Is Blockchain Just a Buzz Word or Will It Change the Way of Auditing?

An Empirical Study on Blockchain and the Audit Profession

Lisa Tengbom Elin Carlberg

Stockholm School of Economics

Department of Accounting and Financial Management

Bachelor Thesis

Spring 2022

Abstract: The purpose of this thesis is to examine the impact of blockchain technology (BT) on the audit profession, which is a topic that has previously received little attention. Moreover, we contribute to existing research by taking both an internal and external perspective, interviewing auditors and blockchain experts. We employ a qualitative methodology and perform a multiple-case study that includes 11 participants. The basis for analysis is our own theoretical framework that examines the impact on the three respective audit phases through four dimensions of blockchain characteristics. The main finding is that blockchain is not impacting the audit profession as of today and that a future implementation holds many challenges. This is due to the skepticism towards blockchain's use case in auditing, the immaturity of the technology, as well as the widely spread knowledge gap. If implemented, however, blockchain is most likely to impact the assessment phase, where the opportunities outweigh the challenges.

Keywords: Blockchain, Auditing, Transparency, Efficiency, Quality

Acknowledgments: We would like to express our sincerest gratitude for Johan Graaf's valuable support and guidance throughout the process of writing our bachelor thesis. We are also greatly thankful for the contribution that each candidate has made to this study.

1. Introduction

1.1 Background

During the past years, the interest in blockchain and *cryptocurrencies* has increased dramatically (George, 2021). The last attention peak was in 2018, while the cryptocurrency market later crashed and the noise around the phenomenon ceased for a while (Andrew, 2021). However, during the Covid-19 pandemic, blockchain and cryptocurrencies once again became hot topics of discussion (Vidal-Tomás, 2021). Yet, the opinions about the concept of blockchain technology (BT) differ (Ovide, 2021). Some argue that the technology will drastically change most industries and draw similarities to the evolution of the internet, while others believe that it is a volatile pyramid scheme with no real usage potential (Kirkland et al., 2016; Ovide, 2021).

Auditors play a vital role in economics as they practice an independent third party validation of a company's financial health by checking the accuracy of its financial statements (PwC, 2022). The information generated by the auditors is not only used for decision making within the company, but also by external parties such as investors, banks, etc (PwC, 2022). Due to technological advancements, the process has become both more efficient and reliable (Rezaee et al., 2001). However, it is still both time- and resource consuming, as the verification of transactions involves fieldwork, manual checking of line items in the financial statements and is dependent on various intermediaries (Lois et al., 2020).

According to the Financial Accounting and Reporting institute (FAR), digitalization constantly breaks new ground and brings changes to the process of auditing (FAR, 2016). As blockchain can be considered such a phenomenon, it can result in a new paradigm shift for the audit profession. This thus makes it relevant to investigate what changes this technological shift will entail for audit practitioners, more specifically with regard to the efficiency, transparency and quality of the process.

1.2 Problem

We aim to address mainly three problems: the gap in blockchain research in an ever changing technological landscape, the fact that the internal perspective has so far been disregarded, and that the external viewpoint has not been taken by people with extensive BT knowledge.

Firstly, as blockchain is an emerging technology, there is currently not much research within the field. For auditors, the utilization of BT can constitute a technological shift that the practitioners must adapt to (FAR, 2016). More knowledge about how it will impact the profession is thus required in order to help them navigate in a future technological sphere. Secondly, several audit and consultancy firms, such as Deloitte, have published reports on the potential future impact of BT in relation to auditing, but these only provide an external perspective on what opportunities and challenges the technology will entail (Psaila, 2017). We instead want to address the topic from an internal viewpoint by asking auditors directly, rather than assuming what their beliefs are. Auditors themselves hold considerable expertise of what the practice of auditing involves, why the implementation of BT should be studied from an inside perspective. Thirdly, there is currently not much research on the actual implementation of the technology, including the risks and challenges involved from a technical aspect. Thus, there is a need for a new external perspective on this matter, namely from blockchain experts.

1.3 Purpose and Research Question

Blockchain technology can revolutionize many industries and change the traditional way of working within these (Kirkland et al., 2016). The immutable transparent ledger technology facilitates a secure transfer of data, which can be used within accounting, among various other application fields (Kirkland et al., 2016). Auditors main role in the accounting process as of today is to execute an independent third party validation of a company's financial statements (PwC, 2022). As blockchain eliminates reconciliation and provides certainty over transaction history, the technology can profoundly change the way that audits work. The purpose with this study is therefore to examine this impact in detail - what opportunities does the new technology offer for the audit profession and what additional challenges will it entail? As blockchain is an emerging technology, the study both includes a present and future perspective on the matter. The underlying research questions are thus the following: *How is BT influencing the audit profession? How do auditors and blockchain experts anticipate BT to influence them in the future?*

1.4 Contribution

We believe that our contribution will be threefold by filling the current research gap, providing an inside perspective from auditors, as well as bringing forward a complementing external outlook on the implications of implementing BT into the audit practice.

Many companies, there among audit firms, are investing in BT and see a usage potential for the technology in their existing operations (EY, 2021). However, there are few researchers who have examined how blockchain technology can impact the process of auditing. Therefore, this study will first and foremost contribute by partly filling this gap in literature. Secondly, the studies that have been conducted have mostly examined the research questions at hand from an external perspective (Psaila, 2017). An outside outlook may not portray a completely realistic view, as it can lack insight into the day-to-day operations and tasks of an auditor. By interviewing authorized auditors, this study will provide an inside perspective on the specific matter, examining the impact of BT on the audit profession through the lenses of the auditors themselves. While there exist some reports published by auditors, these are of an investigative and general approach, why we contribute with a more in-depth qualitative study (Bible, 2017). Lastly, we will complement the external view by including blockchain experts who can contribute with their extensive technical knowledge on the realistic possibility of an implementation. Besides helping audit practitioners navigate the BT landscape and highlight the risks and opportunities related to its implementation, the study also hopes to illuminate areas where more information is needed and thereby give advice on further research.

1.5 Limitations

As previously mentioned, blockchain is a relatively new phenomenon which most people are unfamiliar with (Ovide, 2021). This can also be true for those working within auditing, where the traditional way of accounting is so well-established and known that many may be skeptical towards alternative technologies, including blockchain. Therefore, one limitation of this study may be that there is a lack of knowledge of BT among the auditors interviewed, meaning that they are not aware of its potential impact on their profession. Furthermore, their outlook on the matter can become biased if they do not hold sufficient knowledge. To mitigate this problem, the study will also investigate the research question from the perspective of blockchain experts, with the purpose to fill this knowledge gap. The fact that blockchain is an emerging technology also means that there is much to discover within the field (Kirkland et al., 2016). As one can only speculate about the potential future usage and

development of the technology, the conclusions drawn in this study may not be applicable in a longer time horizon. In addition, the study is based on limited empirical data, where only authorized auditors and BT experts from Swedish firms have been interviewed. A broader selection of respondents would help create a more nuanced picture. However, to the scope of this study, it is considered reasonable to examine the research question within a slightly more narrow context.

2. Theory and Literature Review

In the following chapter, an overview of the existing literature within the field will be presented. Research on auditing and BT will first be presented as separate parts before the two concepts will be linked together.

2.1 The Audit Profession

2.1.1 The History of Auditing

The history of modern auditing has its roots in the 1930s, with the establishment of public company auditing, the recognition of Generally Accepted Accounting Principles (GAAP), and the emergence of audit standards (Levy, 2020). The direction and scope of auditing was clearly focused on the detection of fraud - an outlook that many see as the core of the profession even as of today. However, it was not until 1964 that the American Institute of Certified Public Accountants (AICPA) published the first definition of GAAP, stating that GAAP "are those principles which have substantial authoritative support" (Levy, 2020). The audit report follows the same evolutionary road. When legislation was established during the 1930s, the reports were of a non-standardized form, simply stating that an audit had been performed (Levy, 2020). It was not until 1974 that a "standard" audit report was introduced. Although it made no references to Generally Accepted Accounting Standards (GAAS), it nevertheless included terms such as "[...] fairly present, in accordance with accepted principles of accounting". In 1988, major substantive changes to the audit report were introduced; the "expectation gap" standards, which aimed to better inform users of auditors' responsibilities (Levy, 2020).

2.1.2 Technological Shift

Since the late 1980s, there have been significant technological advances in the audit process. Information and Communication Technology (ICT) have partly changed the tasks of an auditor and the organizations they work for (Omoteso et al., 2010). For instance, ICTs have reduced the number of administrative staff and junior auditors, thus flattening the organizational structure of many audit firms (Omoteso et al., 2010). This in turn indicates that the technological shift has made the more routine and mechanical tasks more efficient and effective. As our entire society has become more automated and digitalized, technological advancements also call for additional demands among auditors. For instance, new audit software will need to be developed to help auditors gain a better understanding of the changing nature of their clients' businesses and to match the complexity of their clients' information systems (Omoteso et al., 2010).

While technology has made many operations and processes more efficient, today's business environment is far more complex than in the 1930s. Therefore, the process of auditing must be dynamic and multidimensional in order to meet changing needs and expectations (Bou-Raad, 2000). In addition, companies also expect audits to keep pace as they innovate their businesses and practices. For instance, there has been a growing interest for audits to provide real-time, relevant information (Mickeler, 2021). Moreover, the scope of auditing is growing far beyond verifying financial statements. According to a Forbe's study, companies also want to include areas such as sustainability practices and cyber risks in their audit (Mickeler, 2021). The fact that audits are being extended also requires a bigger knowledge base within the specific fields, thus calling for auditors to hold expertise within more areas than finance and accounting (Power, 1997). Lastly, it can be argued that we live in an "audit society", where an increasing number of organizations are considered to be auditable entities, leading to further demand for audit services (Power, 2021).

2.1.3 The Tasks of an Auditor

While many interpret the core of auditing as the independent checking of a company's accounts to verify accuracy, the actual process goes far beyond this definition. The first phase in the audit process is about understanding a business, what risks a certain company is exposed to, and advising clients on rules and procedures for the reporting of accounts (GRF CPAs & Advisors, 2011). In fact, establishing a relationship with a client in order to obtain knowledge about its operations is the basis for performing an audit (Rennie et al., 2010).

Although the process as such is to be independent, it nevertheless relies on a two party relationship; increasing understanding both for the auditor and its client (Rennie et al., 2010). Moreover, the second phase of the audit process as of today involves a third party, namely intermediaries such as banks, suppliers etc (PwC, 2022). In order to validate a company's financial statements, external parties must confirm that a specific transaction has been correctly recorded. Besides using intermediaries as a means of control, auditors themselves must conduct audit sampling (Colbert, 2001). This investigative tool enables auditors to make conclusions and express fair opinions based on predetermined objectives without having to check all of the items in a financial statement (Colbert, 2001). The last part of the process consists of analyzing and reporting (PwC, 2022). In the concluding audit report, the auditor is to describe their findings, highlight the key issues, make recommendations, and show the final accounts. This report is then published and used for both internal and external purposes. It is especially interesting for investors, other stakeholders, banks, and creditors who want to ensure that the company's financial statements comply with GAAP (PwC, 2022). Presented below are some of the tasks in each phase of the audit process.

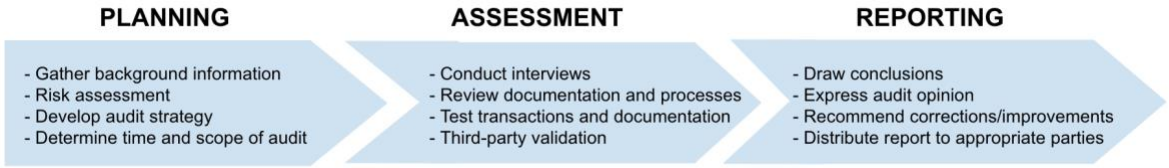

Figure 1. The Audit Process (PwC, 2022).

2.1.4 The Audit Trail

Power describes an audit trail as the documented flow of a transaction (Power, 2021). It is used to investigate how a source document was translated into an account entry and from there was inserted into the financial statements of an entity. Note that the audit trail can also be used in reverse; to track a line item in the financial statements back to its originating source document. Hence, a clear audit trail for all transactions indicates that an accounting system is well-functioning (Power, 2021). In addition, the audit trail is used by both internal and external auditors in order to trace transactions through an accounting system. There are also SEC filed legislations; Final Rule: Retention of Records Relevant to Audits and Reviews, stating that financial records must be retained for seven years (SEC, 2003).

Moreover, the authors assert that the audit trail is threefold; including a material, ideational and processual part (Power, 2021). Firstly, the materiality of the audit trail consists of the documents, records, and traces that result from a transaction. Secondly, it is ideational as it relies on the cultural idea that transparency stems from traceability. The third concept; processual, refers both to the notion that the audit trail is a process for producing accounts of performance, but also that these accounts are to be checked by auditors (Power, 2021). Audit trails have evolved from manual to automated electronic records, which has increased their accuracy, accessibility, and usability (Regueiro et al., 2021). However, they are still vulnerable to different kinds of manipulation schemes, leading to a lack of trust in the process. In addition, audit logs trails are under control of a central authority, which is to control and manage information records. As there is currently no mechanism to verify the status of the audit logs, the reliance on that central authority to maintain correct and accurate information is debatable (Regueiro et al., 2021).

2.1.5 Auditing and Quality

ISA 220 asserts that the audit firm is responsible for designing, implementing, and operating a system of quality management for audits of financial statements (IAASB, 2020). These are to provide assurance that the firm and its personnel fulfill their responsibilities in accordance with professional standards and applicable legal and regulatory requirements, as well as ensuring that the reports issued are appropriate in the circumstances (IAASB, 2020). However, measuring audit quality is problematic as it is not directly or immediately observable (Wooten, 2003). As cited by Thomas Wooten; "Audit quality control procedures attempt to maintain high standards of control over the process of an audit, but an audit failure usually becomes known in the context of a business failure" (Wooten, 2003).

Moreover, the term audit quality has different meanings depending on person and context. For instance, research shows that investors believe that audits should provide absolute assurance that the financial statements are free from fraud or material misstatements, while an auditor may have a different outlook on what high audit quality really is (Geiger, 1994). He or she may be more concerned with minimizing client dissatisfaction and limiting the damage to a reputation that could follow from a "bad" audit. The fact that there are different views on what constitutes high audit quality further complicates measuring the quality of an audit (Geiger, 1994). During the remainder of this study, we relate the concept of quality to

accuracy and trustworthiness, meaning that high audit quality implies that one can be sure that the financial reports are free from fraud or material misstatements.

According to research, one underlying factor for the quality of audits is time (Christensen et al., 2021). The quality of audits is typically lower when the team or auditor is under a heavy workload and thus time constrained (Christensen et al., 2021). Moreover, a low audit effort with regard to the number of hours spent also increases the extent to which managers are able to report aggressively high earnings (Caramanis et al., 2008). Another potential problem that leads to reduced accuracy and quality of audits is objectivity. Research shows that auditors who identify with or relate to a client are more likely to take the client-preferred position (Bamber et al., 2007). While establishing a relationship of some sort is necessary to obtain enough knowledge of the business and the specific company's operations, this very relationship also poses a threat to the auditor's objectivity (Bamber et al., 2007).

2.1.6 Auditing and Efficiency

The process of auditing is both time- and resource consuming. The Financial Education & Research Foundation (FERF) recently examined audit fees as reported by nearly 6211 SEC-filers and found that the average cost amounted to $2.52 million (Morristown, 2021). The high cost of performing an audit is due to its labor- and time-intensive nature (Morristown, 2021). Although methods such as sampling allow auditors to spend less time on verifying every single transaction, one must hold sufficient knowledge about the company's operations and risks in order to know what items to sample - again requiring extensive labor (Keng, 2018).

As previously mentioned, an increasing number of organizations are considered auditable entities, resulting in more clients for each firm (Power, 2021). This puts additional pressure on their respective time budgets, which again can affect the audit quality (Broberg et al., 2016). Moreover, prior research has shown that digitalization of audit processes has made them more efficient, although auditors find it hard and complex to navigate electronic workpapers, why there is room for improvement (Dowling et al., 2014). The most time consuming activities consist of repetitive tasks such as verifying and checking the financial statements of the firm (Cohen et al., 2019). On the one hand, this is vital in order to provide accuracy and assurance (PwC, 2022). On the other hand, part of this process does not add

much extra value to the customer. The value added services instead consist of a thorough risk assessment and the client advisory that follows (Eilifsen et al., 2001).

2.1.7 Auditing and Transparency

The financial reports of a company, including the audit report, are often used as a means of communication towards external parties (PwC, 2022). Since these are often the basis on which financial decisions are made, the reports must comply with applicable standards and frameworks, as well as reflect the company's financial status in a trustworthy manner (PwC, 2022). It is here that auditors play a vital role, thus reducing information asymmetry between the company and its external stakeholders (Almutairi et al., 2009). There are several drivers for why companies are keen on having their accounts audited. Firstly, banks or creditors may require an audit before agreeing to lend money (Biery, 2016). Secondly, research shows that high quality financial disclosures such as an audit can reduce the cost of capital for firms seeking funding (Cuadrado-Ballesteros et al., 2016).

2.2 Blockchain Technology

In the following sections, the public blockchain will be used as the basis for defining and explaining the technology. This as it holds the central characteristics of BT (Bashir, 2020). Thereafter, other types of blockchains will be briefly introduced. Note that an explanation of the concepts in *italics* can be found in the appendix.

2.2.1 Introducing and Defining the Blockchain Technology

In order to understand this study and its purpose, one must first gain basic knowledge of how BT works. There are two definitions that are commonly known and accepted in literature. Layman's definition states that "BT is an ever-growing, secure, shared, recordkeeping system in which each user of the data holds a copy of the records, which can only be updated if all parties involved in a transaction agree to update" (Bashir, 2020). The technical definition instead states that "BT is a *P2P*, *distributed ledger* that is *cryptographically* secure, *append-only,* immutable, and updateable only via consensus or agreement among peers" (Bashir, 2020).

Each block contains *metadata* about the block, a *hash function* of the block, and a *hash value* of the previous block (Bashir, 2020). The stored data within the block depends on the type of blockchain. Furthermore, the hash function is a deterministic function that can transform a random set of data to a fixed size hash value, thus enabling uniqueness of the block. When the block is created, the metadata goes through the hash function and calculates a new hash value. Hence, by changing any of the input data in one block, the hash value will drastically change. Moreover, the third element of a block is the unique hash of the previous block, thereby creating a chain. If the data is altered in one block, the hash value of that block will change, resulting in a mismatch between the two linked blocks. In other words, the *hash algorithm* ensures that alterations to data are easily detected and rectified immediately (Bashir, 2020).

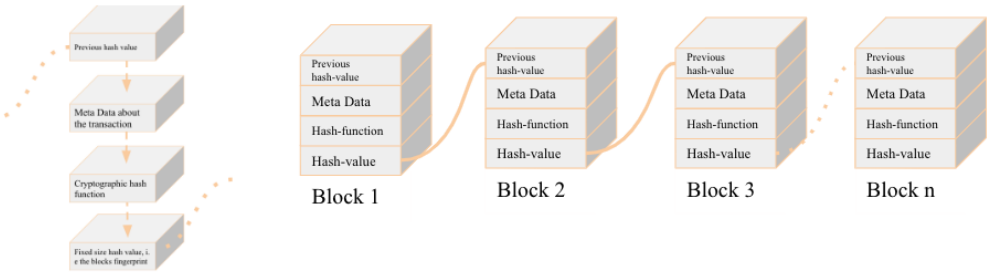

Figure 2. The Composition of a Blockchain (Bashir, 2020).

2.2.2 The Main Characteristics of Blockchain

To begin, BT is a distributed ledger, meaning that all nodes hold a copy of the transactions recorded on the blockchain, that is of the whole ledger (Bashir, 2020). Furthermore, the ledger itself is cryptographically secured against tampering and new data can only be added in a time-sequential order, referred to as append-only. This part of BT enables its *irrevocability*, implying that a transaction once added to the blockchain cannot be changed nor reversed, further ensuring its immutability (Bashir, 2020).

Furthermore, one of the main characteristics of BT is that it is updatable only via consensus and allows BT to sustain without a validating third party (Bashir, 2020). When a new block is created, all the nodes in the network validate the information against criteria that are defined by the specific blockchain's protocol. In this way, the P2P network creates consensus, adding only the blocks that are valid, and rejecting those that are tampered (Bashir, 2020). To reach

this consensus among nodes, there are various *consensus mechanisms*, facilitated in algorithms, to ensure that the blockchain network agrees upon the final state of the data (Sun et al., 2019). Bitcoin utilizes *Proof-of-Work (PoW)* which is a cryptographic puzzle that takes about 10 minutes for a computer to calculate and solve, before the new block is added to the chain (Zhang et al., 2020). Consequently, this prevents the tampering of blocks. Altering one block would require that more than 51% of the nodes in the network are recalculated for the blockchain to be manipulated (Sun et al., 2019). Although it is theoretically feasible, the process would require an immense amount of computational power which is both costly and time consuming (Zhang et al., 2020). Furthermore, the PoW in itself requires a lot of computational power. In fact, it was estimated that the energy consumption of the blockchain Bitcoin would overtake that of Denmark by 2020 (Zhang et al., 2020). A cheaper proof-based mechanism is the *Proof-of-Stake (PoS)* which requires less energy, but instead is less secure (King et al., 2012). Blockchain's ability to further sustain without a third party is enabled through *smart contracts* that ensure that transactions on the blockchain are automatically executed in a predetermined way (Zheng et al., 2020).

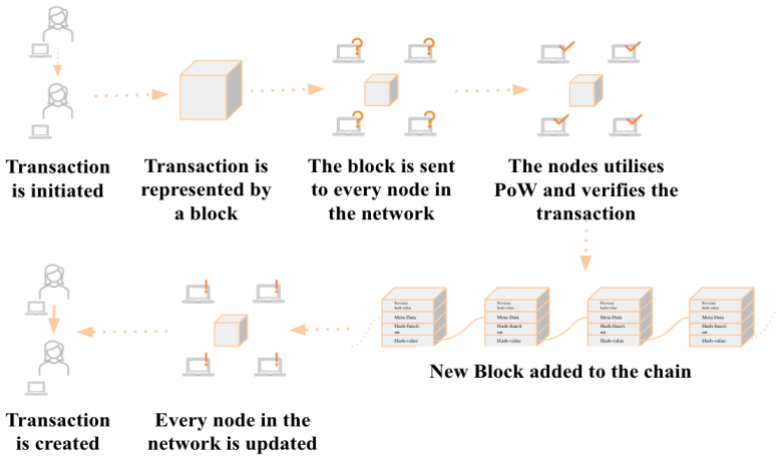

Figure 3. The Blockchain Process (Bashir, 2020).

2.2.3 Different types of Blockchains

In order to understand BT's usability in auditing, one must understand that there are different types of BTs that are appropriate in different contexts. Therefore, four kinds of blockchains are briefly explained in the table below.

	Public Blockchain	Private Blockchain	Semi-Public	Consortium
Brief explanation	The network is fully decentralized and open for everyone. Anyone can become a node and thus read and write on the blockchain. Data is validated through consensus mechanisms, such as PoW, by every node in the network. Every node holds a copy of the full ledger.	The network disregards the idea of decentralization. Permission is required to become a node and read and write data onto the blockchain, which is controlled by a "highly trusted" organization - the owner of the blockchain. The permissioned ledger utilizes a protocol to validate data.	The network is partially decentralized. The public part of the blockchain is open for everyone while the private part is only open for nodes within the "highly trusted" organization. It is a hybrid between a public and private blockchain, and validations are made through a mix of both mechanisms.	The network is decentralized between a predetermined group. Permission is thus required to verify, read and write on the blockchain which is controlled by a predetermined group, for e.g multiple entities. The permissioned ledger utilizes a protocol to validate data.
Advantages (+) and Disadvantages (-)	+ **Secure** as the entire network verifies transactions, almost impossible to tamper. + **Transparent** as all transactions are made public with individual anonymity. + **No intermediaries** are needed. **- Inefficient and costly** as all nodes need to verify the transaction. **- PoW is energy consuming** and bad for the environment.	+ **Efficient** as verification is done by only the owner of the blockchain. + **Private** as the owner can control who has access to read or write on the blockchain. + **Energy efficient.** **- Less transparent** as control is consolidated to a single organization. **- Less secure** because of fewer nodes within the network**.**	+ **Private** but allows for third party communication. + **Partially transparent** as it includes a public part. + **Partially efficient** as it includes a private part. **- Less transparent** as control is partially consolidated to a single entity.	+ **Private** as read and write access is controlled by the predetermined nodes. + **Efficient** as relatively few nodes verify transactions. + **No consolidation** of controlling power. **- Less transparent** as control is consolidated to only the chosen entities. **- Less secure** because of fewer nodes within the network.

Table 1. The Different Types of Blockchains (Sarmah, 2018).

2.3 Theoretical/Analytical framework

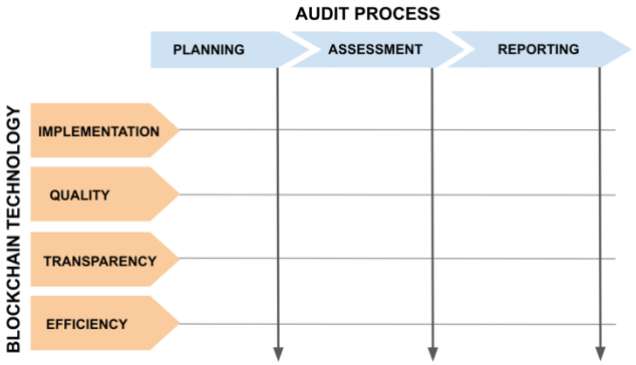

Figure 4. Theoretical/Analytical Framework

This study aims to investigate the impact of BT on the audit profession as a whole. Thus, to further establish where the technology will have the most impact if it is implemented, we have divided the audit process into three phases: planning, assessment and reporting. Note that a prerequisite for each blockchain feature to have an impact on the audit profession is that the technology is implemented, why implementation as such also constitutes a point for

discussion and is included as a separate BT aspect. Furthermore, we study each audit phase through three other dimensions of blockchain characteristics: transparency, quality, and efficiency. The chosen dimensions also play a vital role in the audit process, which is why the study aims to investigate the impact on the respective audit phases on the basis of these specific aspects, given that BT is implemented.

2.4 Blockchain and Auditing

In the following section, the concepts of auditing and blockchain are connected. The opportunities and challenges that the technology could entail are discussed from four different aspects that are relevant to the audit process: implementation, transparency, quality, and efficiency.

2.4.1 Implementation

When it comes to implementing BT, research finds that it has the potential to transform many industries and that there are several potential use cases (Koteska et al., 2017; Zīle et al., 2018). For instance, Hileman & Rauchs have estimated that about 30% of blockchain use cases are related to banking and financial services, meaning that BT could play a role in auditing (Hileman et al., 2017). However, the research on quality requirements for blockchain implementation is still at an early stage and there are many technical challenges and limitations (Koteska et al., 2017). Among these are security, privacy, usability, data integrity, and scalability, which all constitute BT attributes that are necessary for the technology to be implemented (Koteska et al., 2017). On top of this, public blockchains are as of today resource intensive as they utilize PoW, while companies are simultaneously becoming increasingly aware of their environmental footprint (Eccles et al., 2012; Monrat et al., 2019). In addition, there is a large knowledge gap, both among the general public and in existing literature (Wamba et al., 2020). As the technology is evolving, organizations need to leverage research on BT in order for them to introduce it into their operations (Wamba et al., 2020).

2.4.2 Transparency

The advantage of BT that is most relevant for auditing purposes is the decentralized nature of the technology, thus enabling transparency, autonomy, openness, verifiability, and

trustworthiness (Wang et al., 2019). To begin with, transparency stems from traceability, as mentioned in the section on audit trails (Power, 2021). With BT, the transactions are fully traceable as the history of transactions is irrevocable and recorded with a digital stamp (Bashir, 2020). This prevents the client from successfully manipulating transactions. Thus, the technology can be considered as an efficient means to solve the problems related to the vulnerability of audit trails (Regueiro et al., 2021).

As the public blockchain is fully transparent, the *encryption* and anonymity of the nodes can become crucial features in the audit process. This as it protects sensitive business information that otherwise could have been figured out from the public transactions (Sarmah, 2018). As mentioned in the audit section, auditors play a vital role in reducing information asymmetry between clients and their external stakeholders (Biery, 2016). The full transparency of a public blockchain implies that the client's financial information will be publicly displayed as it is continuously uploaded on the chain (Sarmah, 2018). However, if they are not willing to share their information, organizations could instead use another type of blockchain, such as the private one. Nonetheless, private blockchains do not hold the fundamental characteristic of decentralization as there is only one central unit deciding what nodes are invited and how the transactions are validated (Sarmah, 2018).

In addition, non-financial audits are becoming increasingly important (Power et al., 2007). BT enables validation of parties that are involved in a transaction and thus also improves the security in supply chains (Kshetri, 2018). Therefore, the traceability aspect of BT makes it possible to see who received what and when (Sun et al., 2019). It is thus reasonable to assume that the technology could be relevant within this specific audit field.

2.4.3 Quality

The nature of BT makes it almost impossible to tamper information on the blockchain (Sarmah, 2018). This as the P2P network and consensus mechanism ensures the accuracy and trustworthiness of the uploaded transactions (Sun et al., 2019). Although the consensus mechanism can help prevent manipulation of transactions, it is resource intensive and expensive as it requires a lot of computational power (Zhang et al., 2020). However, there are other proof based concepts such as PoS, requiring less energy. The same goes for private blockchains which are neither as expensive nor as bad for the environment as the public, but

instead disregard the basic idea of decentralization (Sun et al., 2019). Furthermore, the irrevocability of the blockchain ensures that all transactions are recorded (Yli-Huumo et al., 2016). As accuracy is a vital part of the audit process, implementing BT may improve the quality of the audits (PwC, 2022). Although this is true for public blockchains, the private ones are less secure as not everyone is free to join (Sarmah, 2018). A smaller network implies that you must manipulate fewer nodes in order to control more than 51%, and thus alter information on the entire blockchain (Sun et al., 2019). The owner of a private blockchain, for instance a company leader, often has access to the nodes in the network, making it easier to successfully manipulate them and thereby execute accounting errors (Rückeshäuser, N, 2017). Hence, there is still partly a risk for manipulation if implementing a private blockchain. Furthermore, there can be *data malleability problems* related to BT (Yli-Huumo et al., 2016). These imply that it is hard to control if the data uploaded on the blockchain already has been manipulated. In other words, it is theoretically possible to upload fraudulent transactions on the blockchain, why BT does not fully eliminate this risk.

Lastly, the process of auditing relies on the auditor's risk assessment of the client's business operations (PwC, 2022). What line items that are to be sampled depends on the auditor's own judgment and risk analysis, why there is a risk of subjectivity (Smith, 1972). BT is built on the idea that nodes in the network verify all transactions in an objective manner, which could lead to increased accuracy and quality in some parts of the audit process.

2.4.4 Efficiency

As previously mentioned, the structure of BT allows it to sustain without a central party of control or intermediaries (Bashir, 2020). From an audit perspective, BT allows for full transparency where all parties can be assured that real time transactions are executed as the protocol demands (Sarmah, 2018). In addition, ISA states that auditors must obtain external confirmation procedures to gather audit evidence (IAASB, 2020). According to research, third party validation is time consuming and there are incentives to make this process more efficient, why it is reasonable to assume that BT can facilitate this activity and hence improve audit efficiency (Aldhizer et al., 2006). However, the irrevocability feature of BT could have the opposite effect as a transaction cannot be removed nor changed if it for some reason was executed in a wrongful way, even if two parties agree on it, which instead can make the audit process less efficient (Bashir, 2020). Moreover, as mentioned above, auditors find it hard and

complex to navigate electronic workpapers, why BT could reduce audit efficiency with regard to this aspect as well (Dowling et al., 2014).

There are also areas of discussion related to designing the proper *consensus protocol*. Depending on the kind of blockchain that is most suitable for auditing, the protocol must meet the demands of specific application scenarios (Zhang et al., 2020). On the one hand, once the proper protocols are set into place, this could make the audit process more efficient and automatic. On the other hand, designing appropriate smart contracts requires a lot of research and monetary investments (Singh et al., 2020). In addition, although the phenomenon of blockchain is not new, it is still complex and hard to understand for the "normal" individual (Bashir, 2020). Thus, some assert that it is not yet ready or mature for mainstream usage (Bashir, 2020). On this basis, it can be assumed that the potential efficiency gains cannot be realized as of now.

3. Method

3.1 Research Method

Seeing that part of the purpose of this study is to contribute to the current research gap of how blockchain can impact the audit profession from an internal perspective, the chosen methodology is a qualitative multiple-case study. Power et al state that "the quantitative research conducted within the field of auditing could be enhanced by an improved understanding of practitioners' work realities as experienced within the field", thus making it appropriate to complement existing literature by using a qualitative method (Power et al., 2015). Moreover, due to the lack of current literature and theory, the study design is of an inductive approach, meaning that the empirics collected will constitute the ground for theory creation. In addition, by performing a multiple-case study, you obtain several perspectives and opinions on the research question at hand (Stake, 2005). Considering that this study aims to examine the impact of BT and its implementation on an entire profession and not a single person or entity, a multiple-case study is suitable (Stake, 2005). However, the cases included are limited to the scope of this study and therefore carefully selected.

3.2 Case Selection

The respondents were divided into two groups: authorized auditors from well known audit firms and "blockchain experts" (BT experts). The chosen auditors had to be authorized and work with BT related questions of some form, as this ensures their legitimacy and knowledge within the fields. The blockchain experts selected also had to hold at least three years experience within the field in order to ensure their credibility. Hence, all respondents chosen were considered knowledgeable within their respective areas - a prerequisite for understanding BT and its implications on the audit profession.

In order to obtain an in-depth understanding of both the BT phenomenon as such and what challenges and/or opportunities it can entail for auditors, respondents from both professional fields were selected. This to obtain a more nuanced picture, where the outlook on the impact of BT with regard to auditing may differ depending on what professional sphere one belongs to. However, both groups had to hold some knowledge about both auditing and blockchain, as the research questions aim to examine the two concepts in relation to each other.

3.3 Study Design

Prior to conducting the interviews, a pilot study was made in order to obtain more thorough knowledge of both the audit process and blockchain technology. While the literature review had provided an external perspective on the two concepts, the pilot study complemented the knowledge foundation from an internal viewpoint. Two meetings were therefore carried out with the purpose to become profoundly informed before designing the actual set of interview questions. The pilot study was rather free to form and explored auditing and blockchain in isolation, before relating the two concepts to each other during the interviews that formed the basis of our empirics.

The interviews conducted were of a semi-structured form, meaning that they followed a few predetermined questions but allowed for new questions that arose along the way (Leavy, 2020). This method was chosen as it opens for exploring the research question from other angles and perspectives than initially planned (Leavy, 2020)). As blockchain is a complex phenomenon and peoples opinions' about its future usage potential differ, a semi-structured approach gave room for asking follow-up questions that were not thought of in advance but appeared to be relevant in each specific interview context. In order to avoid subjective answers, the predetermined questions were openly designed so the respondents could discuss

the subject freely without being influenced by a certain standpoint. In addition, semi-structured interviews provide comparable data as they are based on the same set of questions for all respondents, making them useful for qualitative studies (Leavy, 2020)).

However, semi-structured interviews can be considered less objective than structured interviews, as especially the follow-up questions tend to become targeted (Leavy, 2020). When addressing something that the respondent previously said, there is a risk of becoming subjective and rather making the person confirm his or her answer than further develop it. To mitigate this risk, all interviews mostly followed the same predetermined questions which were neutrally designed and aimed at obtaining uninfluenced answers. When deviations from this script were made, the follow-up questions were mostly used to clarify something rather than to confirm presupposed "facts".
The interview questions followed the theoretical framework and were therefore divided into four separate parts; implementation, transparency, quality, and efficiency. To make the respondents feel comfortable, they were first asked some general questions on their work and interest in blockchain. Thereafter, they were asked questions related to each specific aspect as mentioned above.

3.4 Literature Collection

The data presented in the study was retrieved from reliable sources in order to ensure its credibility. Besides using information from regulatory standards and frameworks, the literature was found by using Google Scholar, SSE databases, and physical books. Furthermore, the articles chosen had all been cited by a considerable number of people and published in academic journals. This to mitigate the risk of using information that lacks academic support or has not been previously used, as this could indicate that the information provided is inaccurate or untrustworthy.

3.5 Empirics Collection

Category	**Company**	**Date**	**Format**
Authorized auditor 1	Big Four audit firm	9/3-2022	Online meeting

Authorized auditor 2	Big Four audit firm	2/3-2022	Online meeting
Authorized auditor 3	Big Four audit firm	30/3-2022	Online meeting
Authorized auditor 4	Big Four audit firm	5/4-2022	Online meeting
Authorized auditor 5	Blockchain firm	11/4-2022	Online meeting
BT expert 1	Blockchain freelance	31/3-2022	Online meeting
BT expert 2	Blockchain freelance	24/3-2022	Online meeting
BT expert 3	Blockchain firm	4/4-2022	Online meeting
BT expert 4	Blockchain firm	5/4-2022	Online meeting
BT expert 5	Blockchain firm	7/4-2022	Online meeting
BT expert 6	Blockchain firm	7/4-2022	Online meeting

Table 2. Interviews conducted.

Eleven interviews were conducted, see the table above for further details. Initially, 33 authorized auditors and BT experts were contacted via email. However, as very few responded and only four agreed to participate in an interview, more people were contacted via LinkedIn. Note that these respondents were required to hold similar knowledge and experience as those contacted via email. This was also ensured by reading their respective LinkedIn profiles, where education and previous work experience was displayed. Seven people agreed to an interview via LinkedIn, resulting in a total of eleven interviews. When the candidates were first contacted, they were briefly informed about the thesis, the nature of the interview, and their role in the study. In addition, they were given the choice to participate online or physically. This was with the intention to provide flexibility to the candidates. Moreover, online interviews opened the possibility to conduct interviews across the whole country, further contributing to a nuanced view of the subject.

As the study is of a semi-structured nature, it allows for dynamic and fluent conversations (Leavy, 2020). However, the possibility to obtain a good flow is dependent on internet quality. A bad internet connection could prevent the respondents from hearing the questions properly, as well as result in low-quality recordings. Consequently, the conversation could become static and thus not benefit from the advantages of the chosen methodology. Moreover, the format lacks human connection which could also result in a less dynamic conversation (Nehls et al., 2015). Due to the absence of physical interaction and thus body language, there is also a risk of misinterpretation. To mitigate the risk of static conversations,

the participants were asked to choose a quiet room with a good internet connection. Furthermore, they were asked to keep the camera on in order to make the online interview resemble the physical format as much as possible.

All respondents were asked to give permission on recording the interviews. This allows the interviewers to be more present and engaged in the conversation than if taking notes simultaneously. Lastly, both authors were present during all interviews with the purpose to bring two perspectives into each meeting and limit the risk of missing relevant follow-up questions.

3.6 Ethical Considerations

The study was voluntary, meaning that each respondent independently chose to participate. This is positive in the sense that they are then more likely to be engaged and actively want to contribute to the purpose of the study (Leavy, 2020). As previously mentioned, they were also informed of the nature of the study before agreeing to participate. Moreover, the respondents are anonymous when mentioned in the study and the data collected is confidential, thus implying that neither personal nor company related information is shared among anyone other than the authors. In order to both ensure the participants that the ethical guidelines were followed and to confirm their consent, a GDPR-form was signed by all respondents.

3.7 Data Analysis

In order to analyze our empirical data, all interviews were summarized under each respective question in the interview guide. This was done by transcribing the most relevant parts of the recordings and keeping them in separate documents. The answers to each respective question were then collected in the same document for us to be able to compare the information and identify differences and/or similarities. As some interviews were held in Swedish, the transcription process involved translating data into English. This was done in close connection to the specific interview in order to maintain the accuracy of each answer. Finally, the theoretical framework was used when analyzing the empirical data.

4. Empirical Findings

The following section describes our empirical findings with regard to the four main aspects: implementation, efficiency, transparency, and quality. To ensure the anonymity of each respondent, their real names have been replaced by numbers, for instance "BT expert 1".

4.1 Implementation

The biggest challenge when it comes to implementing BT into the audit profession is the current knowledge gap, according to the majority of respondents. This gap relates to the lack of general knowledge about the technology, the fact that some may find it hard to trust that the technology works properly, or that people believe that BT is not mature enough for mainstream usage. As mentioned by BT expert 2; *"We can do so little with blockchain today - we are only touching the surface"*, stressing that we do not know the actual usage potential of BT as of now. The lack of knowledge was further emphasized when asking if people find it hard to separate the concepts of blockchain technology and cryptocurrencies, which most respondents considered constitute a risk for implementation. There was common ground that people associate BT with for e.g. Bitcoin, and therefore either have a very negative or positive attitude towards the technology; *"The hype around crypto assets must cease before we can really start talking about implementing the technology"* (BT expert 3). While the knowledge gap can be seen to constitute a threat for implementation, BT expert 4 asserted that auditors perhaps may not have to know how the technology works in detail for them to be able to trust it. In the same way that we do not understand the underlying technology of cloud services or the internet, auditors can thus use BT without fully comprehending how it is built. *"You do not want to build a blockchain application just to claim that it is blockchain based. You want to build an application to be used. You seek for adoption"* (BT expert 6).

According to most respondents, filling the existing knowledge gap requires extensive investments, both in terms of educating people and in implementing the technology. While two of the Big Four audit firms have invested in BT for several years, Sweden seems to lag behind in this area. BT expert 3 mentioned that this can be a result of the high regulatory barriers, making it very difficult to work in a BT related field. It was also clear that while blockchain investments are on the present agenda, they are mostly done at the top level or in a niched department of a company. This was made evident as we interviewed two auditors

working at the same global firm, one being engaged in software and blockchain development and one working as a regular auditor. While the developer said that they had made big investments in BT over the three previous years, the auditor was not aware of any BT related investments at the very same firm. Moreover, the blockchain developer was the only one in his Swedish department and asserted that other countries had taken a head start. The reason why very few Swedish firms have begun investing in BT seems to be threefold according to the majority of BT experts. Firstly, it requires large monetary resources, secondly, companies are afraid to be first movers and lastly, there is need for new legislation that allows for exploring BT.

Although regulatory changes may occur in the future, most auditors believed that a BT implementation would not require new internal audit frameworks or standards. *"As long as blockchain can be used with completeness and accuracy, there will be no need for changes in our internal audit laws"* (Authorized auditor 3). The same respondent further explained that BT is just a technology that helps auditors handle transactions and does not change for e.g., the materiality identification processes, implying that the audit methodology will remain the same. However, Authorized auditor 1 mentioned that ISA requires the verification of a third party. As BT eliminates intermediaries, she thus believed that one must update existing frameworks if implementing the technology. Most BT experts shared the idea that BT can be seen as any other technology investment, not requiring any updates to the standards. Nevertheless, BT expert 4 pointed to the fact that some principles may be removed. For instance, the sampling requirement is likely to change as BT verifies all line items rather than a selected set of transactions.

Most audit respondents believed that developing BT in-house is expensive, both in terms of investments in the actual technology and in human resources. The BT experts instead shared the belief that audit firms could instead buy a blockchain service from an external organization, meaning that the vast majority of the investment is constituted by paying for the service. However, as Authorized auditor 2 stated; *"It is almost impossible to invest in technology without developing internal skills within the company*", meaning that it may be difficult to simply buy the technology from someone else. However, two of the auditors stressed the fact that no audit firm wants to carry the cost and risk of building the system, especially not in Sweden, and that outsourcing the service may be an appropriate starting point. The fear of being a first mover relates to the fact that both auditors and BT experts

believed that an implementation will take time, particularly in Sweden. Audit firms want to wait until other organizations find valuable use cases for BT, before applying the technology to their own operations. As it becomes more widely used, the price of BT is also likely to decrease, which some respondents considered vital for many firms to invest. In addition, the technology will most probably develop and future regulations will be imposed or removed, implying that many companies may be reluctant to rush an implementation. In contrast, BT expert 6 said that *"The real investment happens when you realize it works, not before"*. According to him, ideas do not require investments, meaning that companies can still look into the technology and try to find a good use case, as this does not require significant monetary resources.

On the same note, both BT experts 2 and 4 had a hard time finding the usage potential for BT in relation to auditing. Partly due to the fact that the knowledge gap could imply that the implementation of BT would make the audit process more complex and less efficient, rather than the opposite. They also said that there are other software tools that can help validate transactions. As stated by BT expert 1, blockchain must be superior to existing technologies as the switching cost for the audit firms is otherwise too high. In addition, BT expert 4 said that an alternative to using BT could be a distributed ledger technology that works in a similar way but does require storing the data in blocks. In other words, companies can have a decentralized database without using BT. Moreover, although the same respondent believed that the use of public blockchains could be beneficial within some industries, he was uncertain that auditing was one of these. In contrast, other candidates believed that public blockchains are the only alternative, as the private ones more or less serve the same functionality as the firms' existing databases. However, many auditors stated that private blockchains are the only ones that would be accepted from a client perspective, as there are issues regarding privacy and the displaying of sensitive information.

"*I believe that it is hard to implement a public blockchain since our profession deals with classified matters. Therefore, a private blockchain is the only alternative for implementation as it can be controlled and revised internally. Hence, it has the biggest potential to be used in our internal processes."* (Authorized auditor 2).

Lastly, introducing BT into the audit world is a matter of industry revolution, thus constituting a technological shift within the audit profession. *"If this shift entails challenges*

that outweigh the opportunities related to implementation, then perhaps BT is not suitable for auditing" (BT expert 2). It is crucial that top management supports the implementation, as there is a lot of change management involved. *"When you introduce blockchain in a big corporation, then you have to fight"* (BT expert 6). Hence, if many are reluctant toward new unfamiliar technology such as BT, friction to the new coming and fear of disruptions could constitute a risk for implementation, according to him. Authorized auditor 4 said that for an implementation to take place, audit firms themselves must understand what they can gain by using BT and drive the technological shift on their own.

4.2 Efficiency

To begin with, multiple auditors, as well as BT experts, stated that the technology needs to be implemented on both sides for efficiency advantages to be realized. *"As long as there is a human that books transactions on the company's side, a human must review their work on the auditor's side"* (BT expert 5). The connection between the digital and physical world, including proper controls, was thus emphasized as a crucial aspect for gaining efficiency advantages. Moreover, the auditors referred to the malleability problem of how to ensure that the right records are uploaded on the chain. Therefore, the need for checking the accuracy of the uploaded information on the blockchain would imply time inefficiency rather than time efficiency. However, some auditors believed that blockchain could contribute to the digitalization transformation that the profession has undergone, further increasing efficiency in the audit process. Other auditors instead asserted that the existing tools and systems enabling efficiency will be further developed rather than replaced. The BT experts shared the more critical view on implementation of the technology from an efficiency perspective. *"I do not think that BT will be applicable for the profession in general and it will not make the process more efficient because of the current knowledge gap"* (BT expert 5). However, they also asserted that BT could relieve auditors of workload and free up time if looking through a longer time horizon, given that the technology develops and that the information gap decreases.

According to the majority of the auditors, a suitable BT solution could impact their profession from an efficiency perspective. Firstly, many participants from both groups argued that the technology could eliminate the need for verifying transactions with intermediaries, such as banks, as they can trust the verification through the technology. Secondly, some

auditors asserted that BT does not require sampling of line items, as all transactions are automatically verified. As explained by Authorized auditor 2, there is currently a need for reviewing what set of samples that the junior auditors have selected. This as the samples should be randomly collected in order to ensure objectivity, which they seldom are. According to him, BT would result in less time spent on reviewing junior auditors' work and freeing up time for more complex issues. Moreover, many of the auditors stated that much of their time is spent trying to retrieve data from their clients. BT could make this process more efficient as all transactions are uploaded on the chain given that the technology is implemented on both sides; the company and the audit firm that is. According to most of these respondents, they would spend their potential free time on existing clients. This as the number of authorized auditors is relatively low in Sweden which in combination with their condensed peak season of heavy workload results in time pressure with the individual clients. For instance, Authorized auditor 3 asserted that a more automated and efficient audit process would lead to increased contact with clients as there is more time for discussing complex issues. In addition, Authorized auditor 5 said that they then could focus on other aspects such as risk analysis as well as client advice; thereby increasing both the quality of the audit and the value provided to the customer. In contrast, Authorized auditor 4 instead asserted that the extra time would be used to take on new clients, as audit firms are profit generating entities.

Furthermore, some stated that smart contracts could be used to classify assets, while others argued for the opposite. The ones in favor of smart contracts said that they can be used for validating bonuses, guarantees, and discounts, only to mention some. This would in turn ease the workload of auditors as they would be able to trust that these are valued at the right amount. The realistic possibility to program such contracts was confirmed by BT experts 1 and 4, who shared the opinion of the use case. However, the BT experts believed that these contracts would be most suitable for only simpler transactions, resulting in some efficiency gains as the repetitive and manual work would become automatic. Some BT experts further believed that this would imply less contact with clients. On the contrary, BT expert 6 thought that more time would be spent discussing the technology and how the company has structured and built its processes, leading to time inefficiency.

"Auditing is about verifying operational activities. If everything is on a blockchain and one can leverage smart contracts, it would indeed ease the workload related to verifying various transactions such as accounts payables, group contributions, etc." (Authorized auditor 4).

4.3 Transparency

When it comes to transparency, both auditors and BT experts believed that this was one of the main advantages of blockchain. This as all data can be traced, which as previously mentioned is often seen to constitute the basis of transparency. Moreover, all transactions are visible for all parties who are included in the network, creating transparency both inside the organization and externally among the nodes in the network depending on the type of blockchain. As mentioned by BT expert 6, big corporations today have plenty of systems and tools that are used in auditing. However, there is a lack of integration between these, why *"BT is a technology bringing all parties together"* (BT expert 6). Besides increasing transparency internally, blockchain can also create more trust externally. He asserted that it is natural with a lack of trust between organizations as they all have different interests, despite sharing common goals. This in turn leads to reduced transparency between the parties. Since data is often owned and controlled from the back end of a company, no one can be assured that this information is correct. Thus, the transparency and immutability that certain blockchains entail can provide assurance that the data is not manipulated.

"Today, there is a lack of trust between organizations. This is nothing strange, right? There are different interests in a business context, despite having common goals. This in turn leads to a lack of trust and transparency between the parties. The current model does not work because the one owning the back end of the database is the one in control. Why should the customers trust our firm when we can manipulate the data? BT is immutable so no one can tamper the uploaded information, why we would benefit from using the technology." (BT expert 6).

Although the respondents agreed that BT can increase transparency within the audit process, this requires that the companies agree to have their financial information public, i.e implementing public blockchains. BT expert 6 pointed to an important issue here - the auditors seek for transparency while the owners of the data, that is the clients, may be reluctant to display sensitive information to everyone; *"Go and talk about transparency with finance guys. They do not want transparency."* It thus becomes important to find the right trade-off between transparency and privacy. For instance, article 17 in the GDPR principles states the "right to be forgotten", why the immutability of a blockchain can become a privacy

issue, according to him. BT expert 4 also mentioned that the data market is valued well above the gold market, implying that few companies may want to have their financial information visible. Therefore, public blockchains may not be suitable within the context of auditing, something that respondents from both groups mentioned. The majority of the participants argued that a hybrid BT, such as a semi-public or consortium blockchain, would be most appropriate in the audit profession. However, this involves deciding what nodes should be invited into the transparent network and that these are considered trustworthy. In addition, BT experts 4 and 6 said that there is almost no difference in transparency if using a central database or a private blockchain, meaning that there is no need of implementing that type.

Yet, there are some cases where public blockchains can be useful for auditing. For instance, BT expert 6 believed that for e.g. non-profit organizations could agree to share their information publicly, as this signals trustworthiness and credibility to external parties, such as donors. When it comes to non-financial audits, public blockchains could also be advantageous. This as the traceability aspect makes it easier to control that companies comply with their ESG or cyber risk standards. *"The visibility of supply chains can definitely make non-financial audits more trustworthy, while also being of interest to customers and other external stakeholders"* (BT expert 6).

4.4 Quality

From a quality perspective, most of the respondents stated that the auditors' work could be enhanced by implementing BT. The main reason for increased quality is the decentralized network enabling full trust between all parties. According to the auditors, more trust in verifications of transactions would have a positive impact on the audit report as it increases its reliability. However, the majority of participants emphasized that increased quality can be realized only if the technology is implemented from both sides - the auditable entity and the firm executing the audit. On the contrary, some auditors also thought that overconfidence in the technology could impact the audit quality negatively. *"In order to make a high quality assessment of complex transactions, we as auditors should not rely too much on technology"* (Authorized auditor 1). On the same note, BT experts believed that smart contracts can be used in simple valuation contexts but would as of now not improve the quality of more complex matters as they require human judgment. They further emphasized the complexity of

developing smart contracts as they cannot be altered or updated once uploaded on the chain.

Regarding the question if blockchain can increase the trustworthiness of companies' financial reports, the answers were dispersed. While most auditors focused on the traceability aspect and answered yes, many BT experts instead referred to the malleability problem and said that it is still difficult to ensure that no fraudulent data has been uploaded on the chain. In order to confirm this, you would have to design smart contracts that identify fraudulent transactions. While this can be interpreted as a good solution, it is hard to execute in practice. *"There are too many variables to control in order to design a system that is impossible to manipulate* (BT expert 3). On the other hand, some experts said that it in fact will be more difficult to manipulate transactions if using BT. This as all information is continuously uploaded on the blockchain and cannot be altered afterward.

"It is difficult for people to map out a manipulation scheme at the beginning of the year, before knowing what transactions will occur. You cannot manipulate without being sure what to manipulate. BT can thus make the reports more trustworthy, but there will always be sketchy people who will find their way." (BT expert 5).

In addition, she mentioned that you must be technologically clever to succeed in uploading fraudulent data on the blockchain for the network not to react. When discussing the malleability problem, the BT expert group stated that the audit quality can be reduced if the auditors fully trust the technology, whereas the data on the blockchain has been manipulated beforehand. Authorized auditor 5 asserted that in order for the quality of the audit process to improve, a third party would be required to verify the data in advance. In addition, the auditors believed that an external party continuously would have to control that the technology itself works as it should, hence implementation would require an additional control function. The BT experts agreed that there will be a demand for an external controlling party, but only as a result of the existing knowledge gap and not because the technology risks being inaccurate.

On the one hand, most auditors said that all quality aspects can be linked to the traceability that stems from irrevocability, a core characteristic of BT. On the other hand, Authorized auditor 1 again stated that they already have tools that enable traceability and that they are constantly being developed. She said that wrongfully recorded transactions must be adjusted

by booking a new transaction along with information about who did the alterations. However, BT expert 4 mentioned that it is feasible to delete data in a central database, making the information impossible to trace. He thus explained that blockchain and its irrevocability would increase the audit quality. Furthermore, the participants discussed that the audit quality is dependent on what type of blockchain is used. BT expert 3 and Authorized Auditor 3 asserted that private blockchains would decrease the audit quality as there is a higher risk of manipulation of nodes. Furthermore, Authorized auditor 2 asserted that this type of BT fills the same quality function as their current systems and tools. Some BT experts believed that a consortium blockchain can enhance the quality as entities in the network are screened beforehand. However, they also stated that these types of blockchains disregard the idea of decentralization to some extent, which according to the majority of participants is the central quality advantage.

5. Analysis

In the following section, an analysis of the empirical findings will be presented. The basis for the analysis is the theoretical framework which can be found in section 2.3.

5.1 Implementation

For BT to have an impact on the planning, assessment and/or reporting phase, it is crucial to analyze the realistic possibility of implementing the technology. The perhaps most important empirical finding with regard to this aspect is that many respondents had a hard time finding a proper use case for BT within auditing. This in contrast to previous research which anticipates that there are many usage areas, especially within the finance field (Hileman et al., 2017). The auditors asserted that the tools and systems that are already in place work well and are constantly being developed, thus not requiring a new technological shift. This can be a result of the findings that auditors find it hard to navigate electronic workpapers (Dowling et al., 2014). Blockchain would make the audit process even more technically advanced, which could explain why the auditors are reluctant to implement an entirely new solution. However, new technologies are seldom demanded at an early stage if they are not perceived as superior to the existing ones. As mentioned in the literature review, some draw similarities between blockchain and the internet, where few understood the proper use case initially, but instead came to this realization once the internet technology developed (Kirkland et al.,

2016). This means that blockchain may impact the audit profession in a future time horizon, but not that much as of today. This relates well to what the BT experts said; the technology will develop and improve, it is only a matter of industry revolution. Having said that, they believed that BT had the biggest usage potential for auditing if using public blockchains, as the same transparency and quality gains cannot be realized to the same extent if using private, semi-public, or consortium.

However, there are several issues related to implementing public blockchains into the audit profession. Firstly, the empirics showed that organizations are skeptical toward displaying their financial information openly, why one must find the appropriate trade-off between transparency and privacy. Secondly, the respondents asserted that private data is one of the most valuable resources as of today and that the use of private blockchains may entail problems with regard to the GDPR regulations that have been enforced. This relates well to prior research on technical challenges and limitations for an implementation (Koteska et al., 2017). Lastly, the consensus mechanism PoW that is commonly used in public blockchains is resource intensive (Eccles et al., 2012). Simultaneously, many companies are becoming increasingly aware of their environmental footprint, which may make them reluctant to implement this type of BT (Monrat et al., 2019). Therefore, blockchains that utilize a less energy consuming consensus mechanism, such as PoS, might be more suitable for an implementation (Karpinski et al., 2021). Moreover, with regard to these aspects, private blockchains may be most suitable for auditing, as these also require less energy.

Another aspect that can be seen to constitute a challenge for implementation is that the technology is still seen as immature and the general level of knowledge is very low (Bashir, 2020). For instance, it is expensive and there are few regulations or standards that can guide the organizations who start using BT, according to the empirics. Once again, an implementation may not be appropriate as of now, but the technology is instead more likely to have a future impact. The literature and empirical material further confirm this statement as all respondents discussed that there is currently a very large knowledge gap (Wamba et al., 2020). Implementing BT requires investments in human resources and puts pressure on auditors to hold some form of technical expertise. At the same time, there is also a demand for auditors to perform non-financial audits which requires that they increase their knowledge base (Power et al., 2007). On top of this, the empirics found that the number of auditors in Sweden is scarce and that they are already under a heavy workload. This means that there is

little room to spend on things other than actually conducting an audit, which in turn can lead to a reluctance to explore BT, as it may be interpreted to result in more work than actual gains.

In addition, some respondents mentioned that audit firms themselves must find the incentives to replace existing tools and thereby drive the technological shift. Given that an implementation requires a combination of both monetary and human resource investments, the switching costs may be seen as too high. Having said that, the literature states that companies also expect audits to keep pace as they innovate their businesses and practices (Bou-Raad, 2000). In order to gain a competitive advantage, this means that audit firms may benefit from being at the forefront technically. In addition, previous literature has found that high quality financial disclosures can reduce the cost of capital for clients seeking funding, which could provide incentives for audit firms to implement BT due to pressure from clients (Cuadrado-Ballesteros et al., 2016). Therefore, the alternative of outsourcing the technology rather than building it in-house may be an appropriate solution. This does not require the same internal knowledge as the audit firms can then use the technology without fully comprehending the process on which it functions. Buying a blockchain solution from an external party can thus be seen as the most realistic scenario for implementation as this only requires knowledge about how BT is used and not how it works in detail. Despite this, another important empirical finding is that the technology must be implemented from both sides - the audit firm and the auditable entity. Regardless if the technology is built internally or if it is outsourced, BT can thus only be used in auditing if the client implements the technology as well. This can be seen as a major challenge for implementation as it is dependent on more parties than the audit firm itself. Lastly, auditors are to comply with GAAS, GAAP, and other internal frameworks and standards, as mentioned in the literature (Levy, 2020). Although some respondents did not see that these have to be revised, using blockchain as a tool must nevertheless be "[...] in accordance with accepted principles of accounting" for an implementation to be practically possible.

5.2 Planning

In the literature review, it became clear that the planning phase of the audit process requires the human touch as it has its foundation in evaluation (PwC, 2022). The auditor's main task is to learn about the company and its operations by, for e.g. gathering background information

(PwC, 2022). The auditors stated that this part of the process will not be facilitated by implementing BT. However, when asking about the biggest advantages of implementing the technology, most of the participants mentioned aspects such as transparency and traceability, all of which have a clear connection to the irrevocability of BT. This feature implies that if the technology were to be implemented on both sides, then the auditors would have full access to the history of the auditable entity's transactions. As examining historical transactions is a part of the planning phase, this would help auditors both from an efficiency and quality perspective. Nonetheless, the literature showed that clients are obliged to store historical transactions for seven years (SEC, 2003). BT does thus not provide any additional functionality from a traceability aspect. However, BT experts asserted that the stored data is immutable, possibly improving the quality of the data if it is stored on a blockchain. To realize this advantage, the technology must be in place for at least seven years as it concerns historical transactions.

On the one hand, there is more to the planning part than examining historical transactions, why the majority of the candidates did not think BT would have an impact. Performing a risk analysis, developing an audit strategy, and determining the time and scope of the audit are tasks that once again require the human touch. The risk analysis could to some extent benefit from the transparency aspect, but the technology itself would not be able to execute the job. BT experts explained that BT is not AI and that it is hard to build a structure to improve the risk analysis in the planning part of the audit process. On the other hand, the phases in the audit process are highly intertwined, why BT's impact on other parts may have an effect on the planning phase. For e.g, the majority of the respondents thought BT could eliminate or decrease the need for sampling, thus making the assessment part more efficient. If so, they will have more time to conduct a thorough in-depth risk analysis and discuss complex matters, which in turn could make the entire audit process increase in quality. In addition, this would provide more value to the customers, according to literature (Eilifsen et al., 2001). Nonetheless, this requires that more time is spent on existing clients while some auditors said that they would instead take on new clients, leaving the risk analysis unaffected.

Moreover, the auditors expressed that they would not feel comfortable with relying solely on the technology, something that the BT experts believed was more connected to the knowledge gap rather than the inaccuracy of the technology. This theory can be further strengthened by the fact that previous research also refers to the knowledge gap (Wamba et

al., 2020). However, another aspect that was mentioned in the literature was the malleability problem, which was also emphasized as an important aspect in the interviews (Yli-Huumo et al., 2016). As a consequence of the malleability issue, the auditors would not benefit from having all transactions available in the planning part. Instead, the quality of the auditors' work could decrease drastically as the following parts of the audit process are highly dependent on the auditors initial planning. Nevertheless, if the auditors in fact were to distrust the technology, it would not have an impact on the planning process as it would not be used.

5.3 Assessment

If implementing BT into the audit process, it has the biggest potential to impact the assessment phase. Moreover, all the three aspects of quality, transparency and efficiency can be improved, although several issues in relation to these may also arise. The perhaps most evident factor that BT will impact is the efficiency within the assessment procedure, given that it is implemented on both sides. As stated in literature, many procedures in the assessment phase require extensive amounts of time, although they are of a repetitive and simple nature (Cohen et al., 2019). The automatic verification of transactions than BT enables calls for less sampling as all line items are checked. Blockchain also eliminates the need for third party validation and efforts in order to retrieve data from clients, thus reducing the time spent on assessing transactions. This could allocate time from the assessment phase to planning or reporting, which according to literature provides more value to the customers (Eilifsen et al., 2001). In addition, BT could increase the audit quality as the literature shows that auditors who are under a heavy time constraint typically produce lower quality audits (Christensen et al., 2021). However, as some respondents believed that an external control function will be demanded, it is not guaranteed that the time savings will be as large as anticipated, meaning that the mentioned quality gains can then not be realized.

When it comes to transparency within the assessment phase, the biggest advantage is that BT solves the problem regarding the internal lack of integration and transparency, something that was made evident during the interviews. The literature states that transparency and decentralization are core characteristics of BT (Bashir, 2020). Thus, if all data were to be collected on one single blockchain, the technology could facilitate the assessment of transactions by creating one transparent common tool where all nodes participate in the validation. However, some respondents mentioned that their existing tools already enable

transparency. A private blockchain thus fills the same function as their current systems, that is a central database, why there is no need to replace them. In order to gain transparency advantages, a public blockchain is required. Yet, this type is not regarded as suitable for auditing due to privacy issues, according to the empirics. This in turn means that audit firms may choose to further develop the current systems, rather than introducing an entirely new technology such as blockchain.

With that said, BT nonetheless seems to be a good alternative for organizations that are to issue non-financial audits. According to the empirics, assessing whether a company complies with its ESG or cyber risks standards requires that the auditor reviews processes and data that do not only consist of numbers. This is confirmed by literature, stating that there is increased pressure on the auditor to hold knowledge within areas that go beyond finance and accounting in order to conduct a high quality assessment (Power, 1997). In addition, there is evidence that companies want to include areas such as ESG and cyber risks in their audits, requiring visible supply chains (Mickeler, 2021). BT would automate this process and provide a clear audit trail without the need for extensive human involvement, facilitating the procedure of assessing non-financial audits. In addition, the technology can be seen to improve the objectivity within the assessment phase. As aforementioned, BT eliminates the sampling requirement and instead verifies all transactions (Bashir, 2020). Moreover, research shows that the selection of samples risks being subjective and that auditors with good client relationships are more likely to take the client's preferred side (Smith, 1972; Bamber et al., 2007). Presumably, this means that the chosen set of samples does not include the transactions which hold the most risk, why BT can make this part of the assessment phase more objective. However, some respondents also referred to the fact that some transactions will still need to be verified manually as it is difficult to design smart contracts that can identify fraudulent transactions, leading to inefficiency in the audit process. The assessment process can thus not become fully automated and will still require the human touch. Having said that, this is the phase where most respondents believed that BT had the most realistic usage potential.

5.4 Reporting

To begin with, it is evident from the empirics as well as the literature that the audit process is highly intertwined, with reporting being the outcome (PwC, 2022). When analyzing BT’s

impact on the reporting phase, one must first analyze the impacts on the previous steps. If the technology is implemented, its effect on the planning phase is dependent on potential efficiency advantages in the assessment phase. Based on the empirical finding that some auditors would spend additional time on existing clients, the risk analysis in the planning part may be improved from a quality perspective. This as the auditors can allocate more time for in-depth risk analysis and advisory, providing more value to the clients (Eilifsen et al., 2001). If that would be the case, the reporting may in turn be improved from a quality point of view. However, the mentioned impacts on the reporting phase are highly speculative as they are dependent on the outcomes in the former steps, and the BT experts asserted that these might be realized only in the long run. According to them, there is too much resistance as of now, both in terms of auditor sentiment as well as technological maturity.

When analyzing the reporting phase in isolation, the auditors emphasized that it is more than just numbers that are produced and published in the reports. As mentioned in the literature, the auditors are to draw conclusions, express an audit opinion, and recommend corrections and/or improvements (PwC, 2022). According to the empirical findings, BT will not impact the reporting phase from an efficiency or quality perspective as these tasks require human involvement. However, the main job of the auditor in the reporting part is to produce a trustworthy reflection of the client's operations as the direction and scope of auditing is clearly focused on the detection of fraud (Levy, 2020). In order to do this, the literature mentions that a clear audit trail for all transactions indicates that an accounting system is well-functioning (Power, 2021). However, audit trails are still vulnerable to different kinds of manipulation schemes, leading to a lack of trust in the process (Power, 2021). They are also under control of a central authority that is responsible for managing the information records (Regueiro et al., 2021). As people have different interests and incentives, there is a risk that this central authority may exploit its power and alter the information records for its own gain. Therefore, the empirics found that BT would make the reports more trustworthy as it enables traceability and transparency. It is almost impossible to manipulate nodes, why the risk for fraudulent transactions decreases and the quality of the reports is improved. However, the security of a blockchain is dependent on what type is implemented, with the public blockchain being the most difficult to manipulate (Sarmah, 2018). Furthermore, auditors play a vital role in reducing the information asymmetry between the client and its external stakeholders (Almutairi et al., 2009). Thanks to the consensus mechanism PoW and the P2P network, all nodes hold a copy of the full ledger and agree on the final state of data (Bashir

2020; Zhang et al., 2020). These two features combined provide high standard verifications and reduce information asymmetry. At the same time, research has proven that high quality financial disclosures can reduce the cost of capital for firms seeking funding (Cuadrado-Ballesteros et al., 2016). Therefore, the auditors may not be needed as a means to reduce information asymmetry, as public blockchains enable high quality financial disclosures. Yet once again, the empirics found that public blockchains are hard to implement as they are not suitable in an audit context. However, some respondents thought that smart contracts could be used to detect fraudulent transactions, which could be implemented regardless of the type of blockchain. Nonetheless, the BT experts asserted that it is very complex to program such contracts and that they cannot be changed once uploaded to the chain. This is also confirmed by the literature, stating that this requires a lot of research and monetary investments (Singh et al., 2020). Moreover, the BT experts also referred to the malleability problem which is complex to solve. If the transactions are manipulated before being published on the blockchain, the quality of the reports would thus decrease. Lastly, ISA 220 states that "audits are to provide assurance that the firm [...] fulfill their responsibilities in accordance with professional standards and applicable legal and regulatory requirements" (IAASB, 2020). This means that BT must be seen as a trusted technology that is supported in audit rules and frameworks. Therefore, in order for BT to have an impact on the last part of the audit process, standards will have to be altered. For this to happen, society as a whole needs to accept the technology, which will initially require extensive amounts of investments and efforts to decrease the current knowledge gap.

6. Conclusions

6.1 Contribution

We have addressed three main problems: the gap in blockchain research in an ever changing technological landscape, the fact that the internal perspective has so far been disregarded, and that the external viewpoint has not yet been taken by people with extensive BT knowledge. Firstly, we contribute with more research on the topic, which can help auditors navigate the technological landscape (FAR, 2016). Secondly, our internal viewpoint contributes with new perspectives on the opportunities and challenges related to implementing BT into the audit profession. While previous research conducted by Deloitte mostly discussed potential benefits that BT could entail, we find that there is a lot of skepticism when taking an inside

standpoint, thus contrasting prior findings (Psaila, 2017). Thirdly, the complementing external perspective further emphasizes the many challenges involved. The main contributions are discussed below.

First and foremost, implementation is a prerequisite for the impacts to be realized. According to our findings, an implementation is not relevant as of today. The major reason is skepticism towards the use case for BT within auditing. Moreover, the basis for this is threefold. Firstly, the switching costs to replace existing tools and systems are too high. Secondly, the technology is not yet mature for mainstream usage within auditing and thirdly, there is a large knowledge gap. Therefore, blockchain technology is currently not impacting the audit profession. Hence, the human factor is still playing and will most probably play a large role in auditing as judgments and valuations cannot solely be done by BT. Auditors must still conduct a risk assessment and a concluding report, meaning that the technology cannot replace most parts of the process.

However, some audit firms have begun investing in the technology and an important contribution is that one cannot guarantee that a future implementation will not take place. We again draw a linkage between blockchain and the internet, meaning that it is difficult to foresee the implications of BT at such an early stage. The answer to how auditors and BT experts anticipate that blockchain will impact the audit profession in the future is thus dispersed. Some believe that BT will have a large impact on the audit profession, while others disagree. If implemented, BT seems to have the most usage potential in the assessment phase, resulting in positive spill-over effects in planning and reporting. By using our theoretical framework, we have concluded the most important findings in the figure below. As aforementioned, the case for implementation is complex and will most probably not occur until a future time point, why there are only challenges with regard to this dimension. If implemented, BT will entail both opportunities (+) and challenges (-) for auditors, which are explained briefly with the help of our theoretical framework. The main finding is thus that BT can have the most impact on the assessment phase, where the positive effects seem to outweigh the negative ones. The empty fields indicate that no impacts have been found in those phases when analyzed through the specific dimensions.

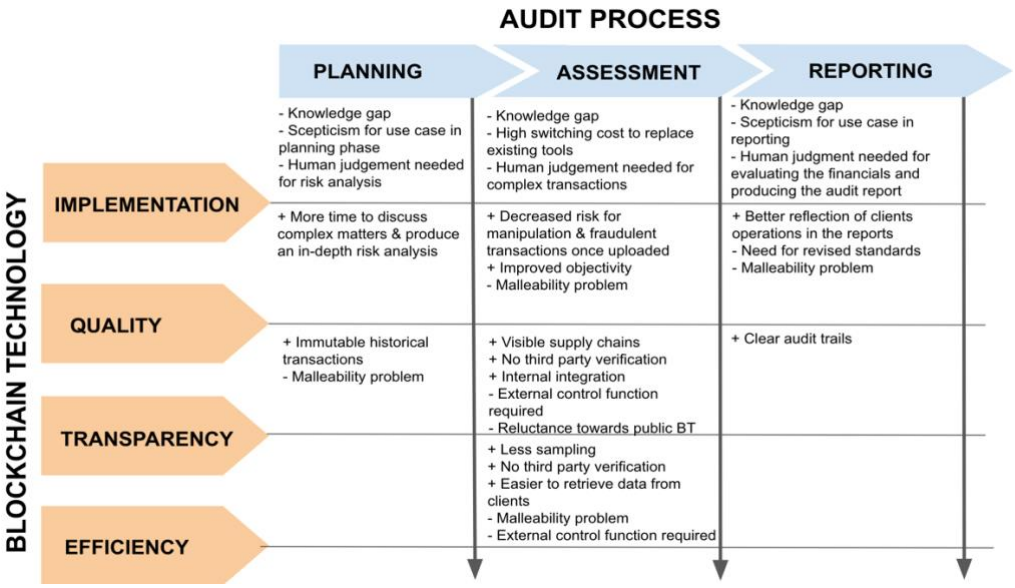

Figure 5. Impacts of BT on the Audit Profession.

6.2 Potential Shortcomings

One important factor that may have impacted the results is the knowledge gap which has been discussed throughout the study. It is not only the general public who lacks knowledge about BT, something that was made evident during the interviews where the level of expertise differed among the candidates. This was also true for the audit process, where some candidates conveyed the impression of having more professional insights than others. Although their responses were most probably affected by this knowledge gap, we are not in the position to evaluate who said the "right" things and gave the most credible answers. We therefore suggest that future studies include a larger selection of participants in order to become less biased.

6.3 Suggestions on Future Research

We advise future researchers to further investigate the topic of blockchain and its future impact on the audit profession, as well as its effect on other industries. The basis for this recommendation is the knowledge gap which was a recurring theme in all interviews, implying that more research is needed within the field. Moreover, we want to give a concrete proposition - to study the concepts of BT and non-financial audits in relation to each other. This as many respondents saw a use case for blockchain when it comes to conducting audits that involve reviewing supply chains. Another interesting aspect that was discussed during

the interviews and that can be linked to the audit process is that we are moving toward an even more digitalized world, which awakens an important question: at what point in time will we have more trust in technology than in human beings?

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8. Appendix

Append-only: Data can only be added to the blockchain in a time-sequential order and cannot be removed (Terry et al., 1992).

Consensus mechanism: A mechanism for distributed consensus in trustless networks through P2P validation. To ensure that the blockchain network agrees upon the final state of the data, the consensus mechanism is facilitated in algorithms (Sun et al., 2019).

Consensus protocol: When a new block is created, all nodes in the network validate the information against criteria that are defined by the specific blockchain's protocol, this is called the consensus protocol (Sun et al., 2019).

Consortium blockchain: Permission is required to verify, read and write on the blockchain which is controlled by a predetermined group, for e. g multiple entities (Sarmah, 2018).

Cryptocurrencies: Encrypted, decentralized and digital money that is based on blockchain technology. There are various types of cryptocurrencies, the most famous ones being Bitcoin and Ethereum (Ashford. et al., 2022).

Cryptographically secure: Cryptography is a primary tool for security which can be used to mitigate network based attacks. When stating that something is cryptographically secure, it means that cryptographic algorithms are used to ensure confidentiality, integrity, authentication and non-repudiation (Chandra et al., 2020).

Data malleability problems: Problems related to controlling if the data on the blockchain already has been manipulated (Yli-Huumo et al., 2016).

Distributed ledger (DLT): The superordinate technology to BT and the framework that underpins BT. DLT is thus a decentralized database, managed across multiple nodes by multiple participants where transactions can be stored in a decentralized, distributed network after validation by peers (Hawlitschek et al., 2018).

Encryption: Algorithms can encrypt and decrypt for example messages using a single key. The key along with the wanted message is passed through an encryption algorithm, creating the encrypted message. This allows for the message to be sent through a more insecure medium, such as a network, since only a recipient who has the original key can decrypt the message by passing it through a decryption algorithm (Viega et al., 2002).

Hash function/Hash algorithm: Cryptographic one-way hashes that take data as input and produce a fixed-size output, called the hash value. Passing the same message through a single hash function/hash algorithm always yields the same result (Viega et al., 2002).

Hash value: The hash value is the fixed-size binary output from a hash function/hash algorithm (Viega et al., 2002).

Irrevocability: Means that a transaction once added to the blockchain cannot be changed nor reversed (Bashir, 2020).

Metadata: Metadata is information about other data. In the context of Blockchain it could be information about features of a specific transaction (Bashir, 2020).

Peer-to-peer network (P2P): The classic idea of peer-to-peer networks is to locate information in a distributed way. In other words, it is built on finding and sharing information. Additionally, Blockchain technology, such as Bitcoin, spreads information about transactions to all participants in the network (Mödinger et al., 2020).

Proof-of-Work (PoW): In the context of blockchain, PoW is a consensus mechanism. It uses a cryptographic puzzle that takes about 10 minutes for a computer to calculate and solve, before a new block is added to the chain (Zhang et al., 2020).

Proof-of-stake (PoS): PoS is an alternative to PoW, that is a form of proof of ownership of the currency. A block is added through a transaction called coinstake. In the coinstake, the owner first stakes currency and then pays him-/herself during the validation, while gaining the privilege of generating a block for the network (King et al., 2012).

Public blockchain: The public blockchain is open for the public and anyone can read and write on the blockchain (Sarmah, 2018).

Private blockchain: Permission is required to read and write data onto the blockchain which is controlled by a “highly trusted” organization - the owner of the blockchain (Sarmah, 2018).

Semi-public blockchain: Semi-public blockchains are controlled by a single organization, where some parts of the blockchain are private and some are public (Sarmah, 2018).

Smart contracts: Smart contracts are programmed contracts that trigger pre-defined actions. They thus make it possible to validate accuracy to agreements by transaction partners and support integrity (Blossey et al., 2019).