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Future of Financial Audit: Impact of Blockchain Technology

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The technology of blockchain has been raising interest in different industries, be that law and economics, or information technology and finance. Blockchain became known for the fact that it is the technology behind such cryptocurrency as bitcoin. However, this technology is much more than just the backbone of a cryptocurrency. It enables peer-to-peer transactions between participants with no trust whatsoever as well as it has the potential to disrupt many fields.

The purpose of this thesis is to showcase the possible implications of the implementation of blockchain technology into the domains of audit and assurance.

In order to answer the research question, we reviewed three research papers discussing the possibilities of implementing blockchain into the domains of audit and assurance. In the first one, in order to increase the verifiability of business data, provide options to share data with interested parties instantly, and store the data itself in a more secure manner a triple entry accounting is suggested which in addition to the conventional double entry registry would also submit transaction data into the blockchain. Consequently, if such new accounting system would be implemented, there would be a need for the assurance possesses to be adjusted accordingly. It is viewed, that the concept of blockchain based assurance would increase the auditability of the information, with the use of smart controls it would allow near real-time assurance, as well as automate most of the auditors' manual tasks.

Another research prepared by the Chartered Professional Accountants of Canada (CPA Canada) and the American Institute of CPAs (AICPA) analyses in an illustrative way how such a technological advancement as blockchain could evolve the professions of audit and assurance and as a result suggest new possible functions for auditors to take up – auditing of smart contracts, consortium blockchains, system administrators, and arbitrators.

Third research describes an interview with Will Bible, a partner at Deloitte who specializes in audit innovations, which raises concerns regarding the idea of recording transactions on the blockchain due to the complexity and high cost.

As a result, there is no clear and unambiguous way to answer the research question due to the novelty of the topic researched. Thus, further research is advised.

Keywords	Audit, Assurance, Blockchain, Accounting, Future

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1 Introduction

The technology of blockchain has been raising interest in different industries, be that law and economics, or information technology and finance. Blockchain became known for the fact that it is the technology behind such cryptocurrency as bitcoin. However, this technology is much more than just the backbone of a cryptocurrency. It enables peer-to-peer transactions between participants with no trust whatsoever as well as it has the potential to disrupt many fields.

One way it is undoubtedly significant is the fact that currently, a vast range of economic activities depend on the centralized and agreed process of recording data so that the government and authentication of the records are reliant on a trusted third party (be that banks, firms, or governmental institutions). However, blockchain in recent years has proven to have the potential to facilitate transactions and disseminate trust without the need for the trusted third party. Since bitcoin's example of marketplace disruption, blockchain gained a lot of attention.

Would this technology have an effect on the profession masters of which for centuries have been working as trusted intermediaries between the company and the public and the state? Could it be possible to automate the processes of audit and assurance?

1.1 Research objectives and research question

The purpose of this thesis it to showcase the possible implications of implementation of blockchain technology into the domains of audit and assurance.

Main research question is formulated as follows:

- How could blockchain technology change financial audit (if at all)?

This question will be divided into sub-questions:

- What is financial audit?

- What is the technology of blockchain?
- How can they be combined?

1.2 Methodology

This thesis work will be exploiting exploratory research approach which will be based on the analysis of the literature review. Exploratory research is mainly used to "identify the boundaries of the environment in which the problems, opportunities or situations of interest are likely to reside and to identify the salient factors or variables that might be found there and be of relevance to the research." (van Wyk, 2012)

We will be concentrating on the use of secondary research material. This is due to several reasons. One, the novelty of the subject in question has a key role in the determination of research method as compared to many other research questions there is comparably less extensive research done on the topic. Another, in case of primary research where the researcher conducts first-hand data gathering by, for instance, facilitating interviews, there is a risk for the interviewee to be biased towards one of the extreme sides (either for or against the implementation of blockchain into the domains of audit and assurance for various reasons).

When choosing a suitable source of information for research, one needs to evaluate the appropriateness of the source. For this research, peer-reviewed articles, academic textbooks, as well as professional research papers, were chosen. In the chapter about financial auditing, the focus is more on the theoretical aspect of the processes of assurance; thus, in most cases, academic textbooks were used to describe the concept. In the chapter about blockchain, the focus is on the theory of blockchain also, but in order to describe the concept peer-reviewed articles as well as professional publications were used. In the chapter discussing the combination of audit and blockchain, the focus is on exploring the possibilities that have been already suggested by other researchers and professionals in the domains of audit and assurance hence peer-reviewed material and professional publications were used.

Thus, by conducting the thesis, we are able to identify the concept of financial auditing, the concept of blockchain. In order to comprehensively analyse the issue, we will present

several studies exploring the combination of the two concepts, followed by a discussion of the key findings of the research incorporated with the reality check.

1.3 Limitations

However, it is worth mentioning that there are some limitations to this study. Due to the novelty of the topic under examination and lack of practical implementation, it seems to be the case that most of the discussion held would be purely theoretical and possesses illustrative form. As will be seen further in the research, most of the ideas covered are thoughts or points of view, which might seem to be biased towards one way or another. Taking this into consideration, it is important to point out that this research should not be viewed as a single source of information on the topic discussed and that the readers are highly encouraged to conduct further examinations themselves.

In addition to that, it is important to mention that this research is intended to be viewed as one to attempt to raise awareness about the topic as in author's opinion it has a great potential for the further research.

1.4 Thesis structure

As literature review is the base of the work, most extensive research will be conducted on this stage. In chapter 2.1, we will cover definitions for the concepts related to financial audit. Namely, definition of financial audit, the process of assurance, and the limitations of audit.

In chapter 2.2, we will cover definitions for the concepts related to the technology of blockchain. Namely, what is blockchain, the technological aspects of blockchain, the technology of Ethereum and smart contracts, and the evolution of blockchain from 1.0 to 3.0.

In chapter 2.3, we will go through several research papers the authors of which propose different suggestions to how the technology of blockchain could be implemented into the domains of audit and assurance. Namely, a proposal for creation of a new accounting system (a triple entry accounting instead of the conventional double entry one) and as a consequence having the auditing possesses conducted with the use of blockchain; a research prepared by the Chartered Professional Accountants of Canada (CPA Canada) and the American Institute of CPAs (AICPA) evaluating the potential impact on the audit

and assurance profession; Last research in the chapter describes an interview with Will Bible, a partner at Deloitte who specializes in audit innovations, who raises concerns regarding the idea of recording transactions on the blockchain for several reasons.

In chapter 3.1 we will have a recap of the key findings from the research conducted.

In chapter 3.2 an analysis and reality check will be conducted in order to evaluate the research outlines.

In chapter 4 we will conclude the research and propose recommendations for future research.

2 Literature review

In this chapter we will cover the following: In chapter 2.1, we will cover definitions for the concepts related to financial audit. Namely, definition of financial audit, the process of assurance, and the limitations of audit. In chapter 2.2, we will cover definitions for the concepts related to the technology of blockchain. Namely, what is blockchain, the technological aspects of blockchain, the technology of Ethereum and smart contracts, and the evolution of blockchain from 1.0 to 3.0.In chapter 2.3, we will go through several research papers the authors of which propose different suggestions to how the technology of blockchain could be implemented into the domains of audit and assurance.

2.1 Audit

Auditing originated in the 19th century in the United Kingdom and the United States and was initially designed to serve the purpose of a check on corporations. In addition to that, the auditors at the time were meant to be independent intermediaries between the government and the corporation. The process of auditing at the time was focused on the procedures during transactions and the transactions themselves. Thereafter, when the laws changed in the 20th century, audits began to focus more on the fairness of the examined financial statements. Lastly, as a result of companies growing bigger and the number of transactions becoming immeasurable, the function of auditors changed significantly as it became impossible to track every single transaction due to time and resource constraints. (AuditMonk, 2017)

The Big Four accounting firms is a generally accepted term describing the four biggest accounting corporations in the world. As of the time of this thesis, the Big Four refers to such companies as Deloitte, EY, KPMG, and PwC.

These corporations are a result of countless mergers of smaller firms, and due to their current size, they possess the skills and resources to be practically the only ones who are able to provide the best services for multinational client-companies. To be more precise, the Big Four provide audits for the absolute majority of the public companies in the United States and listed companies in Japan and all of the top 100 companies in the United Kingdom. Thus, as an outcome, we get a cartel-like industry in which the pricing of the services and the standards are set by the Big Four corporations. (Brooks, 2018)

In most countries, corporations are required to have audits by law. However, instead of providing the government and the public with accurate data describing company's current realities, the Big Four in order to retain customers and the revenue stream are doing their best to showcase their clients to the government and the public in the best possible way. This could be done by, for instance, finding tax loopholes, or covering financial crimes which would profit the corporation and as a consequence, the executives could extract cash through bonuses, and the audit firms could be assured that the client will remain.

The above-mentioned begins to feel like an odd loop of conflict of interests. On the one side, the auditors who are supposed to be independent intermediaries between the government and the company-client. On the other side, the audit – client company relationship, where one is paying another to check for fairness the financial statements. On the third side, the nature of such accounting firms as those in Big Four, where they as corporations are maximizing profits and at the same time provide an independent and trustworthy audit report. (Brooks, 2018)

Such an uncertainty begs the question namely how is this situation even possible to exist? As normally in this kind of situation the government usually interferes as it would not be a legal practice. However, due to the fact that the government needs the auditors to check the companies it does not interfere in the process. Additionally, the investors when making a decision do rely on the information provided by the auditors as the latter ones are perceived as an independent source of information. But as it was mentioned earlier the auditors, particularly the Big Four, are not that independent after all as they in the majority of cases produce information beneficial to the clients. Clearly, these kinds of practices are appreciated by the corporate world as they are continuing to choose one of the Big Fours as an auditing service provider. (Whittaker, 2019)

2.1.1 Defining financial audit

We will begin by setting up a definition of the external financial audit. As Oxford Dictionary puts it, if we talk generally about an audit, it is a process of inspection of the organization's accounts, which is frequently conducted by an independent body. (Oxford Dictionaries | English, 2019) Moreover, a member of academia further elaborates by saying that the process of auditing could be defined as one when evidence collected and evaluated by competent, independent individuals forms an opinion which is eventually

communicated to the person interested in the report. (Basu, 2009:1-10) Furthermore, if we look at a definition provided by one of the Big Four companies (generally accepted concept of four biggest auditing companies in the world, as of the moment of this thesis comprises of EY, KPMG, PwC, and Deloitte) in the field of audit, it says that generally speaking the audit process comprises of evaluation of a subject matter with an intent to communicate an opinion on the subject of fairness of the matter presented be that matter an audit of financial statement, or internal control over financial reporting, or even compliance audit. (Pwc.com, 2017) To sum up, the main purpose of financial audit is to ensure that the financial reporting systems are in order and that published accounts are sufficiently trustworthy. (Brody et al., 1998) However, if we dug a bit deeper, we will realize that audit is only one type of assurance. It is important to differentiate the main ones: reasonable assurance engagements (i.e., audits of historical financial information), limited assurance engagements (i.e., reviews of historical financial information, mainly analytical procedures), and engagements which do not involve assurance (i.e., compilation engagements, a compilation of financial information and agreed-upon procedures). (Bagshaw, 2013:1-10)

In addition to everything stated above, it is crucial to note the importance of audit trail when discussing examinations of financial statements as they are a product of journal entries. There are two types of journal entries – a standard journal entry (comes from the name itself - when an entity records standard or recurring transactions, i.e. sales, purchases, payments, etc.) and a nonstandard journal entry (when businesses record nonrecurring transactions, e.g., asset impairment, etc.). The latter has generally been known to have a higher risk of material misstatement. (DeVries & Kigel, 2004)

2.1.2 Assurance process

In order to understand better the concept of financial audit, we will now concentrate on describing the steps of the assurance process. The process of assurance itself has four main steps which are acceptance and planning, conducting risk assessment through understanding the business' nature, gathering evidence in order to conduct the engagement procedures, and finalizing and reporting. We will now explain each one in more details.

1. Acceptance and planning

Prior to taking up any assurance engagement, professionals must make sure they are in compliance with ethical (i.e., making sure they are independent of the entity they are investigating and qualified to carry out the engagement) and quality control (i.e., performing the engagement according to the professional standards and methodologies set by the firm) requirements. During this step also scheduling of the engagement and allocation of resources is being performed as well as negotiation of an appropriate level of fees.

2. Conducting risk assessment through understanding the business' nature

Each of the engagements involves assessment of risks. For reasonable assurance engagements a broad analysis of risks linked to internal controls is performed, where relevant. For limited assurance engagements, however, risk assessment is conducted only to identify the potential areas which might contain material misstatements.

3. Gathering evidence in order to conduct the engagement procedures

For limited assurance engagements, the process of evidence-gathering focuses primarily on the above-mentioned established risks of a material misstatement by addressing them with probes and other appropriate procedures. For reasonable assurance engagements, the risks are addressed by various tests of control and other substantive procedures (including a test of details and analytical procedures).

4. Finalizing and reporting

During the finalization step, the management of the company is required to provide proof that all the necessary information has been provided to the auditors as well as described the possible subsequent events. In the reporting auditor in charge of the engagement outlines their opinion on the matter of the engagement and presents the either qualified or unqualified opinion of how "true and fair" the content of company's financial statement is. (Bagshaw, 2013:1-10)

2.1.3 Audit limitations

As much as the audits are benefiting the companies by assuring the truthfulness and fairness of the financial statements, as well as pointing out some possible insights on how to improve controls and processes (Pwc.com, 2017), one should also understand the possible limitations.

Those limitations might include, for example, a human error when selecting, performing, and evaluating the procedures. Furthermore, it is important to point out that it is impossible to perform a 100% testing of controls and processes due to the time and resource constraints. (Bagshaw, 2013:1-10)

In addition, to the above mentioned, it is crucial to realize that an audit is an opinion, and not in any ways a guarantee regarding the fairness and truthfulness of the financial statements. As was stated before, management is still responsible for the fraud of their making which could cause a collapse of the company. (Bagshaw, 20131-10)

According to DeVries and Kiger (2004), management has been practicing the use of inappropriate journal entries in order to, in many cases, tamper with the revenue figures to look more profitable. One of the maybe most known scandals related to tampering with financial statements was the Enron Scandal when the company declared bankruptcy after their inability to continue fooling everybody with fake holdings and off-the-books accounting. (Investopedia, 2019) It is worth mentioning though, that Enron's auditor, Arthur Andersen very quickly lost its clients when the reputation of the company was so damaged after it was suggested that Enron had pressured Andersen to provide "clean" audits in return for even more lucrative consulting contracts from Enron.

Such scandals as Enron's case led to calls for the separation of auditors' audit functions from their management consulting activities. As of the beginning of 2019, PwC and EY have presented their plans to eliminate the providing of consulting services to their audit clients. According to their reasoning, these actions would be done in order to restore public trust in a sector shaken by corporate scandals. As of this moment, another large audit corporation, KPMG has already undertaken steps to reduce the consulting services provided to corporations that have their audits done by them. (Jones, 2019)

2.2 Blockchain

Due to the lack of proper terminology, blockchain has become a buzzword raising hype throughout industries making it more complicated to grasp an adequate picture of the concept. Some say it will be so disruptive that eventually, the need in intermediaries will drop. Others, more conservatively, tend to believe that it will likely shift the scope of intermediation towards the reduction of transaction costs and establishment of new marketplaces. In any case, there is a clear need for a better conceptualization of what blockchain is for different fields.

2.2.1 Defining blockchain

We will begin setting up a definition of the concept of blockchain. If we look at the definition of blockchain in Oxford's Dictionary, they identify it as a system which conducts a record of bitcoin or other cryptocurrency transactions and is maintained by a peer-to-peer network. (Oxford Dictionaries | English, 2019) And it is what most of the people believe technology in question does, sometimes even mixing up the two concepts by using them interchangeably. However, if one takes the definition to a broader sense, the technology behind these cryptocurrencies is presented as a peer-to-peer network that is publicly accessible and keeps track of records securely. (Ortman, 2018)

Historically looking, there have been concepts similar to the one of blockchain proposed already in the 1990s. For instance, Bayer et al. in their research paper "Improving the Efficiency and Reliability of Digital Time-Stamping" published in 1992 discuss the possibility of using cryptographic hash functions and so-called trees that would record and timestamp the transactions making them "sandwiched securely into [their] place in history." This procedure, in their view, would aid the process of digital timestamping by drastically improving the process for validating a given certificate. (Bayer, Haber, and Stornetta, 1992)

The concept of blockchain as it is known nowadays started gaining momentum only in 2008 when an individual or a group of people under the pseudonym Satoshi Nakamoto published a white paper. Nakamoto proposed to use the decentralized mechanism of blockchain to track and verify the transactions of bitcoin based on a consensus mechanism (i.e., the actual process when the network validates transactions).

(Nakamoto, 2008) Only later people began speculating that the need in a central authority (be that a bank or a government) could eventually drop.

2.2.2 Technological background of blockchain

In order to describe the way blockchain works, the technological background of it, let's examine figure 1 presented below.

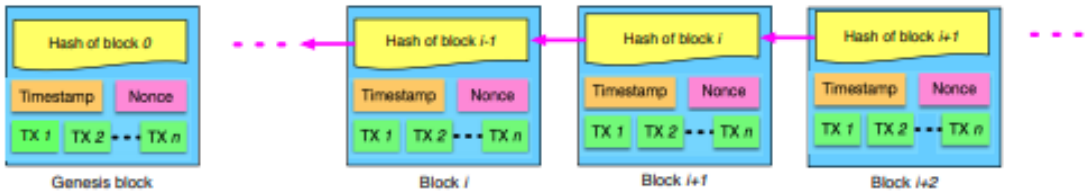

Figure 1. An example of blockchain (Zheng et al., 2018)

As it is illustrated in Figure 1, a blockchain begins with a genesis block (the first block in sequence). Every other block in the sequence is called a child block and is connected to its parent block by a hash function. Every block contains a block header and a body. The first one comprises of a block version (pointing out the set of validation rules for the block to follow), a parent block hash (indicates the previous block with a 256-bit hash value), a Merkle tree root hash (the hash value of all the transactions in the block), a timestamp as seconds of the current moment in time from first of January 1970, nBits (a compact format of current hashing), and a nonce (a 4-byte field increases for every hash calculation and most of the times begins with 0. (Zheng et al., 2018) The concept of nonce ensures the integrity of the whole sequence of blockchain up until the genesis block. (Nofer et al., 2017) The block body includes a transaction counter and the transactions themselves (the maximum amount of which depends on the block's size and the size of the transactions). (Zheng et al., 2018)

In order to be able to sign transactions digitally, blockchain technology uses asymmetric cryptography. This type of cryptography is usually used in the untrustworthy environment (Zheng et al., 2018), which is precisely our case. Put in a nutshell, signing digitally using asymmetric cryptography could be described as follows: all users possess a pair of private and public key, the first one is for signing the transactions, after which

transactions are sent out to the network and are accessed by everyone using the public key. (Zheng et al., 2018)

In a couple of words, the concept of blockchain could be portrayed as decentralized (transactions happen in a peer-to-peer network without the need of a trusted third party that would regulate the transactions otherwise), persistent (easier to check the validity of transactions as the network is constantly validating them which makes finding falsifications easy), anonymous (users interact with each other using a generated address, and there could be generated lots of them to conceal identity; however one should also understand that nowadays with technological advancements blockchain can not guarantee absolute anonymity), and auditable (as in blockchain every transaction is being validated, recorded, and timestamped by the network, the probability of someone tampering with the record decreases). (Zheng et al., 2018)

2.2.3 Smart contracts

The process described above requires human in order to be completed. There is, however, a way to introduce some amount automatization to the process with the introduction of Ethereum.

Ethereum is based on the technology and basic principles of blockchain. The main difference to the blockchain which is at the core of bitcoin, for instance, is that the technology of Ethereum allows developers to write applications that are, among others, easy to create, scalable, and standardized in use. In addition to that, the concept of transactions – messages- in Ethereum is different in several ways:

1. messages in Ethereum are created by an external entity or a contract when to be able to create a transaction in Bitcoin on has to do it only externally;

2. messages in Ethereum can contain data;

3. in case of a situation when a recipient of such a message is a contract account they are capable of responding. (Buterin, 2014)

Ethereum technology makes it possible and easier to use smart contracts as it works in an established Ethereum Virtual Machine (EVM) which provides security and

environment to run code that is not trusted otherwise by computers everywhere in the world. (Ethdocs.org, n.d.)

A concept of smart contract was first presented to the public in 1994 as electronic, computable contracts which execute the contractual conditions automatically. (Szabo, 1994) Mentioned technological advancement made it possible to enforce the performance of the contractual agreements without human intervention which in turn lowered the risk of fraud or a mistake. (Wright and De Filippi, 2015)

Furthermore, a smart contract could be created by two anonymous parties without any kind of intermediary, nor they require (in case of printed contracts) to be verified by any third party. In addition to that, due to the fact that the conditions are executed automatically the cost and time of settling down a dispute decreases as the need for an intermediary evaporated.

2.2.4 Evolution of blockchain from 1.0 to 3.0

Blockchain 1.0 entirely concentrates on the cryptocurrency trade incorporating in itself various functions related to, among others, transfer of digital money and payment which allowed the introduction of a new ecosystem called the Internet of Money.

Blockchain 2.0 broadened the scope of above-mentioned trading to allow the exchange of such assets as derivatives, smart property, and others. In addition to that, it also allowed the use of new types of applications called smart contracts which were able to execute terms of agreements autonomously. With growing complexity and automation, the applications of a smart contract could be expanded even more. In future, it is believed that with smart contracts being automated, the duty of looking after the execution of the terms of the contracts could be decentralized and the need for a trusted third party (for instance governmental institutions) would shrink.

Blockchain 3.0 expands the use of blockchain, even more, disrupting, in theory, such things as voting systems, attestation services. Even government administration could be remodeled into a more decentralized, self-managing model. The limit for the use cases of blockchain at this point of evolution of the technology is only the imagination. (Dai, 2017)

2.3 Combining the two

2.3.1 New accounting system and updated audit

Jun Dai in her dissertation “Three Essays on Audit Technology: Audit 4.0, Blockchain, and Audit app” talks about different ways how the field of financial audit could change in the foreseeable future. The author of the dissertation presents three essays in which she describes such rather new technologies as Industry 4.0, blockchain, as well as apps, which in her view could impact on the domain of audit. For the purposes of this thesis we will concentrate on the first two essays.

In the first essay in the dissertation, the author of the research outlines the evolution of auditing as profession by going through the stages from Audit 1.0, also known as the very traditional audit which for many centuries has been fulfilling many needs, to Audit 4.0, which, in Dai’s opinion, would significantly transform the profession of auditing as a whole with the help of automatization of current procedures as well as expansion of their scope and shortening the timing which all could lead to better and improved assurance quality. Furthermore, she proposes a definition for the concept of Audit 4.0 by analyzing the possible impact of the fourth industrial revolution on the auditing profession by covering such emerging technologies as the Internet of Things, Internet of Services, Cyber-Physical Systems, and smart factories. In addition to that, the researcher connects those two (Audit 4.0 and the emerging technologies) with six technological principles of the Industry 4.0:

1. interoperability - when systems talk to each other; the author brings the possible future interaction of cars and traffic lights as an example which could optimize the movement of vehicles and lower carbon emissions;

2. virtualization - creating a virtual copy of information of smart objects which would enable a value chain that is more transparent and easily audited; as an example of this kind of virtual environment Dai brings up so-called mirror worlds, “informationally-enhanced virtual models (..) of the physical world”, which in her view could greatly scale down audit professional’s fieldwork as well as operate as an independent party which would be facilitating and evaluating accounting information. We will cover these in more detail later on in this part;

3. decentralization - with business models becoming more and more complex in their nature and technological ground it is important to understand how decentralization would be able to aid in the problem of optimization;

4. real-time capability - in the context of technological advancements it is particularly important to be able to conduct continuous monitoring process in order to make various decisions in real time;

5. service orientation - services that are available to use to other participants than the companies and other parties that created them; in terms of Auditing 4.0 this principle could come handy in order to facilitate interactions of auditors and other service providers;

6. modularity - systems incorporating such principle are keen to be very adaptable to change environments and requirements constantly.

She identifies the concept of Industry 4.0 as a manufacturing environment which allows fundamental improvements of various industrial processes, be that manufacturing, material usage, engineering, etc. (Dai, 2017:6)

Dai then presents several challenges that might occur. First of all, she explains how Audit 4.0 with all the benefits of digitalizing, optimizing, virtualizing the audit process could be used in a digital crime by demonstrating an example of RFID (radio-frequency identification) chips and the case of their fraudulent use. Second, she raises a concern in regard to data security and privacy in terms of company wise data exchange. However, the author points out the issue in question could be tackled by encrypting the sensitive information before transferring it anywhere. Finally, Dai points out the problem of standardization of data as nowadays it comes in a variety of formats and cleansing it is compound, complicated, time-consuming. (Dai, 2017: 30-58)

In the second essay, the author of the dissertation discusses the possibility of implementation of blockchain in accounting and as a consequence audit. In her point of view, the potential benefits of blockchain in the two mentioned domains are under-explored. Furthermore, by presenting the idea of creation of a new accounting system – triple entry accounting instead of the conventional double entry one – Dai suggests several points how the process of accounting could be improved and made more secure

and trustworthy. Additionally, she proposes to apply blockchain to the process of assurance in order to, among others, increase the audibility of information, as well as to make it possible to use of smart controls which would enable close to real-time assurance. We will now explore more details about how this could be implemented. (Dai, 2017: 59-84)

As it was mentioned before, the second essay covers the introduction of an idea of a new accounting system based on blockchain and as a consequence development of continuous assurance with blockchain using smart controls.

To begin with, lets discuss the proposal for a new accounting system. Blockchain based accounting system incorporated with smart contracts has a potential to disrupt the way the accounting is done nowadays by increasing the verifiability of business data, providing options to share data with interested parties instantly, and storing the data itself in a secure manner. In addition to that, it would not only provide information about the transactions themselves but also it would allow us to explore the flow of accounting data within the company.

The proposed triple entry accounting is being discussed as a paradigm which would enhance the reliability of corporations' financial statements. Originally, according to Dai (2017), when this new system was introduced for the first time, the system itself was based on the idea to have a trusted third party as an intermediary to facilitate to verification of the transactions. However, with blockchain technology, the need in this kind of intermediary is eliminated.

Thus, Dai (2017) suggests blockchain based triple entry accounting system which would work as follows (see Figure 2 for the graphical representation of the proposal):

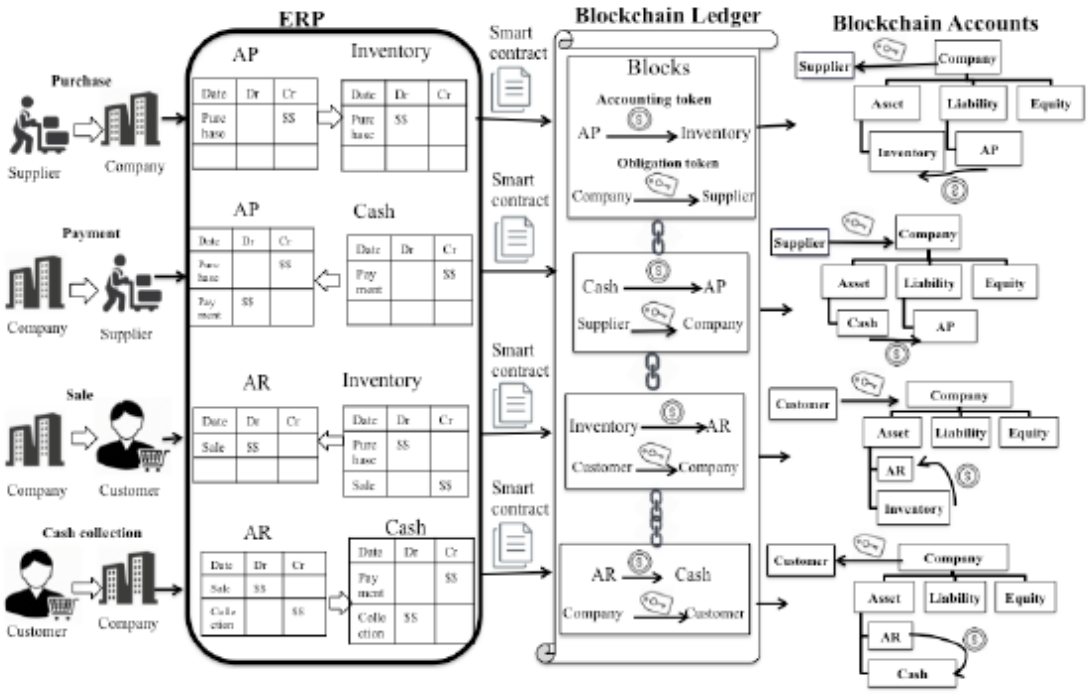

Figure 2. A triple entry accounting information system (Dai, 2017:66)

According to the presented Figure 2, the system would make a record of the information of the business transactions and the data flow. Thus, additionally to the traditional double entry system, every transaction would be stored in the blockchain ledger as a record which would be presented as a transfer from one account to another. The accounts would be arranged in a hierarchical system which would allow the aggregation of data at different levels. Furthermore, it will be possible to investigate possible errors and fraudulent entries in the accounts in a timely manner as well as allows for automation of the process of verification of the transactions.

Figure 2 presented above illustrates an example of an ordinary purchase-sell cycle. In this situation, a company obtains goods from the supplier using credit, which would be then recorded in the Account Payable and in inventory in the ERP system. At the same time, this transaction would be submitted to the blockchain ledger as a transfer of digital token which is considered for recording and tracking purposes. After the submission the network participants would perform verification procedures to establish the authenticity of the recording be the company's ERP system, posting of the transaction, asset transfer, correctness of the amount and the account, and posting party validity. Due to the nature of the information handled in the aforementioned example, such an ecosystem could only be viable in case of permissioned blockchain when only some individuals are

granted rights of use which could cause complications when designing the system so that it would fit all. (Dai, 2017: 63-73)

We are now moving on to the applications of blockchain in the domain of assurance.

As it has been stated before, the technology of blockchain incorporated with smart contracts could cause the field of assurance to undergo fundamental changes as it would allow for the creation of a verifiable and tamper-proof ecosystem.

One of the main benefits of such infrastructure is the increased auditability of the information. Due to the fact that the blockchain ledger allows to store the data securely it could also help with some audit-related documents. As an example, Dai (2017:74) gives a situation when the process of inventory is conducted so that each item is registered in the blockchain at the time of arrival to the warehouse and the information about this item is continuously updated generating a history of the item in the system. Such a registry would be able to provide the user with real-time inventory for the inspections. In addition to that, in order to speed up the process of examinations, audit trails could be documented on blockchain.

According to Dai (2017:74-75), another way how blockchain technology could disrupt the domain of assurance is the implementation of smart controls. In her view, it is no longer enough to conduct an audit on a quarterly or annual basis as businesses nowadays do not operate like that. Moreover, she believes that it would be more meaningful for the businesses if auditors could provide a more near to real-time assurance. However, due to the number of transactions skyrocketing in recent years, it is no longer possible to provide a near real-time assurance due to the manual nature of the auditors' work. Thus, she suggests the implementation of smart controls which would work as follows: managers and auditors would set the firm-specific controls into smart contracts which would track the implementation of the controls; in the case when something goes wrong, it could be instantly corrected. It is, however, worth mentioning that some sort of authority oversight is required in such kind of system in order to make sure that the companies comply with the law and are not doing whatever they want. Additionally, it is important to understand that in such a scenario when most of the audit processes can be automated and the role of accuracy verifications would decline, the idea of complete abolishment of auditing as a profession is an overstatement as eventually the need for their oversight would increase. Furthermore, according to Dai (2017:76), the aim of the auditing world

would switch from verification and record tracking to more consultancy-like tasks (systemic evaluation, risk assessment, etc.), and fraud detection.

Lastly, Dai (2017:77-79) proposes to connect blockchain with Audit 4.0.

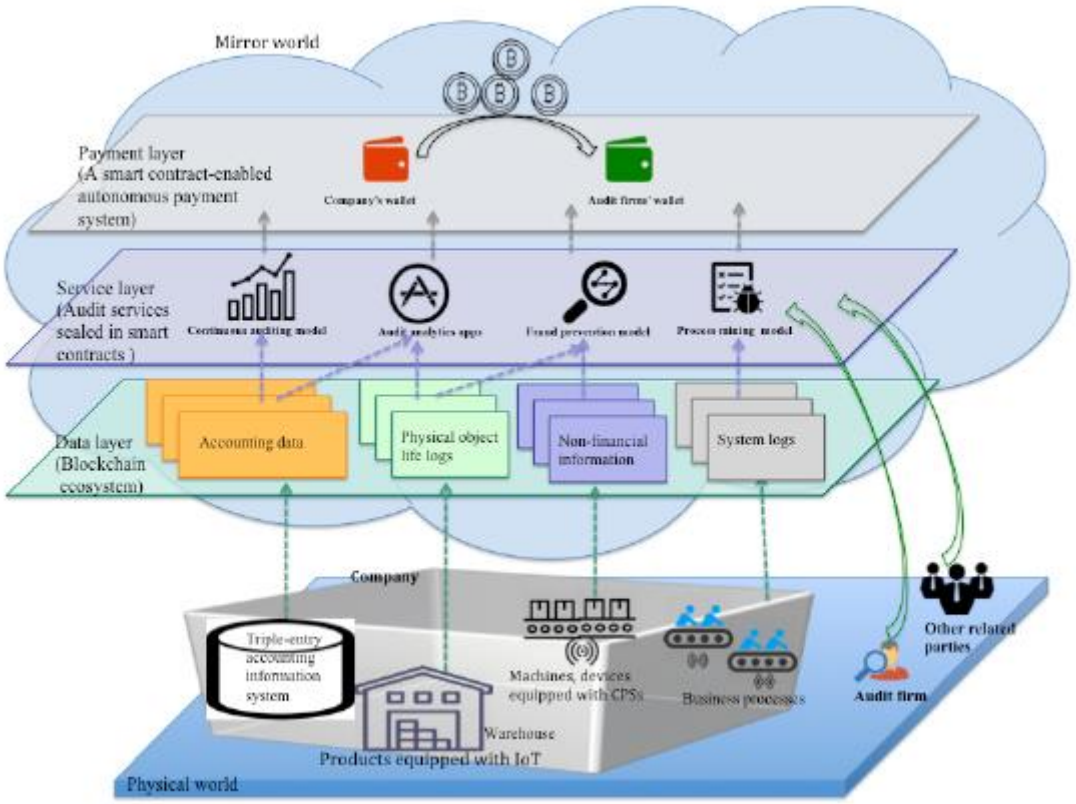

Figure 3. The vision of blockchain based Audit 4.0 assurance environment (Dai, 2017:77)

As it could be seen from Figure 3, in blockchain based Audit 4.0 assurance ecosystem could be divided into two parts: the physical and virtual world. Every significant object in the physical world has a representation in the virtual mirror world. The latter one consists of three layers – data (handles the records of information needed for audits), service (grants the possibility for the auditors or other experts to provide various services by implementing the smart contracts), and payment (an automatic payment environment where transaction would be completed using smart contracts after, for instance, the pre-agreed audit services are done).

As much as proposed technological improvements have potential to, in theory, disrupt the whole profession of audit and assurance, one should understand the challenges in bringing the ideas to life and to full utilization. According to Dai (2017:80-83), there could

be outlined three major challenges when trying to implement such great changes. First, the technological context we nowadays live in. In order to be able to operate in blockchain flawlessly and without complications one needs great amount of resources and computational power in addition to the knowledge of the know-how from the personnel. Second, it is the organizational context when for example in large corporations complex changes such as switching to blockchain could end up being rather difficult and costly. Finally, the environmental context when the regulators are expected to influence greatly on the process of adoption of blockchain in the domains of accounting and audit. (Dai, 2017:77-79)

2.3.2 Professionals' point of view

Let's now focus a bit on the opinion of the professionals working in the field.

A research prepared by Chartered Professional Accountants of Canada (CPA Canada) and the American Institute of CPAs (AICPA) called "Blockchain technology and its potential impact on the audit and assurance profession" suggests several opportunities of how such a technological advancement as blockchain could evolve the professions of audit and assurance. As a matter of fact, they propose four new possible functions (though they do emphasise on the imaginative side of the situation as the list is supposed to be "illustrative only and not all-inclusive") for auditors to take up if the technology of blockchain is to be vastly accepted. (Aicpa.org, 2017)

First on the list comes the idea of auditing of smart contracts. In cases when processes are automated the contracting parties might want to make sure that the smart contract in use are constructed in accordance with the business processes as well as do not have unexpected errors or other vulnerabilities. This would require auditors to obtain rather specific knowledge about technical programming languages on top of the understanding of the functions of blockchain. (Aicpa.org, 2017)

Second, on the list comes the idea of service auditor of consortium blockchains. The main idea behind such an auditor function would be the possible need of an entity for an independent examination of already existing blockchain based products prior to subscribing to it. On a continuous basis, such an independent party could be needed to provide assurance to ensure the effectiveness of private blockchain controls. (Aicpa.org, 2017)

The third opportunity for auditors would be the role of a system administrator. In this role, auditors would be responsible, for instance, for granting access to the blockchain based system to users. In order for the administrator to verify the users' identity, the information has to go through a process of vetting. In addition to that, as a trusted third-party auditor could ensure the trust in the blockchain system. (Aicpa.org, 2017)

Finally, in situations when complex business arrangements end up in conflicts auditors as arbitrators could help to resolve the issues. Especially when talking about consortium blockchain-based applications participants of which might require a trusted third party again to enforce the terms of the contract. According to the research, this function would require conducting further considerations to whether the need to it actually exists. (Aicpa.org, 2017)

In general, when talking about the reliability of transaction information recorded in a blockchain one should be aware of the fact that even though blockchain makes sure the chain is inalterable after the information has been submitted to the chain it still could be untrustworthy information. As examples presented in the research, such transaction data could be generally unauthorized, fraudulent, or even illegal, or linked to an agreement on the side (so-called off chain agreement), or occurred between related parties, etc.

Another research conducted on a similar topic examines the way the mentioned technology could be affecting auditors' work. Connor Ortman (2018) from the Claremont McKenna College in his paper "Blockchain and the Future of the Audit" describes an interview with Will Bible, a partner at Deloitte who specializes in audit innovations.

According to the cited interview, Bible expressed concern regarding recording transactions on the blockchain, especially in large corporations. According to him, the transaction handling processes are in many large firms way too ingrained into the legacy ERP and CRM environments and kick-starting a switch could be rather complicated. Furthermore, he believes the most return on investment companies would to get out of this change of systems would be lowered audit fees, which in many cases are not the main line of expense. Thus, Bible sees no rush for big corporations to alter their legacy systems. (Ortman, 2018)

In addition to that, Bible points out that even if the blockchain is to be adopted, taking into account modern environment, all transactions would need to be stored in two places

simultaneously, which causes inefficiencies and is portrayed as redundant. Thus, it would require a company to completely change the legacy systems completely to eliminate such redundancy, which, again due to cost constraints, is highly unlikely. (Ortman, 2018)

Bible further elaborates that companies do not create their systems to help auditors. On the contrary, firms create technical environments to suit their needs. Thus, taking into account the fact that the profession of auditing is mainly customer service, it is auditors' job to adjust and adapt to the client's environment. Sure, there will be companies that operate on blockchain from the beginning, and only in those cases, it would be reasonable to think about adjusting the accounting systems. (Ortman, 2018)

3 Research analysis and results

In this chapter we will cover the following: In chapter 3.1 we will have a recap of the key findings from the research conducted. In chapter 3.2 an analysis and reality check will be conducted in order to evaluate the research outlines.

3.1 Key findings

To recap all that has been said, it would be beneficial to outline the key findings of this research. So far, we have talked about what is a financial audit, conceptualized the idea of blockchain, as well as looked at some researches that were examining the possibilities of implementation of blockchain in the domains of audit and assurance.

In chapter 2.1, we defined that the main point of the audit is to ensure that the financial reporting systems are in order and that published accounts are sufficiently trustworthy. Moreover, we described the four steps of the assurance process – acceptance and planning, conducting risk assessment through understanding the businesses' nature, gathering evidence in order to conduct the engagement procedures, and finalizing and reporting. Additionally, we pointed out the possible limitations of financial audit, namely human error when selecting, performing, and evaluating the procedures, and time and resource constraints which do not generally allow to perform 100% testing of controls. Finally, we mentioned what could happen if management, with the help of auditors, tries to conceal the real financial situation of the company using the Enron scandal as an example.

In chapter 2.2, we identified that blockchain is much more than just the backbone of a cryptocurrency. In the technological background, we mentioned that blockchain is simply put a chain of blocks that are connected using hashing technology, and it could not be altered after the block is in the chain. The concept of blockchain is portrayed to be decentralized, persistent, anonymous, and auditable. We then looked at what are smart contracts – electronic computable contracts which execute the contractual conditions automatically when the conditions for it has been met. Furthermore, we outlined that this kind of smart contracts could eventually make the trusted third party unnecessary in contractual dealings. Lastly, we went through the evolution of blockchain from 1.0 (the stage of trade of cryptocurrencies only), to 2.0 (broadened scope of trade, allowing the

use of smart contracts which at this stage allow even more automation), to, finally, blockchain 3.0 (the stage when the technology of blockchain could potentially disrupt voting systems, or attestation services allowing the idea of remodelling of the government).

In chapter 2.3, we reviewed three research papers discussing the possibilities of implementing blockchain into the domains of audit and assurance. In the first one, Jun Dai in her dissertation "Three Essays on Audit Technology: Audit 4.0, Blockchain, and Audit app" talks about different ways how the field of financial audit could change in the foreseeable future. While examining the dissertation, we focused mainly on the two essays of the dissertation. First of them talked about the evolution of audit as a whole in the context of the fourth industrial revolution (she identifies six key technological principles that would have an effect on audit – interoperability, virtualization, decentralization, real-time capability, service orientation, and modularity). Dai also outlines challenges for this concept mentioning that it could be used in a digital crime using the RFID chips as well as points out the issue with lack of standardized data formats as nowadays it comes in a variety of formats and cleansing it is compound, complicated, time-consuming. In the second essay, in order to increase the verifiability of business data, provide options to share data with interested parties instantly, and store the data itself in a more secure manner Dai suggests a triple entry accounting which in addition to the conventional double entry registry would also submit transaction data into the blockchain. Consequently, if such new accounting system would be implemented, there would be a need for the assurance possesses to be adjusted accordingly. In her view, the concept of blockchain based assurance would increase the auditability of the information, with the use of smart controls it would allow near real-time assurance, as well as automate most of the auditors' manual tasks. Lastly, Dai outlines three main challenges in bringing the ideas to life and to full utilization, namely, in order to be able to operate in blockchain flawlessly and without complications one needs great amount of resources and computational power in addition to the knowledge of the know-how from the personnel, as well as switching to blockchain could end up being rather difficult and costly, not even mentioning the fact that the regulators are expected to influence greatly on the process of adoption of blockchain in the domains of accounting and audit.

Second research in chapter 2.3, called "Blockchain technology and its potential impact on the audit and assurance profession," was prepared by the Chartered Professional Accountants of Canada (CPA Canada) and the American Institute of CPAs (AICPA).

They analyse how such a technological advancement as blockchain could evolve the professions of audit and assurance and as a result suggest new possible functions for auditors to take up – auditing of smart contracts, consortium blockchains, system administrators, and arbitrators.

Last research in the chapter describes an interview with Will Bible, a partner at Deloitte who specializes in audit innovations, who raises concerns regarding the idea of recording transactions on the blockchain as in his view it would be too complex for many companies and not worth the investment, as well as he does not see a point to store data simultaneously in two places as it causes redundancy and is inefficient.

3.2 Analysis and reality check

As we can see from the research presented above, there is no clear and unanimous opinion on whether or not the idea that blockchain, when implemented into the domains of audit and assurance, would definitely benefit society.

As it has been mentioned before, on the one hand, we have the idea of automation of the manual processes of gathering the data required for conducting the engagements as well as speed and timing. However, on the other side, we have a whole bunch of challenges and issues slowing the processes down.

For one, we would have the problem of trust. It is natural with all things that are new to seem untrustworthy at first. As auditors as seen to be the ones who act as a trusted intermediary between the company and the public and government, it might get tricky at some point to explain that instead of conventional manual checking of the books there would be a smart electronic control in place doing that job for them. Time has to pass for people to adapt to the idea that blockchain is a thing and that I can be trusted as well as their own solutions that they use currently.

Another issue is the environmental factor. We live in a society which is yet not ready to make the leap of faith towards a complete digitalization of the financial industry. In many countries still, till this day credit cards even if exist as a mean of paying for goods and services not necessarily so common. As it was mentioned before, it is the regulators who will eventually have to push for the change.

Moreover, if we look at the technological aspect of the matter – nowadays it is very expensive to have a blockchain system rolling as it requires a lot of computational resources. Until some sort of a solution is created to bring the cost of maintenance down, it would not be worth for companies even to try to implement blockchain into their systems.

Last but definitely not least is the problem of security. There have been talks about the creation of different kinds of blockchain systems – permissioned and permissionless. According to their names, the first one is open only to a small number of vetted users, and the other one is open to anyone. In such political regimes as in China, for instance, the government would surely want to control what kind of dealings companies make with each other. And in that case, it would ease the work for the government to arrange observation and lurking.

Regardless, it feels too early to say anything concrete to whether this would actually work or when it could be implemented. The main point would be that the potential is huge; the other question is the implementation.

4 Conclusion

The purpose of this thesis was to answer a question how the technology of blockchain could change financial audit. Even though the research did not give a comprehensive and one-sided answer, we managed to look at the issue from different perspectives.

In order to answer the question, we explored the concepts of audit and technology of blockchain. We identified what is the financial audit, what are the four steps of the process of assurance, and what are the possible limitations of the financial audit. As for the concept of blockchain, we identified the definition of blockchain, looked at the technological background of it, as well as Ethereum and smart contracts, and went through the evolution of blockchain from 1.0 to 3.0.

In addition to that, we went through several research papers the authors of which propose different suggestions to how the technology of blockchain could be implemented into the domains of audit and assurance. Namely, a proposal for creation of a new accounting system (a triple entry accounting instead of the conventional double entry one) and as a consequence having the auditing possesses conducted with the use of blockchain; a research prepared by the Chartered Professional Accountants of Canada (CPA Canada) and the American Institute of CPAs (AICPA) evaluating the potential impact on the audit and assurance profession; Last research in the chapter describes an interview with Will Bible, a partner at Deloitte who specializes in audit innovations, who raises concerns regarding the idea of recording transactions on the blockchain for several reasons.

As a result, it is important to point out that due to the limitations of this research it is highly encouraged to conduct further research on the topic of implementation of blockchain into the domains of audit and assurance, as this field has a lot of potential.

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