing and being adapted to help and improve the operational efficiency of businesses across a variety of industries to make these processes efficient way. **Blockchain** is one of the technologies which can help to make these processes efficient. The use of blockchain is being researched in different services such as supply chain Longo *et al.* (2019), Financial servicesChang *et al.* (2020), reservation systems Shrestha *et al.* (2020), Know-your-customer process Kapsoulis *et al.* (2020), Inter-organizational Nakamura *et al.* (2018) and many other businesses .

The Bitcoin whitepaper established the blockchain concept in order to address the double-spending issue that arises when a transaction is carried out over a communication means without the assistance of a bank or other reputable third party Nakamoto (2008). Over the past few decades, consensus approaches in a traditional distributed system have been well studied Viriyasitavat and Hoonsopon (2019). The Blockchain's architecture makes it possible to restructure business processes, particularly when cooperation among parties with mutual mistrust can be advantageous Milani *et al.* (2020).

The benefits of blockchain include data immutability, transparency, verification, privacy, and security. The blockchain creates a single, virtually tamperproof transaction history, boosting network trust and preventing transaction disavowal. This history comes with openness, which allows for traceability, and auditability, which protects against fraud and corruption. It can save money on verification and maintaining many ledgers as a transaction system. However, there remains skepticism about blockchain's ability to deliver on its promises Milani *et al.* (2020).

The efficiency-boosting benefits of blockchain are frequently highlighted through time and cost savings Milani *et al.* (2016). Therefore, it has the ability to actualize execution without a central party serving as a single point of trust, blockchain technology holds out a significant promise for rethinking how interorganizational business processes are conducted (and failure) Mendling *et al.* (2018).

A **business process** is the combination of a number of operations carried out inside an organization and a framework detailing their logical relationship to one another and the goal of producing the desired outcome. In fact, an enterprise's business processes can be examined and integrated. Therefore, it is crucial to accurately represent its business operations Aguilar-Saven (2004).

1.1 Motivation

The use of blockchain technology is advantageous in a wide range of fields. In recent years, it has been clear that blockchain technology has the potential to revolutionize

numerous industries and business processes while also resolving systemic issues. While this thesis makes students interested in studying topics related to blockchain technology, it is also useful for students interested in business to integrate their knowledge of business processes with blockchain technology. This thesis addresses the fundamental definition of blockchain in order to broaden students' horizons by educating them on this technology. In addition, since the findings presented are open to enhancement, students have the opportunity to take advantage of this technology to improve various business processes or to reorient their way of working.

1.2 Research Questions

The goal of this study is to determine **how blockchain technology might support redesign in business processes** . This thesis is presented as a systematic literature review (SLR). Analysis of instances where business processes have been altered and enhanced performance has been measured is the goal of the systematic literature review.The study aims to look into how business process changes might be made possible by blockchain technology.
Therefore, The thesis discusses the following research questions:

RQ1: What types of business processes have been supported or enabled by blockchain technology?

RQ2: How can business processes be redesigned when executed on blockchain technology?

RQ3: What technologies were utilized to enable process improvements?

1.3 Contribution

The findings of this study are the presentation of blockchain technology that aims to provide a guide to companies and industries for the improvement of traditional business processes and add value to their businesses. In this study, I aim to discover the characteristics of a number of business processes that blockchain technology can support. The use of these findings is not limited to business analysts and company managers, however, gives engineers working on blockchain solutions high-level information as well. The contributions of this thesis are accomplished by the use of a systematic literature review (SLR). I utilize SLR to search databases that contain academic studies for relevant literature.

1.4 Structure of the Thesis

The structure of the thesis is as follows:

- **Chapter 2:** In this chapter, I describe the main concepts of blockchain technology, characteristics and benefits of blockchain, main blockchain platforms and business process management (BPM) is also discussed in this chapter.
- **Chapter 3:** I explain the method in detail in this chapter. It is described what is my systematic literature review, and how I extract data and I also make some graphs to show my results based on my data extract.
- **Chapter 4:** This chapter presents the results based on my findings for each research questions from previous chapter.
- **Chapter 5:** I discuss about my findings and results from previous chapters, I also explain the limitation of this study.
- **Chapter 6:** In this chapter, I basically describe the conclusion.

2 Background

In this chapter, we examine early research efforts at the convergence of BPM and blockchain and summarize the key components of connecting the BPM parts with blockchain parts.

2.1 Blockchain technology

In this section, we introduce the concept of blockchain technology and its main components such as characteristics and Benefits of Blockchain, Public vs private Blockchain, smart contract, oracles and Main blockchain platforms.

A secure, transparent, extremely resilient to outages, auditable method of recording transactions or any digital interaction is provided by blockchain technology. It will still be a few years before this technology is widely used in commerce because it is still in its infancy and is evolving quickly. To avoid disruptive surprises or missed opportunities, decision-makers across industries and corporate functions should pay notice right away and begin to research applications of this technology.

The idea of Bitcoin was first suggested by Satoshi Nakamoto in 2008. By disseminating the widely read document "Bitcoin: A Peer-to-Peer Electronic Cash System," this was accomplished Atlam *et al.* (2018). The report made a recommendation for dispersing electronic transactions rather than keeping the exchange reliant on centralized organizations. Ahram *et al.* (2017).

The Blockchain is defined in a variety of ways Atlam *et al.* (2018). A distributed database of records, or public ledger, of all executed transactions or digital events that have been shared among participating parties is what the blockchain is described according to Stanciu (2017). The consensus of a majority of the system's users verifies each transaction on the public ledger. Information cannot be deleted once it has been entered. Every transaction ever made is contained in a particular, verifiable record on the blockchain Stanciu (2017).

As seen in Figure 1, a blockchain comprises of two key components Banafa (2017): The acts produced by system participants are referred to as transactions. Blocks: keep a record of the transactions and ensure that they are correctly ordered and unaltered.

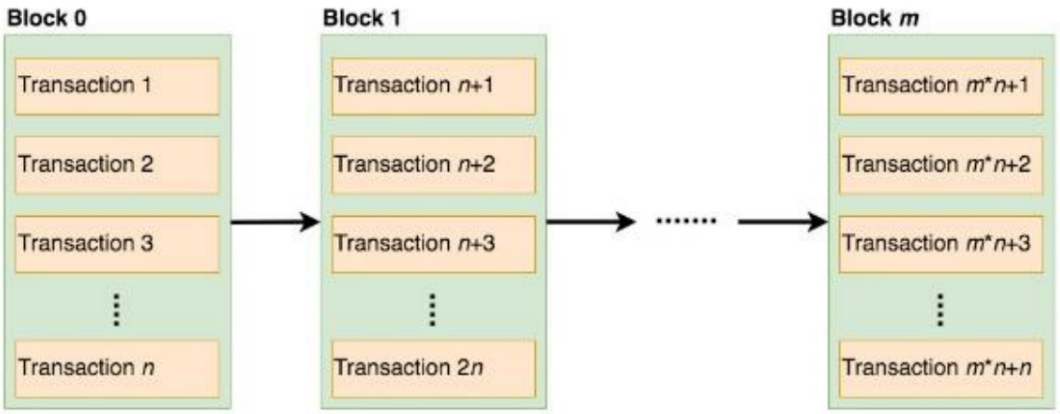

Figure 1. Blockchain architecture Stallings (2015)

2.1.1 Characteristics and Benefits of Blockchain

The IoT finds the blockchain to be very appealing for solving many of its problems due to its various features.

1.Decentralization: By utilizing the resources of all participating nodes and removing many-to-one traffic flows, the absence of centralized control assures scalability and robustness, which in turn reduces latency and eliminates the single point of failure issue that arises in the centralized model Atlam *et al.* (2018).
2.Anonymity: Users' identities can be effectively hidden and kept private through the use of anonymity Atlam *et al.* (2018).
3.Immutability: One of the main benefits of blockchain is the ability to create immutable ledgers. Any centralized database that relies on confidence in a third party to maintain information integrity is susceptible to corruption. A transaction cannot be altered once it has been agreed upon and documented Atlam *et al.* (2018).
4.Better Security: Blockchain provides better security because there is no single point of failure Benefits, Difficulties, and Future Directions of Combining Blockchain with the Internet of Things Atlam *et al.* (2018).
5.Increased Capacity: One of the significant things about blockchain technology is that it can increase the capacity of an entire network. Having thousands of computers working together as a whole can have greater power than a few centralized servers. Atlam *et al.* (2018).

2.2 Public vs private Blockchain

Both public and private blockchain networks are distributed among their users and decentralized, allowing them to record all peer-to-peer transactions without the need for the third party who is typically trusted to authorize them. However, there are some key differences between public and private blockchains Yang *et al.* (2020). In this section we want to compare both public and private blockchain.

Public Blockchains

A public blockchain, sometimes referred to as the Unpermitted or Permissionless Blockchain, enables anybody to participate in the blockchain by adding and validating new blocks as well as changing the chain's current state by storing and updating data through transactions between involved parties Yang *et al.* (2020).

This indicates that the blockchain's state, its transactions, and the data it stores are all open and transparent to everyone. This gives rise to privacy problems in specific situations where the confidentiality of such data must be maintained Ferdous *et al.* (2021). The public blockchains, have a relatively slow rate of transaction processing Yang *et al.* (2020).

The append-only data method used by the public blockchains creates immutable data storage. Furthermore, since every node in a public blockchain stores the same data, any update must be approved by every node. As a result, it takes longer to mine only one block to the blockchain and any modification must be recorded in all subsequent blocks. Additionally, all blocks are connected to the genesis block in order to maintain the integrity of the blockchain Yang *et al.* (2020).

Controlling user data uploads is a challenge for public blockchains.For instance, there is no way to stop someone from uploading sensitive information into the system. Although there are an infinite amount of anonymous nodes on the public blockchain, each actor can communicate secularly using cryptography Yang *et al.* (2020).

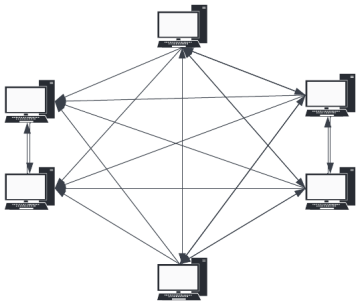

Figure 2. Public Blockchain
Source: Made by the author
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Private Blockchains

We have private blockchain, where nodes require authorization to join a managed blockchain and view the chain's current state. Although the private blockchain is quicker, safer, and more effective, decentralization is sacrificed because permissions are held centrally Rouhani and Deters (2017).

Private blockchains process transactions incredibly quickly and only allow a small number of authorized users. As a result, reaching agreement for the network takes less time, and more transactions can be handled in a second Yang *et al.* (2020).

One of the most well-known examples of a private blockchain is Hyperledger [1], which allows only authorized users to join the network following authentication.The Distributed Ledger Technology (DLT), in which each peer supports one ledger per channel, serves as the foundation for the HLF network. Though peers in the Hyperledger Fabric network play a variety of roles, unlike the Ethereum networkFedorov *et al.* (2021).

Since there are more nodes and a greater degree of decentralization on public blockchains, it is more difficult for malicious parties to alter the network's configuration. On the other hand, Private blockchains, have fewer nodes, making it simpler for any malicious party to take over the network. As a result, private blockchains are more vulnerable to hacking and data tampering than public blockchains. The public blockchains are therefore considered to be more secure Yang *et al.* (2020).

[1] A blockchain framework called Hyperledger Fabric (HLF) is used to build plug-and-play components for blockchain-based applications Fedorov *et al.* (2021).

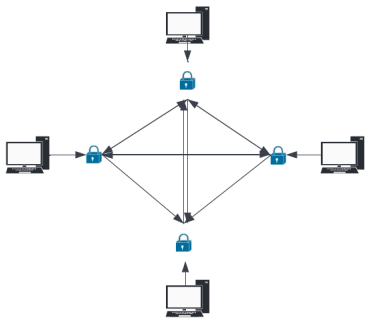

Figure 3. private Blockchain
Source: Made by the author
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2.3 Smart contracts

Different blockchain systems allow for the development and deployment of smart contracts. For creating smart contracts, a number of platforms provide unique capabilities such contract programming languages, contract code execution, and security levels. Some platforms enable the creation of smart contracts using high-level programming languages Khan *et al.* (2021).

For example, the lock-in requirement for cash withdrawal or the automated payment upon an importer's successful delivery of the goods are just two examples of how smart contracts can improve contractibility and enforceability on certain eventualities Cong and He (2019).

One of the most popular platforms for creating smart contracts is Ethereum. On the Ethereum platform, smart contract developers are free to create any kind of decentralized application (DApp) Sayeed *et al.* (2020). While the Ethereum blockchain allows computer programs to be written in a "Turing complete" language that is theoretically as expressive as every other general purpose programming language, the Bitcoin blockchain only supports very basic forms of smart contracts Staples *et al.* (2017).

A hypothetical example of an Ethereum Smart Contract Application is shown in Figure 4. It is significant to remember that the smart contract functions entirely independently, with no input from the owner. Following is a description of this scenario Salah (2018):

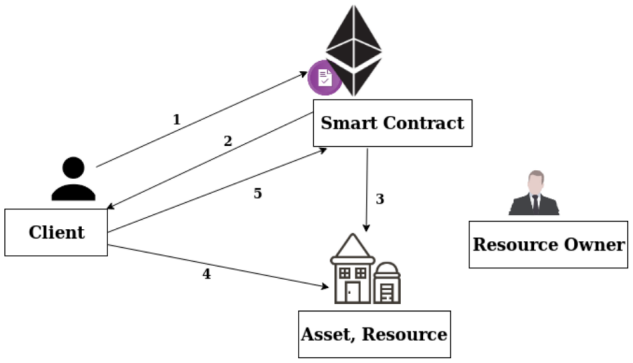

Figure 4. An example scenario for an Ethereum smart contract Salah (2018)

The client asks the smart contract for access to a certain resource or asset. Then, the smart contract first determines whether the object is free before recording the customer charge. In this instance, the client is making a payment using the cryptocurrency Ethereum. Therefore, the resource is reserved for the present client via the smart contract. After that, the client makes proper use of the resource.The smart contract charges the client as specified if everything happened according to the terms of the contract Salah (2018).

As well as, other smart contract platforms besides Ethereum are used for the creation of DApps Sayeed *et al.* (2020). Another platform for constructing privacy-preserving smart contracts is Hawk. Because Hawk does not require the implementation of cryptography, it allows non-programmers the chance to create a Hawk program. To compile Hawk programs, a compiler is available Sayeed *et al.* (2020).

2.4 Understanding the Oracle

What Are Oracles?
Greek mythology gave rise to the term "oracle," which describes a person with the ability to talk with god and predict the future. Thus according legends from the past, people consulted oracles for knowledge that was beyond their comprehension since they lacked the information essential to make decisions Buck (2017).

Based on Oracles are systems that deliver information from the outside world to blockchain in the context of the blockchain technology. A gateway from the outside world is required if smart contracts deal with decentralized mechanisms such as climate, trading volume, or political events rather than cryptocurrency exchange Caldarelli (2020).

For blockchains and smart contracts, oracles retrieve and validate external data using tools like web APIs or trade data feeds. Smart contracts can require a variety of data types, such as price feed data, weather data, or even randomly generated for gaming. Utilizing oracles entails requesting specific information from the data source, connecting to it, and then using that connection as an interface between the blockchain and the data stream. Smart contracts can therefore operate based on the specific information coming from the data feed Curran (2019).

Oracles work as a bridge by processing outside, non-deterministic data and converting it into a language that a blockchain can understand Curran (2019).

Moreover, Blockchain oracles can be categorized based on a variety of characteristics, including: What is the data source? Human, hardware or software?
Is the flow of information inward or outward?
How decentralized or centralized is trust?
One oracle may fit into more than one category. A centralized incoming software oracle, for instance, would draw information from a firm website. Hermann *et al.* (2019)

2.5 Main blockchain platforms

The three main blockchain platforms are Hyperledger Fabric, R3's Corda, and Ethereum. In contrast to R3's Corda, which is primarily employed in the financial services sector, Ethereum and Hyperledger Fabric can be used in any business Yang *et al.* (2020). Therefore,in this study, Ethereum and Hyperledger Fabric are covered and used.

2.5.1 Ethereum

According to Nakamoto (2008) the foundation of Bitcoin, the first cryptocurrency Nakamoto ever developed, was Blockchain 1.0. Beyond cryptocurrencies, Blockchain 2.0, the following significant stage in the development of the blockchain industry, released a second public blockchain called Ethereum in 2015 and introduced the idea of smart contracts, which broadens the scope of blockchain applications and enables the decentralization of markets and transactions Shojaei (2019).

Ethereum was created as a result of Bitcoin and Buterin's planned blockchain-based distributed computing platform Buterin *et al.* (2014). A general-purpose blockchain platform is Ethereum (permissonless, public and private). Proof-of-stake (PoS), a consensus algorithm that is bootstrapped from but more effective than PoW, is the one used by Ethereum Shyamasundar and Patil (2018). The majority of cryptocurrencies use the PoW algorithm, which is based on game theory and cryptography Zhang *et al.* (2018).

2.5.2 Oracles on the Ethereum Blockchain

The way that Oracles work with Smart Contracts on the Ethereum Blockchain is different. A second signature is not required because the Smart Contract may authorize the transaction without it.When giving data on-chain, the Oracle will send the data to the requesting smart contract by way of a signed transaction that includes the requested data. The contract could only be carried out if this transaction materialized Egberts (2017).

2.6 Business process management (BPM)

In this section, we introduce the concept of Business process management and its main components such as BPM and its lifestyle, redesign and why it's important, and redesign heuristics.

2.7 BPM and its lifecycle

Corporate essential assets include business processes. They directly affect how the market perceives how attractive certain goods and services are. They establish responsibilities, objectives, and tasks, thus, influencing each employee's work. Systems, data, and supplies are integrated through processes both inside and outside of businesses, and any failure can put an end to business as usual Dumas *et al.* (2013). Figure 5 shows BPM and its life cycle. Analysts can suggest a redesigned version of the process, or a method that would solve the flaws discovered in the as-is process, once they have a grasp of one or more issues in a process and a candidate set of potential remedies. The important outcome of the to-be process is the redesign phase. Dumas *et al.* (2013)

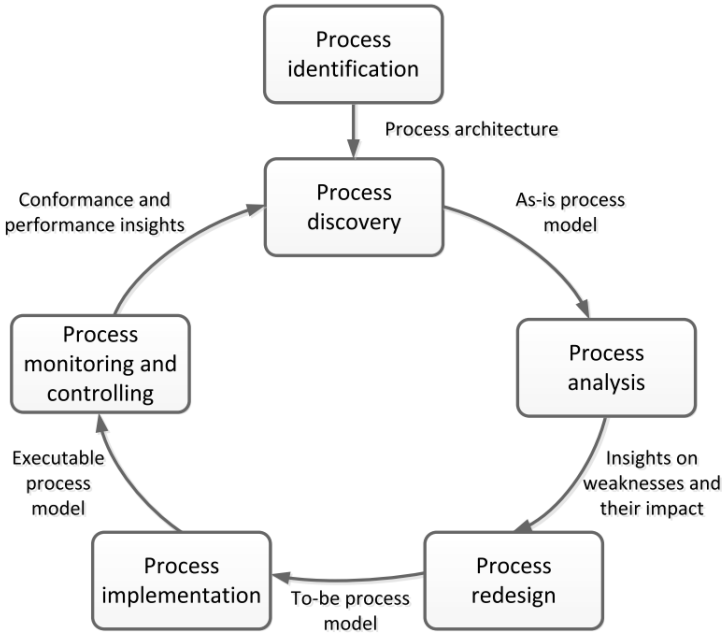

Figure 5. BPM and its life cycle Dumas *et al.* (2013)

2.8 Why redesign is crucial?

A business process produces and provides a certain good or service that clients are looking for. The most effective strategy to increase the quality of such a product or service from the standpoint of the client is probably to enhance the associated business process. Business process redesign emphasizes on rethinking and reorganizing business processes in order to increase the quality of goods and services. The fact that the world also changes is another justification for redesigning a business process, even if it was ideal when it was first created Dumas *et al.* (2013).

2.8.1 Heuristic Process Redesign

The best practices are universal in the sense that they can be used in a variety of procedures. Therefore, the deployment of a certain best practice is determined by the technology and the analyst's experience. Analysts might not be familiar with how to apply best practices to novel and possibly disruptive technology like blockchain. By explicitly adjusting the best practices for redesign of blockchain-based processes, it is possible to overcome this challenge by converting best practices into redesign heuristics for blockchain. Milani *et al.* (2020)

2.9 Summary

Blockchain technology has drawn a lot of interest as a powerful tool for business process redesign. To implement certain functionality connected to the applications, it must be integrated with other Business Process Management system (BPM) components. Blockchain and business process characteristics must be determined in order to integrate blockchain into business processes effectively (figure 6). Viriyasitavat and Hoonsopon (2019).

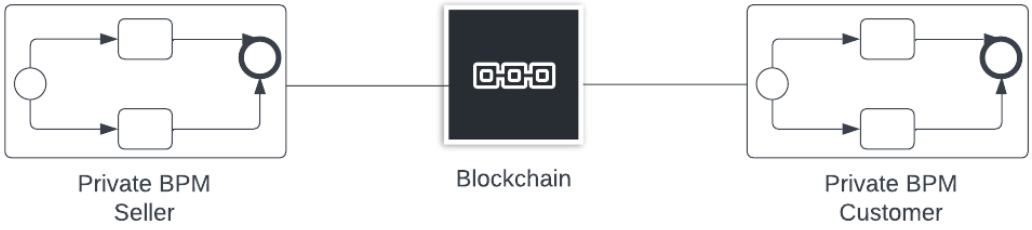

Figure 6. BPM and Blockchain collaboration
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3 Systematic Literature Review

The main objective of the Systematic literature review is to identify studies where business processes have been improved and the improvements measured.

3.1 Planning of SLR

The SLR follows the guidelines suggested by Kitchenham and Charters (2007). SLR is outlined in three main phases (Figure 7). The first stage of a review involves the rationale for it, the formulation of the research questions, and the creation and assessment of the review methodology. In the second stage, studies are found, primary studies are chosen, quality is evaluated, data are extracted, and data are synthesized. The third phase also takes into account how the report will be distributed, formatted, and evaluated. Kitchenham and Charters (2007)

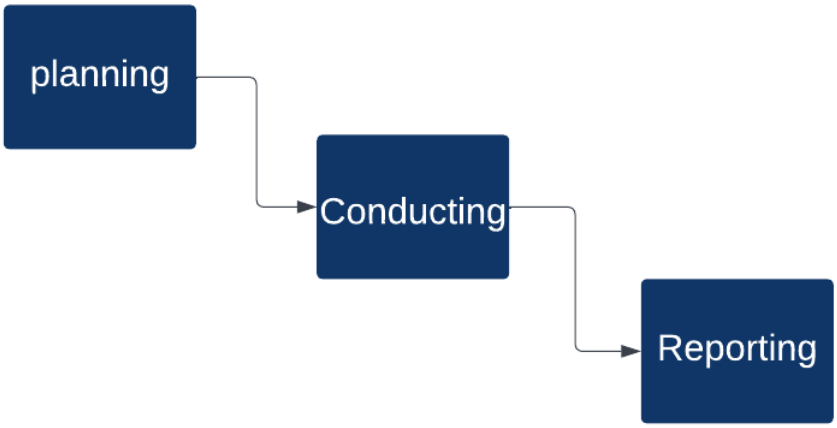

Figure 7. Three main phases
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3.2 Motivation for this SLR

The main objective of the SLR is to identify studies where business processes have been improved and the improvements measured. An unbiased selection of cases is required for systematic and scientific evaluation of how blockchain technology can redesign business processes. An SLR is methodologically rigorous in contrast to an ad hoc review.

The following questions will guide our review of the literature:

RQ1: *What types of business processes have been supported or enabled by blockchain technology?*
The main research question aims to identify blockchain technology that extend beyond cryptocurrency.This inquiry identifies the characteristics of processes that make them interesting for blockchain.

RQ2: *How can business processes be redesigned when executed on blockchain technology?*
After determining which business processes might benefit from blockchain, we must determine how these improvements will be made possible.

RQ3: *What technologies were utilized to enable process improvements?*
The purpose of this question is to know about different type of technologies which use for redesigning processes.

3.3 Search Strategy

The overall search strategy is to find a body of relevant scientific studies. Two search strategies were used, as recommended by some studies Fink (2019), to secure that important studies were not missed. For the primary search, we used search strings on several electronic databases. Following the primary screening, we conducted a secondary search by means of backwards and forward tracing.

3.3.1 Primary Search

The primary search aimed at enabling a comprehensive search to identify an initial set of papers.

3.3.2 Search String

The development of the search strings, we followed the guidelines suggested by Kitchenham and Charters (2007). The guidelines were originally produced by a single person (Kitchenham) Kitchenham and Charters (2007) addressed the issue of whether it was possible to use cross-company benchmarking datasets to produce estimation models suitable for use in a commercial company.

"Blockchain" “distributed ledger”
1. The term “blockchain” and “distributed ledger” are key and derived from the scope of

the study.

“Business process” “process”
2. The term “Business process” is also derived from the research questions. However, the term improvement is far from standard in this domain. Therefore, we also need to use the following terms:

a. “Business process” Based on the search terms, the following search strings were formulated.

ST1: ("blockchain" OR "distributed ledger") AND ("business process")

3.4 Search sources

The electronic databases were selected based on coverage of journal papers, conference proceedings, and workshop papers in the field of computer science where research on business process improvement is mostly published (Brereton et al. 2007). Additionally, the databases have to be openly accessible via the university domain. the following databases were used as a result:
(1) Web of Science
(2) Scopus
(3) IEEE Xplore
(4) ACM Digital Library
(5) Wiley online library
(6)Google Scholar

3.5 Secondary Search

Having identified a comprehensive list of potentially relevant papers with the aid of the primary search followed by relevance and quality screening, a secondary search was conducted. To identify additional relevant papers, backward and forward tracing techniques were used. We took the final list of papers produced from the primary search as basis. The same exclusion and inclusion criteria were applied for identified papers. Google Scholar was used for forward tracing. The resulting list of hits were screened according to same relevance and quality criteria used for the primary search. The search was stopped when we did not discover any new relevant concepts as recommended by Webster and Watson (2002).

3.6 Articles Selection Criteria

Given the aim of the study, it is important that the papers cover process improvements. Process improvement can be named differently and as such, the first inclusion criterion refers to any study where a business process has been changed with the aim of improving its performance.

IC1: Does this paper present anything from a process perspective?

IC2: Do they present a process that was changed or do they present you of the new solution?

IC3: Do they change business processes by using blockchain technology?

IC4: Do they describe the motivation behind the process change?

The purpose of the selection criteria is to identify relevant studies that provide sufficient information to address the research questions. The criteria consisted of exclusion and inclusion criteria.
The second criterion aims at capturing papers that propose process improvements and present the studies sufficiently for further analysis. For our purposes, papers selected must have enough information about the as-is and to-be models. Otherwise, it will be impossible to evaluate how blockchain technology could improve process performance. To compare process performance, it is necessary to have information about what aspects of the process performance were improved and by how much. Thus, the third inclusion criteria.
Finally, the fourth inclusion criterion ensures including inter-organizational improvement initiatives. This criterion is included as blockchain technology mainly operates in inter-organizational settings.

Studies that treat the improvements superficially, on an aggregated level, or fail to present changes made.
EC1: Is the full-text version digitally accessible? (I)
EC2: Is the study written in English? (I)
EC3: Is the study is less than 5 pages? (E)
EC4: Is the study a duplicate? (E)

The first two exclusion criteria are defined to ensure access and understandability. If the study is not accessible or in English, it will be impossible to understand them. Papers accessible via digital libraries subscribed to by the University or available on the Internet, are considered as accessible. Papers behind paid walls and not available via mentioned

channels, are considered as inaccessible. Papers less than 5 pages are also excluded as they cannot contain enough information for analysis. Finally, duplicates were excluded. Duplicate papers are those where papers with the same title from the same authors appear in different digital libraries (exact duplicate). Duplicates are also studies from the same authors with approximately the same topic (version duplicate). In case of exact duplicate, only one is included and in the case of version duplicates, the most recent version is included.

The full copy of the list of papers resulting from the first screening, was reviewed. Each study was examined against the inclusion criteria following the same procedure as the first screening. As such, following a top to bottom approach, if a paper failed an inclusion criteria, it was excluded without the other criteria being considered. The two list of papers (one per reviewer) following the second screening was evaluated for inter-rate-agreement by means of Kappa. Disagreements between the reviewers were resolved by discussion and consensus.

3.7 Data Extraction Strategy

Following the identification of the final list of papers, relevant data was extracted. To ensure unbiased data extraction strategy, it has been recommended Okoli and Schabram (2010), Brereton *et al.* (2007), Randolph (2009) to develop a data extraction form and strategy. These are discussed below.

3.8 Data Extraction Form

The data extraction form can be developed before the screening process [Okoli], allowing for utilize the insights drawn during the screening phase. We extracted three types of data. The first relates to data about the paper. The second was data related to the context of the study and finally, the third type related to the actual process improvement. The data was extracted in an iterative manner. One author extracted the data and populated the form. The extracted data were reviewed and in cases of questions, uncertainty, ambiguity, or differing views, both authors examined the paper and used a consensus approach to resolve discrepancies.

3.9 Data Synthesis and Reporting

The extracted data was summarized and analysed. The results were used to create a framework capturing the process optimizations efforts used for inter-organizational processes.

Table 1. Data extraction form

Data about the Paper	Description
Identifier	Unique code of the articles.
Title	Title of the paper.
Authors	Authors of the articles.
Publication Year	Year of publication of the articles.
Industry	The industry where the case study was performed.
Product/ service	The service or product provided by that industry.
Process Characteristics	Process Characteristics of the business process.
Description	Description of Process Characteristics.
As-Is Process	Business process model before using Blockchain.
To-Be Process	Business process model after using Blockchain.
Changes	The main changes (from as-is to the to-be).
Redesign Pattern	Re-design method applied.
Blochcian Technology	An explanation of the Technology they use.

3.10 Results

In this section, the exact results of the paper search, selection, and screening, as well as data extraction results, are presented. The developed search string was applied to each of the selected databases. The search results per source are shown in Figure 8. A single list made up of 3181 publications was created by combining the search result lists from each database.

Based on the defined paper selection criteria, the selection procedure was executed as follows: first, data cleaning was conducted, then duplicates and papers containing fewer than 5 pages were removed, filtering by paper title and paper abstract was performed, and finally, filtering by reading the full paper was executed. Further, this section describes each of the filtering stages. Figure 8 summarizes the data on the number of papers that were processed and filtered, Figure 9 depicts a visual representation of the paper filtering process.

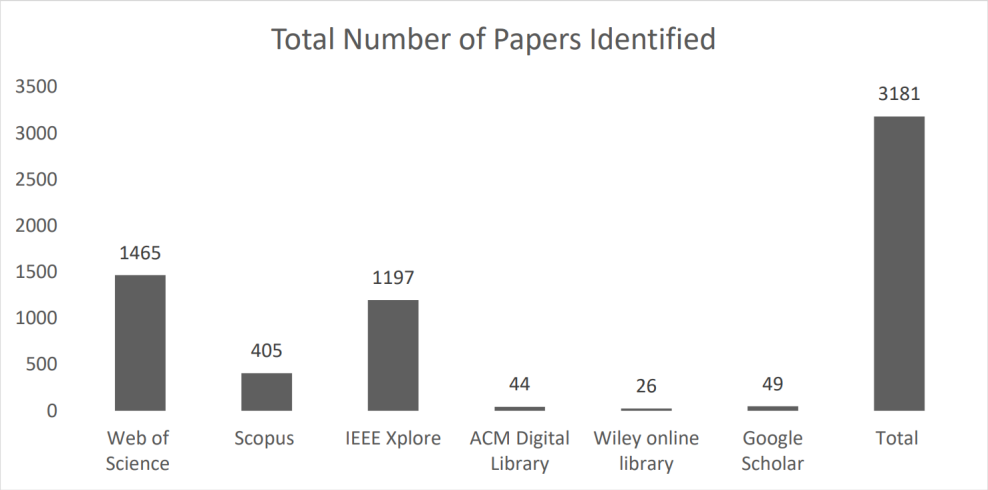

Figure 8. The search result lists from all databases
Source: Compiled by the author

1.Filtering out duplicates:
Since there are 4 resources of paper search, some papers can inevitably occur in several resources, thus creating duplicates in the list of research papers for data extraction. Hence, the next step was to remove the duplicates from the list. 686 duplicated were identified and removed, leaving 2495 papers for the further filtering stage.

2.Filtering by the number of pages:
A total of 2391 papers entered the next phase of filtering after 104 papers that were less than 5 papers were excluded based on exclusion criteria EC4.

3.Selecting based on paper title:
The rest of the papers are filtered by the title matching the research topic. If it is evident from the title that the paper does not relate to the research, such paper is removed from the list. In case it is not clear and/or confusion occurs, the paper is left for the next filtering stage. In the result of filtering the paper title, 329 papers were considered irrelevant for this research and removed from the list. 2062 papers entered the next round of filtering that is filtering by the abstract.

4.Filtering by paper abstract:
Similar to the filtering by title, this kind of filtering considers paper relevance to the research topic, but this time we examined paper abstracts. When the paper abstract gave a clear understanding that the paper is focused on different research questions not connected with this research, such paper was excluded from the list. During this filtering stage, 1968

papers were identified as those examining different research questions and removed from the list. As a result, 94 papers formed the next list of papers relevant to the research study.

5.Filtering by reading the full paper:
Similar to the filtering by abstract, this kind of filtering considers paper relevance to the research topic, but this time we examined paper by reading full paper. When the full paper gave a clear understanding that the paper is focused on different area not connected with this research, such paper was excluded from the list. During this filtering stage, 94 papers were identified as those examining different research questions and removed from the list. As a result, 25 papers formed the final list of papers relevant to the research study and are eligible for the data extraction session.

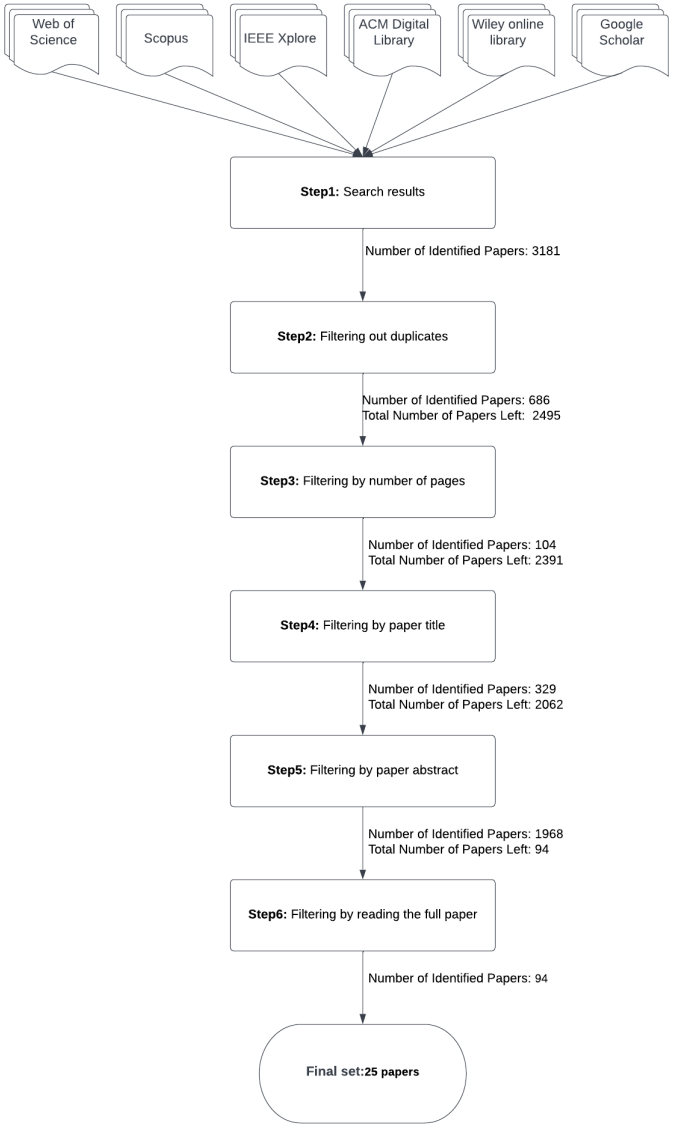

Figure 9. The result of filtering papers
Source: Compiled by the author by using www.lucid.app website

4 Results

4.1 Introduction

Based on papers and scientific hypotheses from chapter 3, the following chapter examines the hurdles to using blockchain technology in the different use cases. In this study, we analyzed using a model that included blockchain as a component of the solution, and then we looked at the key differences or changes between the processes before and after using blockchain technology. In order to answer the research questions, it is also helpful to examine the type of technology that was utilized to change the process as well as how and why each technology was employed.

Our entire collection of **25** papers was deemed qualified for the data extraction based on the inclusion and exclusion criteria that we defined. Moreover, We mainly considered studies after the year 2016.As blockchain is a new technology, fewer articles were written before 2016 could not properly support our research questions. In this thesis,based on our Systematic Literature Review, we examined the articles between the years 2016 and 2022. Based on figure 10, most of our data extracted are from the papers year 2020 (7 articles).

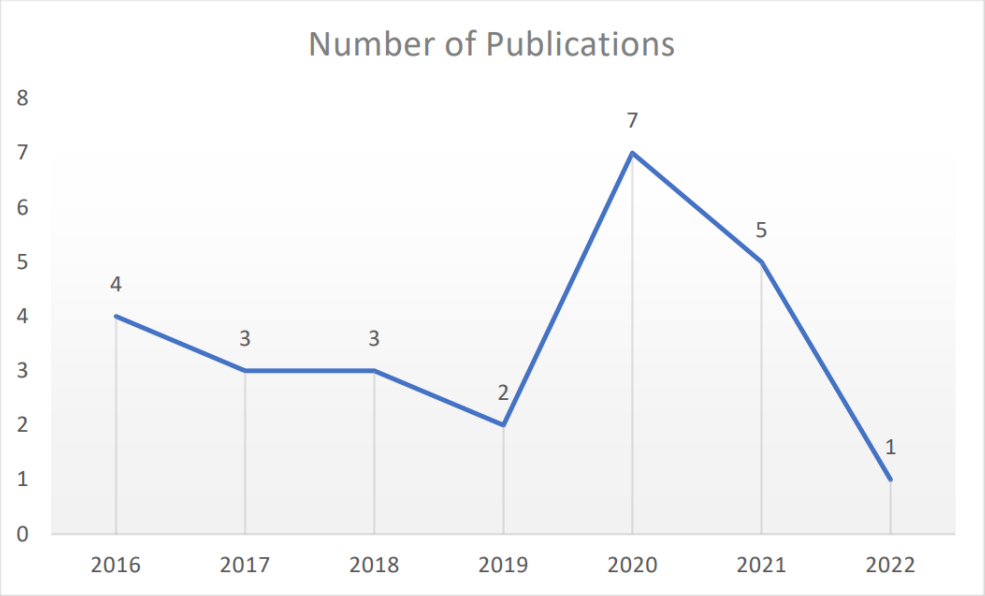

Figure 10. Number of Publications
Source: Compiled by the author based on papers

4.2 Types of business processes

In this section, we describe the results of the different type of processes that are supported by blockchain. Then we are able to answer to the **RQ1 (What types of business processes have been supported or enabled by blockchain technology?)**
We categorized processes according to data extracted from articles. Analyzing processes that are believed to be able to be redesigned by using blockchain. The processes are:

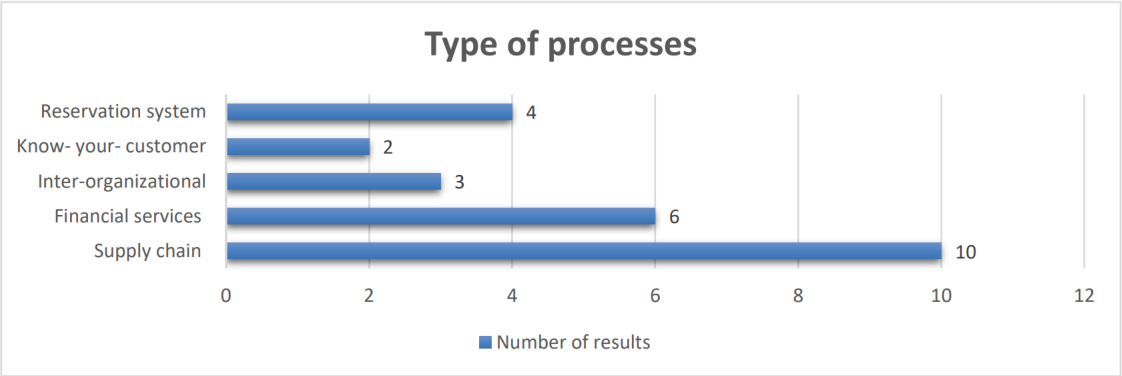

Figure 11. Types of business processes
Source: Compiled by the author based on articles from chapter 3

1.Supply chain: Supply chain can get help from blockchain because it creates a shared, secure record of information flows, lowering safety concerns, boosting consumer confidence in the provenance of products, and improving supply chain effectiveness Longo *et al.* (2019). There are many other supply chain processes for instance, fresh milk processing Longo *et al.* (2019), clothing industry Agrawal *et al.* (2021) that are able to use blockchain.

2.Inter-organizational: It is difficult to ensure the accuracy of the data in an inter-organizational process when control of the process is given to participants outside the organization Nakamura *et al.* (2018). Therefore, many different inter-organization need to redesign processes that using blockchain can be helpful.

3.Financial services: In sectors like the banking sector, where trust is important, blockchain technology is considered to be the advancement Ali *et al.* (2020).

4.Know- Your- customer: Blockchain even can help us to change some processes in the banks. As KYC is the essential compliance processes in the bank. Kirss and Milani (2020). After reviewing various articles from the previous chapter, we found that the KYC process is a very time-consuming process for institutions and does not add value to

financial institutions. And this process is almost done manually. The overall effectiveness of KYC may be significantly improved with the use of decentralized Blockchain technology in terms of faster processing, shorter onboarding times, lower risk, and lower overall costs. Malhotra *et al.* (2021)

5. Reservation system: Another Process which we considered is reservation system. For instance, one of our findings is about reservations parking Panduwinata and Yugopuspito (2019).This reservation service can be paid through the digital money in the member's account. This approach can speeds up the reservation process. This indicates that the member owns the account's remaining balance. The member must have the minimal balance needed to make a reservation. The smart contract will cancel a reservation after it has been made if the member's balance falls below the minimum required before the reservation deadline. Prior to the reservation deadline, the member may park if their balance still matches the minimal criteria. Panduwinata and Yugopuspito (2019).

In conclusion, 5 potential type of business processes that can be redesigned utilizing blockchain were found using the data extraction from 25 articles (Table 2). We had the opportunity to analized about various processes and the flaws in them. We were able to answer to the first research question and we covered RQ1. In the next chapter, we discuss about characteristics of these business processes which can be interesting for blockchain technology to be used.

Table 2. Types of business processes

Process	Description	Numbe of articles	References
Supply chain	A linear economy model called the supply chain satisfies supply needs either directly or indirectly. Longo *et al.* (2019).	10	Longo *et al.* (2019), Ekawati *et al.* (2021),Al-Rakhami and Al-Mashari (2021),Aitken (2017), Guerreiro *et al.* (2020),Omar *et al.* (2020), Latif *et al.* (2021), Figorilli *et al.* (2018), Agrawal *et al.* (2021), Korpela *et al.* (2017)
Financial services	Financial sectors that provide economic services.Ali *et al.* (2020).	6	Ali *et al.* (2020), Cermeño (2016), Fanning and Centers (2016), Lewis *et al.* (2017), Chang *et al.* (2020), Nguyen (2016)
Inter organizational	Controlling commercial operations that cross organizational boundaries. Nakamura *et al.* (2018).	3	Nakamura *et al.* (2018), Carminati *et al.* (2018),Kostić and Sedej (2022)
Know-your-customer	The KYC procedure makes sure that businesses evaluate the risk of doing business with a client.Kirss and Milani (2020).	2	Kirss and Milani (2020),Kapsoulis *et al.* (2020)
Reservation system	This reservation system enables transactions between buyers, sellers, or other parties.Panduwinata and Yugopuspito (2019).	4	Panduwinata and Yugopuspito (2019), Pustišek *et al.* (2016), Rani *et al.* (2021), Shrestha *et al.* (2020)

4.3 Processes that can be modified using blockchain

This section addresses the second research question **((RQ2)How can business processes be redesigned when executed on blockchain technology?)** aiming at identifying the lack of progress in some of the processes where blockchain technology able to redesign. As we mentioned in previous section, our findings are based on 25 articles. From the extracted data analysis, a total number of 5 different aspects of the processes were identified, among which are the following:

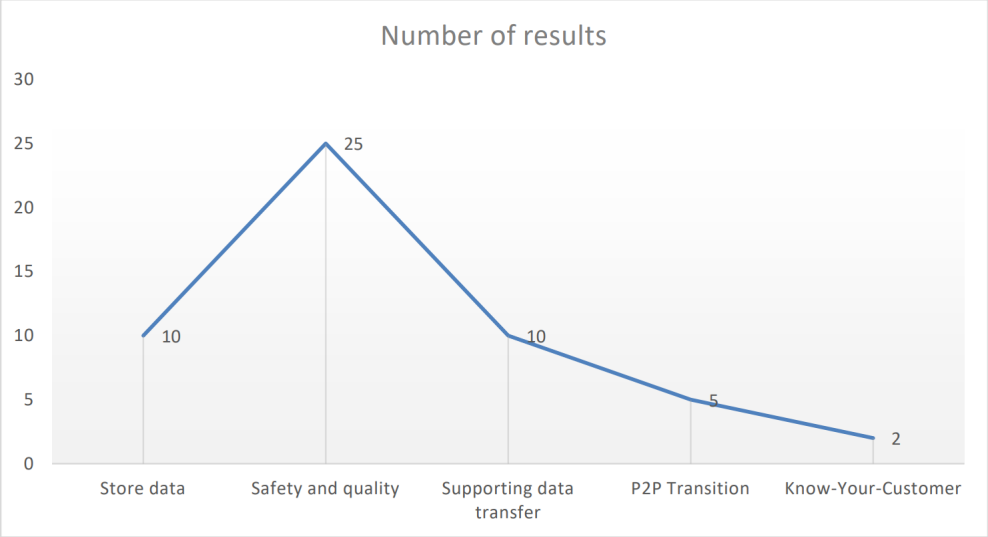

Figure 12. Processes that can be modified using blockchain
Source: Compiled by the author based on articles from chapter 3

1.Safety and quality: Figure 12 shows that in many business processes lack of safety and quality are the biggest issue (25 articles). For instance in supply chain processes Longo *et al.* (2019), Financial services Ali *et al.* (2020), Inter-organization (Nakamura *et al.*, 2018) and Energy markets Hermann *et al.* (2019).

2.Store data: The second biggest deficiency that was seen in most processes was the problem of data storage (10 articles). These days, IoT data storage has grown to be a serious issue Li *et al.* (2018).

3.Supporting data transfer: Data sharing between stakeholders is another challenging process between companies and many sectors, such as Parking reservation process Panduwinata and Yugopuspito (2019) and Financial sector Ali *et al.* (2020).

4.P2P Transition: Regarding cross-border payments, where the clearing processes vary depending on the nation Ali *et al.* (2020).

5.Know-Your-Customer: Another important process for companies is KYC process which we extracted from the articles. For instance, KYC is the most essential compliance procedures through the banks Kirss and Milani (2020). Moreover, this finding is in agreement with Kapsoulis *et al.* (2020) findings which showed a Quorum [2] blockchain was incorporated into the system for redesigning the KYC procedure. They used Quorum solution because it is based on the Ethereum blockchain that can enable the adoption of KYC procedures Kapsoulis *et al.* (2020).

As a result, 5 main processes that can be improved using blockchain were found based on the use of data extracted from 25 articles. We had the opportunity to analyze various processes and their process flaws in them. We were able to answer to the second research question and we covered RQ2 (Table 3).

[2]Quorum is a permissioned blockchain, built on the Ethereum base Baliga *et al.* (2018).

Table 3. Processes that can be modified using blockchain

Process	Description	Numbe of articles	References
Store data	To store many information inside the database in different company and industry.Li *et al.* (2018).	10	Longo *et al.* (2019), Ekawati *et al.* (2021),Al-Rakhami and Al-Mashari (2021),Aitken (2017), Guerreiro *et al.* (2020),Omar *et al.* (2020), Latif *et al.* (2021), Figorilli *et al.* (2018), Agrawal *et al.* (2021), Korpela *et al.* (2017)
Safety and quality	Creating a reliable process between different stakeholders and maintaining quality. Longo *et al.* (2019).	25	Longo *et al.* (2019), Ekawati *et al.* (2021),Al-Rakhami and Al-Mashari (2021),Aitken (2017), Guerreiro *et al.* (2020),Omar *et al.* (2020), Latif *et al.* (2021), Figorilli *et al.* (2018), Agrawal *et al.* (2021), Korpela *et al.* (2017), Ali *et al.* (2020), Cermeño (2016), Fanning and Centers (2016), Lewis *et al.* (2017), Chang *et al.* (2020), Nguyen (2016), Nakamura *et al.* (2018), Carminati *et al.* (2018),Kostić and Sedej (2022) , Kirss and Milani (2020),Kapsoulis *et al.* (2020), Panduwinata and Yugopuspito (2019), Pustišek *et al.* (2016), Rani *et al.* (2021), Shrestha *et al.* (2020)
Supporting data transfer	The information only reaches the people who need this information.Panduwinata and Yugopuspito (2019).	10	Longo *et al.* (2019), Ekawati *et al.* (2021),Al-Rakhami and Al-Mashari (2021),Aitken (2017), Guerreiro *et al.* (2020),Omar *et al.* (2020), Latif *et al.* (2021), Figorilli *et al.* (2018), Agrawal *et al.* (2021), Korpela *et al.* (2017)
P2P Transition	A persistent path of direct communication between two parties. Ali *et al.* (2020).	5	Ali *et al.* (2020), Cermeño (2016), Fanning and Centers (2016), Lewis *et al.* (2017), Chang *et al.* (2020)
Know-Your-Customer	Industries and banking can verify the identity of their customers.Kirss and Milani (2020).	2	Kirss and Milani (2020),Kapsoulis *et al.* (2020)

4.4 Technologies are used

This section addresses the third research question (**(RQ3) What technologies were utilized to enable process improvements?**). Regarding to our findings from 25 articles, Smart contracts are most useful technology which many business process try to use. Moreover, other technologies such as public blockchain, private blockchain, IoT and oracles are able to redesign processes.

1.Smart contracts:
Figure 10 shows, many business processes tend to use smart contracts technology to redesign their processes. Regarding to our findings, approximately all of the articles consider smart contracts (25 articles). According to our research, nearly all of the publications take into account smart contracts (25 articles). As a result, many processes, including **supply chains** Longo *et al.* (2019), Ekawati *et al.* (2021),Al-Rakhami and Al-Mashari (2021), , **Financial services** Ali *et al.* (2020), Cermeño (2016), **Inter organizational** Nakamura *et al.* (2018), Carminati *et al.* (2018),**Know-your-customer** Kirss and Milani (2020), **Reservation system** Panduwinata and Yugopuspito (2019), Pustišek *et al.* (2016), may find that this technology is the best option. For instance, in parking reservation system, smart contracts able to redesign the process Panduwinata and Yugopuspito (2019). The service provider can accept reservations from members for parking. A parking reservation is created by the service provider. Between the participant parties of the service provider and member, the smart contract created a transaction contractPanduwinata and Yugopuspito (2019).

2.Private Blockchain:
After smart contracts technology, Private blockchain has had the highest number of times used in processes. Figure 13 shows, many processes prefer to have a third party to get permission for different users. Therefore, it can help to be trusted by the entire system Jabbari and Kaminsky (2018). Such as Know-your-customer process Kirss and Milani (2020). Based on our findings, While one common application of blockchain, namely cryptocurrencies, employs public blockchain, KYC is handled by financial organizations using private blockchain. Malhotra *et al.* (2021).

3.IoT:
IoT makes it possible for Internet-connected devices to transmit data to private blockchain networks in order to produce tamper-proof records of shared transactions. According to our findings (4 articles), this technology is useful for redesigning processes such as Financial services Ali *et al.* (2020).

4.Public Blockchain:
According to the results of the extracted data analysis, the total amount of 3 redesign

processes were identified which they used public blockchain. According to our research, the majority of processes choose private blockchain over public blockchain in order to have a high level of security in their processes. However, according to what we discovered in section 4.3, a Quorum-permissioned blockchain that could be established on private/permissioned blocks provides a solution for KYC processes Kapsoulis *et al.* (2020).

5.Oracles: According to the results of the extracted data analysis, Oracles have been used less frequently compared to other technologies which our findings sorted based on 3 articles. This technology is able to manage to store many different data Viriyasitavat *et al.* (2019).

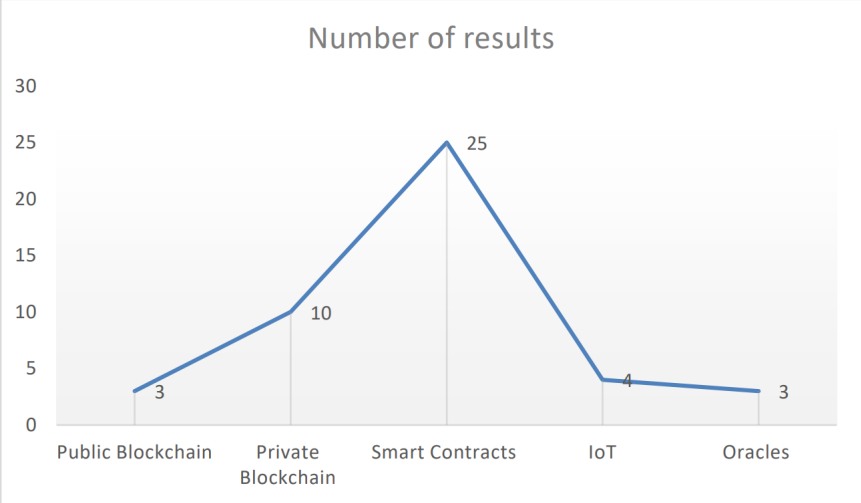

Figure 13. Technologies are used
Source: Compiled by the author based on articles from chapter 3

In conclusion, we were able to find 5 main technologies of blockchain which used to improve processes. The results were based on the use of data extracted from 25 articles. We had the opportunity to cover various technologies that are able to boost the process. We were able to answer to the third research question and we covered RQ3. Next page, we have a summary of our findings in Table 5.

Table 4. Technologies are used

Process	Description	Numbe of articles	References
Smart contracts	They are computer programs that function on a blockchain network and are digitally verifiable and enforceable.Al-Rakhami and Al-Mashari (2021).	25	Longo *et al.* (2019), Ekawati *et al.* (2021),Al-Rakhami and Al-Mashari (2021),Aitken (2017), Guerreiro *et al.* (2020),Omar *et al.* (2020), Latif *et al.* (2021), Figorilli *et al.* (2018), Agrawal *et al.* (2021), Korpela *et al.* (2017) , Ali *et al.* (2020), Cermeño (2016), Fanning and Centers (2016), Lewis *et al.* (2017), Chang *et al.* (2020), Nguyen (2016) , Nakamura *et al.* (2018), Carminati *et al.* (2018),Kostić and Sedej (2022) ,Kirss and Milani (2020),Kapsoulis *et al.* (2020) , Panduwinata and Yugopuspito (2019), Pustišek *et al.* (2016), Rani *et al.* (2021), Shrestha *et al.* (2020)
Private Blockchain	A limited number of nodes are permitted to join the network.Kirss and Milani (2020).	10	Kirss and Milani (2020),Kapsoulis *et al.* (2020), Ali *et al.* (2020), Cermeño (2016), Fanning and Centers (2016), Lewis *et al.* (2017), Chang *et al.* (2020), Nguyen (2016) Panduwinata and Yugopuspito (2019), Pustišek *et al.* (2016)
Public Blockchain	Anyone without a specified identification can join the network.	3	Kirss and Milani (2020),Kapsoulis *et al.* (2020), Guerreiro *et al.* (2020)
IoT	Machine-human interactions.Ali *et al.* (2020).	4	Ali *et al.* (2020), Longo *et al.* (2019), Ekawati *et al.* (2021), Al-Rakhami and Al-Mashari (2021)
Oracles	In the context of blockchain technology, deliver data from the outside world to the blockchain.Viriyasitavat *et al.* (2019).	3	Viriyasitavat *et al.* (2019), Mammadzada *et al.* (2020), Xu *et al.* (2016)

5 Discussion

Based on our research questions that were initially formulated, We aim to assess how much this study's models captured the common components or patterns of actual blockchain-based use cases.

5.1 Process types

In this section, the results of identification of process types will be explained. With the first research question **(RQ1)**, the types of processes that able to change due to the use of blockchain were determined. The complete sum of descriptions of process types were identified within reviewed 25 papers. Data on various processes was combined and analyzed to enable differentiation. In order to get a broad overview of the various processes that have been found, for identifying certain shared traits, they were examined.

supply chain

Based on the studies we conducted on the supply chain system, one of the important characteristics that make this process attractive for adding blockchain is its **transparency**. During supply chain processes, there is a continuous flow of information from supply to final delivery. A supply chain that functions well has dynamic communication. Omar *et al.* (2020). Good example from our data extracted can be about VMI. Vendor Managed Inventory (VMI) is an advantageous partnership between a supplier and a buyer in which the supplier manages inventory and replenishment based on the buyer's inventory state. VMI operations have significant challenges with regard to **transparency** in today's supply chains.Omar *et al.* (2020). Therefore, this characteristic can make the process attractive for blockchain technology. These findings further support the idea of blockchain can affect on transparency in supply chain process. However, it takes a lot of resources to convert a complete supply chain infrastructure to a blockchain Cordova *et al.* (2021).

Inter-organizational

According to our research on the Inter-organizational system, one of the key elements that make this process appealing for the addition of blockchain is its **privacy**. Considering that several organizations are connected with each other, the information exchanged between them must be able to respect privacy. As a result, this characteristic may make the procedure appealing for blockchain technology. However, the findings of the current study do not support the previous research. A possible explanation for these results is that these solutions were created primarily to address the issue that blockchain data being public. They do not address the problems that an inter-organizational process always involves due to their collaborative character. Carminati *et al.* (2018).

Financial services

Based on our research on the Financial services system. This procedure is interesting for the integration of blockchain due to a number of factors, including its **efficiency** and **security**. The results of this study on financial sectors will now be compared to the findings of previous work. The financial services could become more efficient and secure thanks to blockchain technology.However, to address the fundamental issues, a lot of work was required.Chang *et al.* (2020).

Know- Your- customer

According to our study of the Know- Your- customer, For the integration of blockchain, this process is attractive because of **reduction in costs**. For instance, given that every bank should have a KYC process, however, this mandatory process is costly and lowers customer happiness while failing to generate profit for banks Kirss and Milani (2020).

Reservation system

The present findings seem to **trust** and **performance** are the main features for reservation systems. Therefore, many companies want to use blockchain to improve the level of trust and performance. For instance, Airlines reservation system is able implemented adopting blockchain technology in light of the difficulties facing the airline industry Rani *et al.* (2021). These results match those observed in earlier studies.Smart parking reservation system is another processes which can consider.

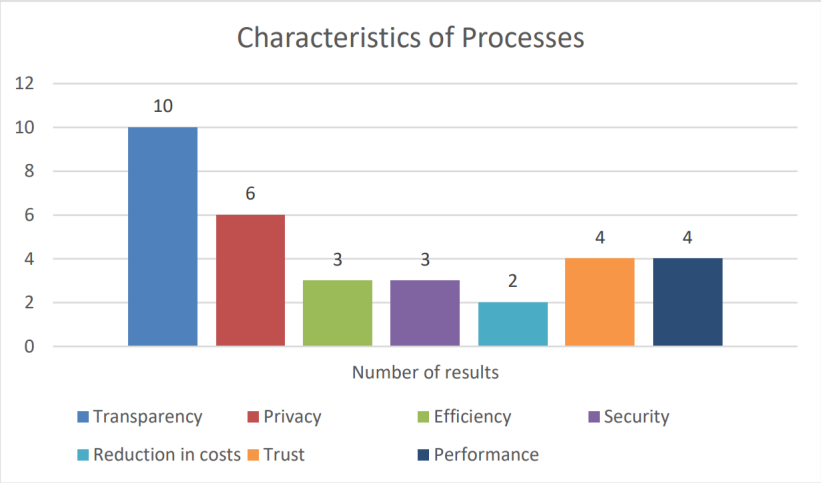

Figure 14. Characteristics of Processes
Source: Compiled by the author based on articles from chapter 3

In conclusion, Figure 14 shows, since **Transparency** was mentioned in 10 distinct articles, it is an essential attribute for the majority of supply chain processes. The second most frequently repeated attribute is the **privacy** (6 articles) feature that we found this vision in inter-organizational processes. Then, our findings indicate that the qualities that reservation system processes wish to enhance are **Trust and Performance**, figure 14 shows these feature in 4 different articles. Moreover, **Efficiency and security** characteristics were highlighted, particularly in the financial industries(3 articles). Last but not the least is the **cost reduction** feature targeted at the reservation system. Moreover, we compared our findings with other with existing research to explain if it is aligned or in contrast.

5.2 Pattern processes

In this section, the results of pattern process will be explained. With the second research question **(RQ2)**, the types of pattern processes that able to redesign due to the use of blockchain were determined. The complete sum of descriptions of pattern processes were identified within reviewed 25 papers. Data on various processes was combined and analyzed to enable differentiation. In order to get a broad overview of the various processes that have been found, for identifying certain shared traits, they were examined. There were 25 articles for redesign pattern applications in total, and five different redesign patterns were found.

A:Safety and quality

According to the results of the extracted data analysis in chapter 4, **first** pattern process is **Safety and quality**. This pattern process has the highest number of requests in different type of business process as we found (25 articles) and can be improve safety and quality by using blockchain. The importance of security in storing information can be exemplified in the **reservation system**. The hiding technique can be used in the parking reservation system to hide the drivers' location in order to secure their privacy.The blockchain participating nodes return parking offers that are available within the covered area. Al Amiri *et al.* (2020) .

B:Supporting data transfer

Smart contracts are used to automatically execute payments, while the blockchain is used to record data acquired from smart meters and transactions. Brilliantova and Thurner (2019). Moreover, Blockchain technology enables huge data to be automatically recorded Ali *et al.* (2020) The procedure also enables institutions to retain and exchange encrypted versions of consumer credit status Ali *et al.* (2020). Therefore, these findings further support the idea of data transfer through the process based on using blockchain.

C:Store data

According to the results of the extracted data analysis in chapter 4, third pattern process is **data storage**.This pattern process is essential for business process as we found (10 articles) and can be improve data storage by using blockchain. Regardless of the blockchain used, businesses can save information that cannot be altered or deleted after it has been saved, regardless of the time it was stored, for instance, Ethereum can be used with blockchain to support monitoring and traceability needs in dairy farms. such that the data is stored in a traceable manner. From the producer to the customer, this process can be observed. Longo *et al.* (2019). These results agree with the findings of other studies, in which there is the ability to store and monitor data Florian *et al.* (2019).

D:P2P Transition

Every day, a large amount of money is transferred between financial institutions; however, because the process is so intricate, the money transfer may take longer than expected which among financial firms can demonstrate low efficiency. The present findings seem to be consistent with other research which found blockchain technology can positively impact this field and essentially eliminate middlemen between financial institutions. Therefore, according to Ali *et al.* (2020), blockchain technology can boost service efficiency in addition to lowering transaction costs. Moreover, Blockchain technology can be used to address problems including fraud, expensive transactions, and a lack of mutual trust Ali *et al.* (2020). There are similarities between the attitudes expressed by

Ali *et al.* (2020) in this study and some described by Aoun *et al.* (2021).According to Aoun *et al.* (2021), without a central authority, blockchain may centralize the point to point transition, and these transactions are immutably recorded and validated.

E:Know-Your-Customer
Based on our findings in chapter 4, KYC is another proposed process that can be redesign by using blockchain These findings further support the idea of the KYC procedure can be completed with high security storage and at a lower cost by using blockchain. According to our findings, future blockchain-based transactions will be implemented in a way that emphasizes the KYC procedures even more Kapsoulis *et al.* (2020).

5.3 Technologies used

In this section, the results of technologies are used will be discuss. With the third research question **(RQ3)**, the technologies are used in the processes that able to redesign due to the were determined. The complete sum of descriptions of technologies used were identified within reviewed 25 papers. Data on various processes was combined and analyzed to enable differentiation. In order to get a broad overview of the various processes that have been found, for identifying certain shared traits, they were examined. There were 25 articles for technologies used in total, and five different blockchain technologies were found.

Our findings indicate that the 5 technologies found in Chapter 4 can be used in different type of processes. However, this study has been unable to demonstrate that Oracles are able to redesign processes without any issue, and this technology still need to examine Caldarelli (2020). Therefore, Because oracles reintroduce the idea of a third party trusted by all parties and centralization, their use is frequently viewed as problematic Caldarelli (2020).

5.4 limitation

We were able to examine and research articles that are completely related to the topic of the thesis.However, these articles were between a certain time period.

6 Conclusion

In my master thesis, we firstly theoretically focused on background of blockchain. The study was carried out from a wide to a narrow perspective, focusing on business processes before and after using blockchain in a broader context and then going deeper into the main differences or changes (From as-is to the to-be). Moreover, we considered the technology used for redesigning process and we analysed how each of the technology is used. We considered to have a systematic literature review in chapter 3 with the accordance guidelines.25 papers were chosen for the SLR based on the predetermined inclusion/exclusion criteria, and data were then retrieved from these papers and analyzed. Based on our findings, blockchain can redesign supply chain, financial sectors, KYC, Inter-organizational,and Reservation system processes. Moreover, we explained the pattern processes which we extracted in chapter 3. The most repeated patterns were the A:safety and quality, B:Supporting data transfer, C: Store data, D: P2p Transition,and E: Know-Your-Customer. Every process and pattern requires the use of existing blockchain technologies, which we have examined. Smart contracts, Private and public blockchain, IoT, and Oracles have been used in the many different process.
To conclude, the study revealed that there are many factors affecting on redesigning processes. That the process has the ability to change, also, the technology used can change the process or not, has there been a positive change for improvement after the use of technology in the redesign of the process or not? were found as determinants that directly and indirectly affect improvement processes.

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