



SCHOOL OF
ECONOMICS AND
MANAGEMENT

Big Data Analytics effects on audit processes and audit competence

- *Perspectives from audit practitioners*

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We wish you a pleasant reading!

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Abstract:

Title: Big Data Analytics effects on the audit processes and audit competence - Perspectives from audit practitioners

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Keywords: Audit process, audit competence, professional judgment, Big Data Analytics (BDA).

Purpose: The purpose of this study is to add further knowledge and deepen the scarce and deficient empirical understanding of how BDA, from the practitioner's point of view, affects audit processes and audit competence.

Theoretical perspectives: The theoretical foundation is based on previous literature on BDA, audit processes, audit competence, and professional judgment. The chosen theoretical framework is Technology Acceptance Model (TAM) that facilitated the understanding on how BDA affects the audit process and audit competence.

Methodology: A qualitative research method with an exploratory design with eight semi-structured interviews from big-4 accounting firms in Sweden has been chosen in order to answer the research question. A literature review was conducted on the topic where the authors discovered deficient empirical understanding of BDA impact on audit processes and audit competence. A thematic analysis was used to analyze the gathered data.

Empirical foundation: Eight interviews have been conducted, constituting of four junior auditors and four senior auditors.

Conclusion: BDA effects audit process by removing repetitive tasks, increasing efficiency in audit engagements, and enhancing the understanding of clients' businesses. Moreover, perceived usefulness and perceived ease of use of BDA among auditors and clients determine the actual use of the technology in the audit process, where the study concludes that senior auditors indicate a more reluctant perception of new BDA tools. The increased BDA implementation reshapes the required competence that auditors should possess, as well as it threatens to expand the already existing expectations gap and lead to deprofessionalization.

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List of Abbreviations

ACCA	Association of Chartered Certified Accountants
AICPA	American Institute of Certified Public Accountants
BDA	Big data analytics
Big-4	Deloitte, EY, KPMG and PwC
CAAT	Computer Assisted Audit Techniques
FRC	Financial Reporting Council
GDPR	General Data Protection Regulation
IAASB	International Audit and Assurance Standards Board
IFRS	International Financial Reporting Standards
IIA	Institute of Internal Auditors
IOS	International Organization for Standardization
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action

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1. Introduction

The first chapter will narrate the background to the topic where the authors present how Big Data Analytics (BDA) has evolved, and the status quo on how BDA is used in the audit process. Furthermore, the problematization will be presented where the authors present what contemporary research has found on the topic and what needs to be further researched. This is followed by contribution to existing research gaps, and finalizes with purpose, question formulation, and delimitations of the study.

1.1 Background

Auditing is often viewed as something that the firm must perform to comply with standards and regulations, and firms often neglect the underlying reason to conduct an audit. However, in times of corporate scandals, regulators, society, and the business world is often harshly reminded of what the underlying meaning of the audit is, to ensure trust, reliability, and audit quality in the company's reports (IAASB, 2014; 2017). Corporate scandals have cost investors billions of dollars, and have disrupted the investors' confidence in the integrity of the financial market. These scandals are obviously not always the product of bad audit procedures, nevertheless, several anecdotal examples highlight the fact that auditors have a pivotal role to play in these events, such as Enron, Lehman Brothers, and more recently Wirecard (Power, 2003; Alles and Grey, 2015; Storbeck, 2021).

To understand how the audit influences these events, one must understand how a modern audit process is performed. The objective of an audit process is to identify patterns in company records, both financial and non-financial. The regulations are being reviewed to adequately guide audit processes and procedures to gather sufficient evidence. This process is subjective to the auditors' ability to assess the evidence (Adrian and Viorica, 2015). The modern process in audit consists of five phases: pre-audit engagement, planning, audit strategy and plan, execution phase, and finalization or reporting of the findings to relevant stakeholders (Appelbaum, Kogan and Vasarhelyi, 2017; PwC, 2017). As of today, technological advancements, most prominent and recently, BDA have been extensively discussed by regulators, academics, and practitioners within the auditing sphere. The reason behind this extensive discussion is because this technology will revolutionize the industry

(ACCA, n.d; AICPA, 2014; IAASB, 2017; Salijeni, Samsonova-Taddei and Turley, 2019), and “BDA will act as a game-changer in innovating audit practice and improving audit quality” (De Santis and D’Onza, 2021, p. 1088). BDA refers to the process of extracting appropriate information from big data¹, where the latter is characterized by the collection of substantial data sizes, *volume*, in a very fast way, *velocity*, from almost infinite amounts of data sources, *variety* (Cao, Chychyla and Stewart, 2015). Accordingly, implementation of BDA into the audit process provides auditors with appropriate and adequate information, enhanced accountability and efficiency in fraud detection, and credible audit engagements (Alles and Grey, 2015; IAASB, 2014; 2017; Salijeni, Samsonova-Taddei and Turley, 2019).

Henceforth, the importance of the BDA development is demonstrated by the Big-4 firms’ investments and research projects within the technology (Salijeni, Samsonova-Taddei and Turley, 2019). KPMG is developing new BDA tools, committing 5 billion dollars (KPMG, 2019a), EY is in the process of developing a BDA tool called Helix (EY, 2021), PwC is currently developing several BDA tools such as Halo, Connect, Aura and Extract (PwC, n.db) and, Deloitte is promoting new BDA tools which will change the audit methodology² (Deloitte, 2018). Contrary, smaller audit firms are excluded from this extensive development due to a lack of financial resources to invest in expensive BDA tools (Salijeni, 2019).

De Santis and D’Onza (2021), claim that BDA reshapes the way financial statements and financial audits are performed, making them more efficient and effective (IAASB, 2014; 2017; ACCA, n.d). The reason for this is because Big Data makes it possible to collect and analyze substantial datasets from various sources (De Santis and D’Onza, 2021; Cao, Chychyla and Stewart, 2015). The implication for audit practitioners is that by implementing these new techniques auditors can analyze 100%³ of the transactions, use text mining tools to interpret unstructured data such as press releases and analyze internal controls on a much larger scale than before (De Santis and D’Onza, 2021). In parity with BDA reshaping the audit process, auditors must gain and learn new competencies and skills in order to cope with the new BDA tools introduced in the audit, otherwise, the audit process risk of becoming

¹ Big data refers to datasets, too large for traditional data software and constitute an environment where almost everything can be recorded (Cao, Chychyla and Stewart, 2015). Big data will be discussed further in section 2.3.

² Audit methodology is an expression that is used within the audit literature to describe how an auditor performs his or her working tasks (e.g. in De Santis and D’Onza, 2021; Salijeni, 2019).

³ “Investigate 100 % of the population” or “Investigate the whole population” or similar phrases are common expressions used in the audit literature to highlight the difference between testing transactions based on samples and test transactions using BDA tools which can process much larger datasets (e.g. in Salijeni, 2019).

fragmented since some tasks are performed by a data scientist and just delivers the result to the auditor (Brown-Libur, Issa and Lombardi, 2015; Salijeni, 2019).

1.2 Problematization

The rise of BDA in the audit methodology is a new phenomenon that has contributed to auditors' ability to capture, record, and measure almost infinite amounts of data in the audit engagement. In comparison to older statistical sampling, BDA allows auditors to track multiple transactions (IAASB, 2014; Buhl et al., 2013; Cao, Chychyla and Stewart, 2015). BDA in the audit methodology examines Big data to identify and assess information for instance risk assessment, bankruptcy assessment, managerial fraud, and “*identifying and assessing the risks of material misstatement*” (Cao, Chychyla and Stewart, 2015, p.424). Moreover, BDA allows auditors to test 100% of populations instead of being limited to test assorted parts of a gathered material and “*to fully verify transactions*” (Salijeni, Samsonova-Taddei and Turley, 2019, p.106). Additionally, Yoon et al. (2015) accentuate that BDA in audit works as a supplement to traditional audit evidence in which BDA enhances audit quality by collecting sufficient, reliable, and relevant material. Salijeni, Samsonova-Taddei and Turley (2019) and Salijeni (2019) emphasize that the introduction of BDA in audit processes has moved the repetitive tasks, previously assigned to auditors, to be carried out by the system, and the auditor can focus on complex tasks that require more competence and professional judgment⁴. It is argued that BDA can be seen as a tool that provides “*utility to the auditor's professional judgment*” (Salijeni, 2019, p.33).

Literature describes many benefits of BDA implementation in the audit process (Cao, Chychyla and Stewart, 2015; Salijeni, Samsonova-Taddei and Turley, 2019; Yoon et al., 2015; Salijeni, 2019). However, besides the perceived benefits of BDA in the audit methodology, the research emphasizes that the benefits are extensively conceptual and that the area of research refers mainly to theoretical benefits and shortcomings, and as of today, the practical implication of BDA remains salient (Salijeni, 2019; Brown-Libur, Issa and Lombardi, 2015; De Santis and D'Onza, 2021). Research has neglected how technological development within BDA has affected audit practice in audit firms. In regards to the nascent era of BDA in the audit process (Buhl et al., 2013), and the deficient empirical research, researchers accentuate the necessity of increasing understanding from an empirical

⁴ Professional judgment in this thesis is defined as a subcategory within audit competence, the concept is further explained in chapter 2.5.1.

viewpoint, of how audit process and competence are affected by BDA (Salijeni, Samsonova-Taddei and Turley, 2019; Brown-Liburd, Issa and Lombardi, 2015; Salijeni, 2019).

Furthermore, De Santis and D'Onza, (2021) argue that the introduction of BDA will essentially change the financial statements and audit processes performed. Due to this change, literature argues that the introduction of BDA in the audit methodology reshapes the required competence the auditor should possess to manage the daily operations (Brown-Liburd, Issa and Lombardi, 2015). The authors emphasize that the problem with this change of competencies is essentially that auditors do not possess the required skills. More specifically, the practitioners in the audit firms often have inadequate competencies to handle large amounts of information, and therefore usually struggle with information overload and have a hard time recognizing relevant information (Salijeni, 2019; Brown-Liburd, Issa and Lombardi, 2015; Appelbaum, Kogan and Vasarhelyi, 2017). Additionally, the authors emphasize that the auditors do not have adequate programming competence to actually perform relevant BDA audit tests, resulting in IT experts performing the test and just communicating the results to the auditor.

BDA in the audit methodology is motivated by rationales, however, as accentuated by literature, the empirical understanding of this topic is deficient and is predominantly conceptual, which calls for research on how it affects the practitioners in the audit. As of today, research has failed to provide knowledge and understanding of what implications BDA has on the audit processes from a practitioner standpoint, and how it affects required competence which underlines the necessity for future research in this area (Salijeni, Samsonova-Taddei and Turley, 2019; Salijeni, 2019; Brown-Liburd, Issa and Lombardi, 2015; De Santis and D'Onza, 2021).

Although many scholars mention the fact that BDA will increase the quality and efficiency of audit processes, the implementation of BDA is dependent on how it is perceived by the practitioners (Razi and Madani, 2013; Al-Ateeq et al. 2022). Scholars mention that even though the enhancing effects of BDA, the perceived usefulness and perceived ease of use of the technology (BDA) will determine to what extent BDA will be implemented in the audit process. Additionally, Al-Ateeq et al. (2022), stress that there is a shortcoming in the literature on practitioners' perceived usefulness and ease of use of BDA in the audit process. Hence, by using Technology Acceptance Model (TAM) as a theoretical framework, this study

contributes to deficient research on this topic and will facilitate the understanding of what effects BDA has on audit processes and audit competence, from the practitioner's viewpoint.

By studying the implications of BDA in the audit process from a practitioner's point of view, this thesis will contribute to the scarce amount of literature on how BDA affects audit processes and audit competence. By providing an empirical investigation of this issue, the thesis answers existing research gaps on the salient practical understanding of BDA and its impact on audits. Additionally, the thesis outset from the practitioner's point of view has practical contributions as well. By using TAM as a theoretical framework, the thesis will shed light on where audit firms need to put more effort to enhance usability and ease of use among the practitioners to implement it more in the audit process and also facilitate for audit firms to point out what hinders them to implement BDA in the audit processes.

Furthermore, the implementation of BDA in the audit process is dependent on country-specific peculiarities such as cultural and regulatory environments. Moreover, the question of implementation is dependent on company-specific characteristics, where larger audit firms tend to use and invest in BDA tools to a greater extent (Salijeni, 2019). Accordingly, Salijeni (2019) and De Santis and D'Onza (2021) point out that future studies should aim their focus on the country-specific level, and firms operating in homogeneous business environments that facilitate BDA to a similar extent to gain a deeper understanding of BDA's impact on the audit process and audit competence. Hence, this study will focus on the Big 4 accounting firms operating in Sweden.

1.3 Purpose of the study

The purpose of this study is to add further knowledge and deepen the scarce and deficient empirical understanding of how BDA, from the practitioner's point of view, affects audit processes and audit competence. In order to fulfill this aim, the study asks the following research question:

How does BDA affect audit processes and audit competence?

1.4 Delimitations

The outset of the study is the Swedish context which brings in delimitations of the thesis. Previous research underlines that outcomes of BDA implementation in the audit process vary

across firms and countries (Salijeni, 2019), hence, the presented findings could thus be different if the authors would have altered the interviewing firms and from another country. Moreover, the question of BDA implementation is a monetary question, and since the companies introduced in this thesis belong to the largest audit firms in the world, the conclusion also might have changed if smaller companies with less financial resources would have been introduced (Salijeni, 2019; Vasarhelyi, Kogan and Tuttle, 2015). This means that the findings of this study are of limited application to other firms than those of larger sizes and the study can not depict how BDA affects the whole spectrum of audit firms. Furthermore, the thesis covers a relatively nascent area of research which inevitably entails a limited amount of accessible literature.

2. Literature review and theoretical framework

In chapter two, the authors account for previous research, theories and explain concepts that are relevant for this study. This section is divided into six parts, where the authors initially present theoretical delimitations. Furthermore, the authors present BDA, the current state of BDA in the Big-4 accounting firms, audit processes, and audit competence, finalizing with the theoretical framework TAM.

2.1 Literature delimitation

This section of the chapter aims to motivate the theoretical considerations of the study and highlight what main parts the section will contain in order to respond to the research questions. Research emphasizes that introducing BDA in the audit methodology has revolutionary effects, and acts as a game-changer in the way audit processes are conducted (De Santis and D'Onza, 2021), however, there is a need to deepen the understanding of the link between BDA and its impact on audit practitioners. Since the effects of BDA on the audit methodology are extensively conceptual, and the area of research refers mainly to theoretical benefits and shortcomings, practical implications remain salient, (Salijeni, 2019; Brown-Liburud, Issa and Lombardi, 2015; De Santis and D'Onza, 2021), the literature will cover parts of audit process where the audit practitioners involvement in the process is prominent and where BDA is used the most.

The audit process consists of five phases (PwC, 2017), and this chapter will focus on the phase in the audit process where the auditor's competence and professional judgment is most prominent, namely the execution phase (Knechel et al., 2013; Francis; 2011; IAASB; 2014; FRC, 2008)(see figure 1). The most prominent controls carried out by the auditor in the execution phase refers to (i) risk assessment, (ii) analytical and (iii) substantive procedures, and (iv) tests of internal controls which also are controls that are heavily influenced by BDA tools (IAASB, 2017; Knechel et al., 2013; FRC, 2006; 2008)(see figure 3). Moreover, BDA reshapes the required competence possessed by the auditor in the audit process. Hence, it is imperative to increase the understanding of how BDA reshapes the demanded competence and skills of the auditor in order to fully understand how BDA impacts audit from the practitioner's point of view. Additionally, since BDA is a new phenomenon in the audit methodology (Buhl et al., 2013), and that the topic of BDA and its implications on the audit

methodology from a practical standpoint is deficient (Salijeni, Samsonova-Tuddei and Turley, 2019; Salijeni, 2019; Brown-Liburd, Issa and Lombardi, 2015; De Santis and D’Onza, 2021), the delimitation to focus on this phase of the audit process and focusing on the audit competence, contributes to research since these aspects are focusing on the audit practitioner.

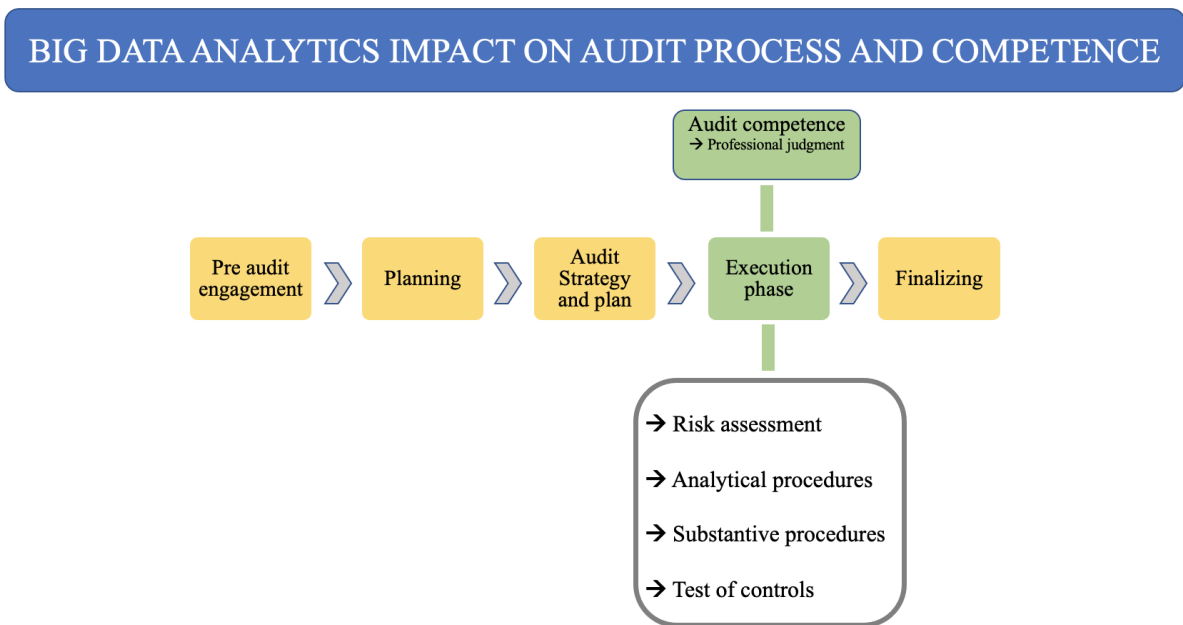


Figure 1: Illustration of the audit process. Highlighted in green is Audit competence and the subcategory, professional judgment. Also, the execution phase is the phase this thesis will focus on since this is the phase mostly influenced by BDA, and where audit competence and professional judgment is used most. Moreover, the four subcategories in the execution phase are highlighted in the bubble below.

2.2 Audit methodology and the objective of audit

The primary objective of auditing is to establish a high audit quality, and with an absence of it, the audit engagement is undermined (Mansouri, Pirayesh and Salehi, 2009). Audit quality has been on stakeholder’s agenda for a long period of time and traditionally “*audit quality is described to be the market-assessed joint probability that a given auditor will both (a) discover a breach in the client's accounting system and (b) report the breach*” (DeAngelo, 1981, p.187). DeAngelo (1981)s definition has two distinct elements which (1) refers to auditor's competence to discover misstatements in the financial figures and (2) the auditor’s objectivity to reveal and correct the misstatement when it is discovered (Knechel, 2016).

To meet the needs of users of financial information, the information has to be reliable and credible. Quality assured financial information is of high importance for stakeholders and the financial market, and for the financial figures to be reliable and credible, trust lies in that the

audit is of good quality (IAASB, 2014). Additionally, consistent audit execution and audit quality are crucial to establish confident and independent audit engagements. Independent auditors embody trustworthiness in the provided financial statements, which is done by gathering adequate and sufficient audit evidence (IAASB, 2014).

2.3 Big data analytics

Big data (See figure 2) is often characterized by the three V's; Volume, Velocity, and Variety. Volume represents the actual size of the data collected, meaning how much information does the dataset contain. Velocity essentially measures how fast the data is coming in, basically how fast and how up to date is the data collected. Variety refers to the multiplicity of the data sources, how many places and in what formats are the data collected in (Cao, Chychyla and Stewart, 2015). As of today, Big data reshapes the way businesses are managed to become more effective, agile, and customer-focused (Reinsel, Gantz and Rydning, 2018).

According to Appelbaum (2016), Big data has become a new business currency and corporations are now collecting more data than has ever been recorded. The data that is being collected is being considered by some scholars as a firm asset, and some authors claim that firms can increase their productivity by five to six percent by analyzing this data (Brynjolfsson, Hammerbacher and Stevens, 2011). However, the majority of the data is characterized as unstructured data from a variety of many sources, resulting in large flows of widely differing data that cannot be processed using traditional database management tools (Cao, Chychyla and Stewart, 2015). Big data is essentially just more information and larger datasets and therefore, big data by itself has no value if not used correctly (Gandomi and Haider, 2015). Therefore, hereafter this thesis will not discuss Big data extensively, but the focus in this thesis is on how the Big data is analyzed and used, i.e., BDA.

Troilo et al. (2016) emphasize that firms adopting BDA tools achieve an annual growth of seven percent compared to the expected growth of the firm of three percent when the firm did not adopt BDA tools. Furthermore, according to de Medeiros, Hoppen and Maçada (2020) the main benefits that are realized when a corporation adopts BDA tools is firstly that the firm's analytical capability improves, meaning that the organization's predictions become better and more trustworthy. Secondly, the organization's dynamic capabilities improves, resulting in better knowledge sharing, which helps the organization's understanding of the business environment and sensing opportunities. And lastly, the organization improves its

competitive advantage. The firm can improve its performance by utilizing the benefits that the competitors do not recognize. However, de Medeiros, Hoppen and Maçada (2020) also mention challenges that can occur when an organization adopts BDA tools. For example, the organization might have difficulties changing to a data-driven decision culture and some employees might be resistant to change. Furthermore, it might be difficult for the organization to have the appropriate data quality and information architecture to be able to achieve the mentioned benefits. Moreover, implementing BDA tools requires a substantial initial investment in both data science training for employees, but also in the actual hardware and tools that are being implemented (de Medeiros, Hoppen and Maçada, 2020).

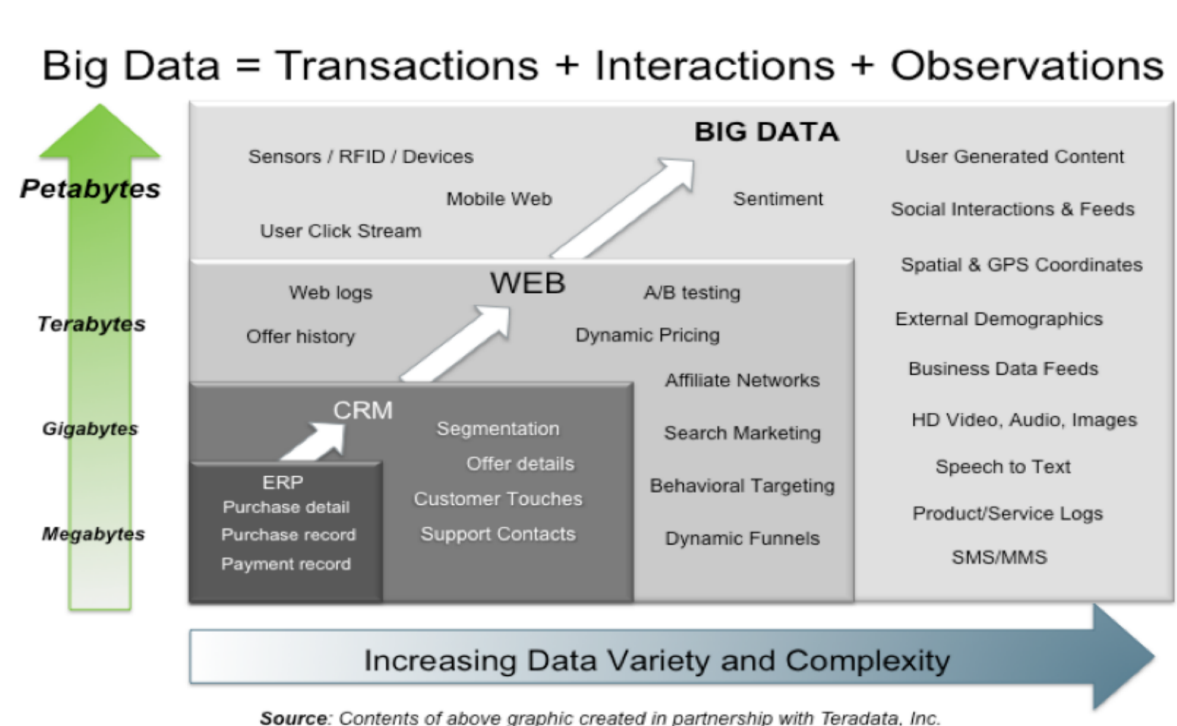


Figure 2: Connolly's' (2012) definition of Big Data Source: Alles and Grey (2015, pp.10).

2.3.1 Big data analytics in audit:

The concept of using analytical tools in the audit is not a new phenomenon. All major firms have since the 1960's been using some kind of Computer Assisted Audit Technologies (CAAT) with the purpose of detecting fraud and errors. However, from 2013 and forward, new developments have expanded, these new tools can capture value of an enormous amount of data that is collected (Salijeni, Samsonova-Taddei and Turley, 2019; Buhl et al., 2013).

Several studies underline that BDA has the ability to reshape the way financial statements in audit engagements are conducted to make them more efficient and effective (De Santis and D'Onza, 2021). Several definitions have been used to describe BDA, however, BDA in auditing can be summarized as *“the science and art of discovering and analyzing patterns, identifying anomalies, and extracting other useful information in data underlying or related to the subject matter of an audit through analysis, modeling, and visualization for the purpose of planning or performing the audit”* (AICPA, 2014, p.5). BDA differentiates from other tools that have improved the audit before since data science has taken major steps in how to analyze and collect huge amounts of data. Furthermore, De Santis and D'Onza (2021) claim that BDA has the possibility to influence every phase of the audit. For example, during the pre-engagement process, auditors have the opportunity to use text mining and text analysis tools to study press releases and social media networks to examine the reputation of a potential client or key individuals in the management.

Another benefit is that the auditor can investigate the internal controls using BDA. For example, the auditor can use process mining tools to conduct compliance tests that enable the auditor to identify violations of segregations of duties controls (De Santis and D'Onza, 2021). Additionally, another opportunity generated by implementing BDA tools is that the auditor can perform tests of transactions that expand to the whole population and not just a sample. The results from these tests can later be compared to similar firms in the same industry to investigate whether the firm differentiates from industry expectations and benchmarks (De Santis and D'Onza, 2021). Furthermore, Cao, Chychyla and Stewart (2015) also mention the fact that BDA has the possibility of improving the auditor's ability to identify and assess the risk of material misstatement through better understanding of the entity and its environment. For example, a better analysis of the firm's internal controls and evaluation of its effectiveness can be conducted. By implementing BDA in these work assignments, the auditor can, for instance, identify problems in regards to segregations of duties, hence, many risks can be eliminated before they even occur (Cao, Chychyla and Stewart, 2015).

Another benefit of BDA is that the auditor has a higher probability of detecting fraud. Alles and Grey (2015) justify this since the auditor will have access to several data sources and will be able to investigate a greater number of transactions. Accordingly, the authors claim that fraudsters will have more difficulties with committing and hiding fraudulent behavior.

In contrast to this, Earley (2015) and De Santis and D'Onza (2021) present the idea that auditors will have a higher degree of accountability when it comes to fraud detection. Traditionally, auditors have been able to point to the fact that they only audit a small sample of the transactions, and therefore it is impossible to be completely certain that fraud has not occurred. Although BDA tools allow an auditor to examine the whole population, malicious behavior that is complex might still go undetected. The risk will be that auditors will be held liable for events that they cannot control (Earley, 2015). Another risk with using BDA in auditing is that since Big data is collected from multiple sources, the analysis could lead to a greater number of false positives. If too many false positives are generated, this leads to information overload which in turn weakens the reliability of the audit since the auditor does not have the possibility to investigate every generated anomaly (Yoon et al., 2015). Additionally, these new tools require that the auditor will need much more data and information in order to actually utilize the benefits of the BDA tool. The problem is that clients might be reluctant to share nonpublic information and clients might be concerned with privacy issues once the auditor has received the data (Cao, Chychyla and Stewart, 2015).

Furthermore, another issue highlighted by Curtis and Turley (2007) is that some auditors might be reluctant to fully commit to these new tools. This results in over-auditing since the individual both performs the audit with the BDA tools, but also performs a traditional audit with sample testing. Moreover, Razi and Madani (2013) stress that it is more senior employees that mostly are reluctant to adopt new technologies since they are not sure that it will deliver the same results as the old systems. In a similar vein, Al-Gahtani (2008) stress that age is determinant factor that impacts the integration of technologies. The problem often lies within the understanding of the technique due to the fact that senior employees are often not used to practically working with the tools (Romney and Steinbart, 2017). Another challenge when trying to implement BDA is the regulations. IAASB (2017) emphasizes the fact that *“The ISAs were written in a completely different technological era. While the ISAs are not that old, there have been rapid changes in technological advancements in recent years, the breadth and scale of which was not and probably could not have been reasonably anticipated at the time that many of the ISAs were developed or revised (p.9).”*

2.3.2 Current state of BDA in Big-4 audit departments

The following section explains how the big-4 accounting firms describe their progress regarding BDA tools. It has been included since the data collected in this thesis mainly

derives from interviewed employees from the aforementioned firms, and to attain a broader understanding, documents and press releases have been studied.

KPMG: KPMG states that they want to enhance their leadership position in the digital transformation of professional services. They demonstrate this commitment by announcing that they expect to spend 5 billion US dollars during a five-year period (KPMG, 2019a). KPMG is currently using an audit platform developed with and powered by Microsoft and IBM called Clara. According to KPMG, the cloud-based platform is one of the leading innovations within the industry that enables an enhanced audit methodology through a data-driven workflow (KPMG, n.d). According to KPMG, the firm will be able to provide powerful insights that the audited company was not aware of due to the fact that Clara processes much larger datasets compared to traditional tools, *“KPMG Clara can unleash the potential of your data by helping you see meaningful patterns across business units and geographies, and at a deeper level than before, giving you a more holistic view of your customer and competitive environment”*(KPMG, 2017, p.4). Also, KPMG explains that they see innovation as a continuum of evolution, not a series of replacement parts. They highlight that Clara will only improve the more the application is used, and predictive capabilities will be developed as the firm takes information from multiple sources (KPMG, 2017).

EY: EY is also progressing when it comes to BDA in the audit. EY has developed an audit platform called Helix based on Azure Synapse Analytics and other PaaS technologies (EY, 2021). They point out that Helix gives their teams the ability to analyze large volumes of audit-relevant data, which allows them to derive richer insights and a deeper understanding of clients' financial close and business operations (EY, n.d). Furthermore, EY highlights that *“Building analytical models that produce high-quality audit evidence and valuable business insights across multiple business processes and industries is no small task. We are committed to addressing these challenges in order to deliver a high-quality and valuable audit”* (EY, 2017, p.3). Moreover, EY summarize the following benefits generated by Helix as gaining greater confidence in the financial reporting, they receive a better picture of the business activities since they analyze larger populations, they can better identify trends and anomalies, they have the possibility to give relevant feedback and insight and, they work more efficient thanks to their globally integrated data capture and extraction tools (EY, 2017).

PwC: PwC has developed a platform called Halo. PwC describes Halo as a multi-hosted server-based analytics platform that collects data from the client’s financial information

record system that later can be reviewed by the auditor at PwC. Further, by using Halo the auditor can conduct numerous analyses on the collected data which later can be presented to the client. PwC claims that this tool is transforming the way that an audit is conducted since it utilizes the power of data to enhance the quality of the audit, improve the risk assessment, analysis, and testing, revealing numerous insights (PwC, n.da). Furthermore, PwC has developed other tools as well in order to identify risks and have real-time monitoring, share information faster and more securely, and extract large datasets called Aura, Connect and Extract. They claim that these platforms are just the beginning of the plans that they have for the future of audits. In the coming years, they will invest and innovate new ways to improve their audit quality and ability to generate better strategic insights to their clients (PwC, n.db).

Deloitte: At Deloitte, they acknowledge that audit, historically, has not been at the forefront of innovation. Nevertheless, that is changing, and Deloitte is working towards having the same technological pace as their clients to be able to deliver more valuable insights. Furthermore, they claim that *“At Deloitte we’re investing several hundred million dollars in data analytics and artificial intelligence with some cutting-edge applications that we really believe differentiate us and our audit approach”* (Deloitte, 2016a, p.5). Moreover, Deloitte has also developed an audit platform related to data analytics called Illumia. With Illumia, Deloitte claims that they can analyze large datasets with both structured and unstructured data to discover trends patterns, and anomalies to identify hidden risks. (Deloitte, 2016b). Further, Deloitte is currently using a tool called Argues in the US, Canada, and Australia. Argues is a tool that can analyze huge amounts of data in documents and contracts in order to find anomalies in the contracts that otherwise most likely would go undetected if analyzed by a human manually. This tool is just in its infancy, Deloitte says, and believes that as the technology advances its application in the audit process will increase a lot more, reducing the number of manual tasks performed by the auditor (Deloitte, 2018).

2.4 The audit process

Audit processes refer to the series of steps that auditors conduct in their audit engagements. Every audit process is idiosyncratic in nature because of the different inherent risks and internal control systems used by the client. The implementation of BDA in audit processes enhances the audit quality throughout the different steps of the audit engagement (PwC, 2017). The audit processes are divided into five different steps and refers to (i) *Pre-audit engagement*, (ii) *Planning*, (iii) *Audit Strategy and Plan*, (vi) *Gathering evidence*, and (v)

Finalization or report the findings. The fourth step, gathering evidence, also known as the execution phase, is the step where audit competence and professional judgment are applied foremost, and this is the step in the audit process this thesis mainly will focus on when answering the purpose of this study (PwC, 2017).

The first step refers to the pre-audit engagement phase, which refers to the auditor's responsibilities prior to accepting an audit client. Prior to every audit engagement, auditors have to comply with rules and regulations regarding what clients the auditors can undertake to audit. The auditors are not allowed to undertake clients that would compromise the integrity or violate relevant requirements such as independence (PwC, 2017; IAASB, 2010). To avoid this, an assessment of the integrity of management and owners of the client is carried out. Additional considerations in the pre-engagement phase refer to ethical requirements such as assessment of threatening self-interest that would violate independence. Moreover, in this phase, additional services are discussed such as consultancy and legal services (IAASB, 2010). Once the auditors have accepted the client, the second, planning, phase is initiated. This phase stipulates the strategy on how the audit engagement is going to proceed, from the start to the very end. This step constitutes the foundation of the proceeding of the engagement; however, unpredictable events can occur which lead to that the audit process deviates from the actual plan (PwC, 2017).

Additionally, the planning process determines to what extent the auditors will carry out certain activities and procedures to ensure that the engagement is done effectively (PwC, 2017). During this phase, the auditor gathers material on the entity and its environment and determines the size of the audit team, what required competencies are needed, and divides the different tasks among the engagement team. By gathering information about the entity and its environment, the auditors can plan and decide on the materiality of the entity, meaning what significance and amount will the auditors check in the execution phase (IAASB, 2010; PwC, 2017). When the planning is done, the audit strategy and plan initiates where the auditors amongst others decide to what extent they should rely on the clients' internal controls, evaluate the design of the controls and evaluate how they are implemented in the entity. This control evaluates the timeliness and reliability of the internal system and whether they are transparent towards stakeholders (PwC, 2017).

The fourth step, the *gathering evidence* or *execution phase*, is where the actual audit takes place and refers to when auditors utilize their competence, judgment, and skepticism, to carry out *analytical procedures*, *substantive procedures*, *test of controls*, and *additional risk assessments* (See figure 3). This part refers to the auditor's use of competence and judgment to assess the different risks the client faces which could lead to misstatements. The final step of the audit process refers to *finalizing*. In this step, the findings are evaluated, and the auditors conclude on what opinion they will leave on the audit report. Due to that the fourth step, first and foremost involves audit practitioner's performance, competence, and judgment, this is the step that the thesis will refer to in the audit process (PwC, 2017).

2.4.1 Big data analytics impact on the execution phase

Literature emphasizes that BDA usage in audit engagements has a substantial effect on audit processes and the implementation of BDA affects the way the auditor records his or her work. Additionally, BDA assists the audit engagement which contributes to enhanced quality and efficiency (IAASB, 2014; 2017; ACCA, n.d). For instance, the implementation of BDA allows auditors to shift focus from repetitive time-consuming tasks toward tasks characterized by more risk that require more judgment (IAASB, 2017). With a background in the widespread interpretation from stakeholders on audit quality, IAASB (2017) has established a model that aims to emphasize the awareness of what process factors are affected by BDA the most. The results of IAASB (2017) study reveal that the biggest controls in the execution phase, namely *risk assessment*, *analytical procedures*, *substantive procedures*, and *test of controls* are substantially influenced by the technological advancements in BDA.

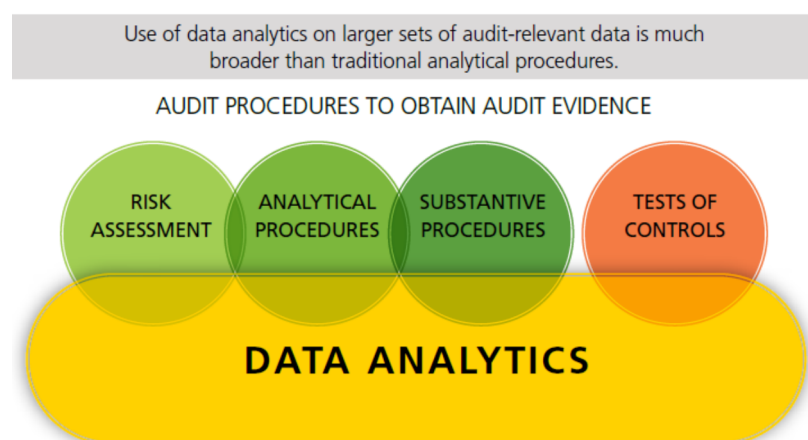


Figure 3: IAASB (2017 pp. 7) process factors mostly impacted by BDA.

To conduct an audit with high audit quality, a substantial risk assessment of the entity must be conducted. Risk assessment constitutes the foundation of an audit engagement where entity potential and significant threats, risks, and impacts related to the organization's operations and goals are identified (Deloitte, 2020; AICPA, 2015; Allen et al., 2006). In risk assessment procedures, BDA has reconfigured the task from being two-dimensional, meaning that the auditor tested risks because of their likelihood and severity, towards testing and analyzing the structure of the entire risk system and the links between the risks with the BDA system. In risk assessment procedures, BDA has contributed to enhanced confidence in financial reports and contributed to qualitative audit reports (PwC, 2021; KPMG, 2019b). Furthermore, analytical and substantive procedures are two central determinants which are highly influenced by BDA. Typical analytical procedures in audit engagements refer, for instance, to accounts receivables, and revenue analysis, where BDA identifies discrepancies in quantity or price between freight documents, selling orders, and invoices (IAASB, 2017; 2020).

By introducing BDA in these analytical processes, more precise statistical and analytical documentation can be gathered (KPMG, 2017). Additionally, to gather sufficient and reliable audit evidence, auditors must conduct substantive testing on the entity's financial figures. In these procedures, auditors use BDA systems such as CAAT to conduct more precise and qualitative testing (Deloitte, 2015; AICPA, 2015). Ultimately, test of controls in audit engagements has been influenced by BDA and refers to when auditors oversee and test the effectiveness of the controls implemented in an organization that prevents and detects fraud and material misstatement (KPMG, 2018; AICPA, 2015). For instance, audit firms utilize process mining tools to do compliance tests, enabling them to find violations on segregation of duties and check that pricing information on invoices comes from approved price lists (AICPA, 2015; De Santis and D'Onza, 2021).

2.5 Audit practitioners attributes

2.5.1 Competence and professional judgment

Even though this thesis does not investigate how BDA affects audit quality in a comprehensive way, audit quality will be discussed in relation to audit competence and professional judgment in the following two chapters. The reason for this is because when literature (e.g. DeAngelo, 1981; IAASB, 2020; BSI, 2011) discusses audit competence and professional judgment it does so in relation to audit quality. Furthermore, the authors of this

study have defined professional judgment as a subcategory to audit competence (see section 2.1). Considering the way literature describes professional judgment, it can be seen as the application of audit knowledge, that is, professional judgment is when an auditor applies her audit knowledge and therefore is a subcategory within audit competence (CICA, 1995; Grout et al., 1994; IAASB, 2020).

To begin with, competence and professional judgment are pivotal attributes and extensively used in the conduct of an audit, and is foremost present in the “*execution of controls and evaluation of these results*” (IAASB, 2020, p.241). Competence is a central determinant in audit engagements, however, the term is vague and is widely interpreted (IAASB, 2020). The overall definition of competence according to IAASB (2020) refers to the combination of the audit practitioner’s understanding and experience of engagements and expertise, both technical and accounting, to be able to achieve the objective of the audits.

De Santis and D’Onza (2021) suggest that the way financial statements are produced and how audits are performed, is going to undergo a transformation during the coming years. Because of this change, some literature argues that auditors must gain and learn new competencies and skills in order to cope with these new BDA tools introduced in the audit process (Brown-Liburd, Issa and Lombardi, 2015). The authors emphasize that although auditors possess several valuable competencies in order to perform an adequate audit engagement, the auditors often do not have the required competence to deal with the BDA tools, resulting in the audit process becoming fragmented since some tasks are performed by an IT expert and delivers the result to the auditor (Brown-Liburd, Issa and Lombardi, 2015; Salijeni, 2019).

According to DeAngelo (1981), audit quality is a function of the auditor’s ability, i.e., competence to detect accounting misstatements and the auditor’s independence to report these misstatements. According to this view, it is evident that the quality of the audit is affected by the audit practitioner and how the auditor uses her capabilities to conduct the audit. Besides the generic description of competence at the beginning of this section, the Institute of Internal Auditors (IIA) defines competence as “*the ability of an individual to perform a job or task properly, being a set of defined knowledge, skills and behavior*” (IIA, 2014, p.5). More specifically, International Organization for Standardization (IOS) issued a guideline, (ISO 19011: 2011), for auditors, and includes some criteria that should be considered when compiling the audit team. Confidence in the audit process and the ability to achieve its objectives depends on the competence of the people involved in the process.

Competence should be evaluated through a process that considers both personal behavior and the ability to apply knowledge and skills gained through education, work experience, and auditor training. The competence needed to conduct a good audit can be divided into four areas. The first one is that the auditor can apply relevant audit principles, methods, and procedures. The following competence is that the auditor should have an understanding of the client's management accounting system. The third competence that the auditor should have is specific competence about the client's industry and knowledge about the organizational context. Lastly, the auditor should be familiar with laws and regulations regarding the client's business, to understand the basic legal terminology and contractual requirements (BSI, 2011).

In order for the audit to be of good quality and besides the above-mentioned competencies, the auditor must possess the skill of professional judgment. Similar to competence, professional judgment is a vague term and consists of a wide range of interpretations. The reason for it to be subjective is because professional judgment refers to the individual experience and qualifications and the personal ability to make judgments (IAASB, 2020).

A Canadian study (CICA, 1995) defines professional judgment as *“the application of relevant knowledge and experience, within the context provided by auditing and accounting standards and Rules of Professional Conduct, in reaching decisions where a choice must be made between alternative courses of action”*(p.9). As auditors review financial statements, they deal with subjective and non-quantifiable factors, however, the auditor still needs to make decisions and judgments based on these subjective factors. The auditor, therefore, needs to make decisions and statements based on subjective factors with the knowledge that the individual has retrieved during education and experience (Grout et al., 1994; IAASB, 2020).

Auditors' professional judgment is *“essential to the proper conduct of audit engagements”* (IAASB, 2020, p.31) and represents the cornerstone of audit processes. Since every audit engagement and circumstances around the engagement are idiosyncratic, the auditors' ability to interpret information and make judgments when executing the audit is essential for the process. For instance, in the execution phase, when the evidence is gathered and controls are completed, the auditor evaluates if the risk assessment reduces the engagement risk *“to a level that is acceptable in the engagement circumstances”* (p.32).

Moreover, the fact that auditors need to possess professional judgment is evident when studying the individual accounting standards, since the standards are not created to have

certain rules for every situation but rather count on the auditor being able to apply his professional judgment (IAASB, 2020). For example, West and Buckby (2022) examined 40 accounting standards published by the IFRS and found that the word *judgment* was mentioned in 21 of the standards. The judgment covered a wide range of applications, such as identifying major customers, estimating the useful life of an asset, determining the appropriate functional currency, and allocating costs based on their function.

2.5.2 Big data analytics impact on competence and professional judgment

Alles (2015) claims that auditors need to keep pace with recent technological trends and stay updated within recent technological advancements to stay competitive as an auditor. Additionally, IAASB (2020) underlines the importance of developing technological expertise among auditors. Moreover, FRC (2017) argues that by implementing BDA tools in the audit process, the efficiency of the audit will increase significantly. One reason for this stems from the fact that auditors can shift their attention to focus on complex tasks and tasks with higher risks because the technology performs the repetitive and manual tasks instead (FRC, 2017). Richins et al. (2017) argue that auditors must apply their problem-driven approach to data analysis on larger datasets and need to build competencies in analyzing large unstructured datasets. The authors argue, in the context of financial auditing, current auditors can leverage their knowledge in business and apply this knowledge with BDA tools to stay competitive.

More specifically, according to Yeo and Carter (2017), auditors will have to be competent in three main areas to cope with the development of BDA in audit; analytical skills, development of new metrics, and visualization skills in the language of data. In other words, the auditor must be able to work with these new tools and must be able to handle and interpret big data. However, Earley (2015) presents some challenges the audit will face when BDA is introduced into the audit. The author stresses that the educational foundation does not facilitate the practitioner with relevant competence to, for instance, utilize “*pattern recognition and understanding how to evaluate anomalies*” (p.496). Scholars are concerned that there is a discrepancy between the education given to auditors and the tools used in the audit processes. Moreover, the auditors can give account for applying different accounting rules and understand risks in the audit related to a transaction, however, they are not equipped with the requisites to apply new techniques, like BDA, in the process (Earley, 2015).

In regards to the professional judgment, since it is subjective in nature (IAASB, 2020), it is difficult for BDA to take over this cognitive task, but will rather work as a side-by-side tool, facilitating the auditor in her professional judgment in the audit process (Richins et al., 2017). Moreover, Brown-Liburd, Issa and Lombardi (2015) argue that BDA has the potential to enhance and improve the professional judgment of the auditor. However, these improvements also contain some risks. Brown-Liburd, Issa and Lombardi (2015) argue that auditors might experience information overload due to the fact that they simply receive too much information. Individual decision-makers lack the ability to process large amounts of information, and previous research has consistently shown that combining cues from multiple sources can lead to poor outcomes. Specifically, accounting research studies suggest that large volumes of accounting data can contribute to suboptimal financial and auditing judgments (Alles et al., 2006; Alles, Kogan, and Vasarhelyi, 2008).

Additionally, some studies have shown that auditors have a hard time recognizing patterns in financial and non-financial information when the output is generated by BDA tools instead of traditional tools (Brown-Liburd, Issa and Lombardi, 2015). In addition to this, some practitioners mention the risk of deskilling the profession as it becomes too reliant on technologies instead of human knowledge, meaning that auditors actually lose their professional judgment as the technology progresses (Fischer, 1996; Curtis and Turley, 2007) Although these risks seem crucial, Salijeni (2019) argue that BDA will have a positive effect on the professional judgment of the auditors. The auditors will be able to reduce the uncertainty of the judgment that the auditor makes, which will decrease the gap that occurs between different stakeholders when an auditor exercises professional judgment. Further, Richins et al. (2017) claim that *“it is less likely that we will be able to develop models that will be able to assess management’s ability and intention to carry out plans to “alleviate substantial doubt” due to the idiosyncrasies in any given organization’s plans and the possibility of management intentionally providing misleading information”*(p.27). Therefore, it is likely that analyzes from BDA will supplement rather than replace auditors' professional judgment. Thus, it is imperative that auditors still have and develop the skills that correspond with professional judgment in the future (Richins et al., 2017)..

2.6 Technology acceptance model

TAM, by Davis (1989), stem from Fishbein and Ajzens (1975) model theory of reasoned action (TRA). To attain a better understanding of TAM, a brief explanation of TRA will be given in the following paragraph.

TRA is a model trying to explain the relationship between attitudes, norms, behavioral intention, and actions. The actions taken by the individual are determined by the individual's intention towards that action. Furthermore, the individual's intention is determined by the individual's attitude and subjective norm towards that particular action. Attitude towards the action is determined by the individual's assessment of the action and whether the outcome of the action is positive or negative. The subjective norm is a social factor that is determined by the social pressure towards the individual to perform the specific action. i.e., the subjective norm is the opinion of other people towards the action. The model tries to explain the relationship between attitudes and norms and tries to predict how an individual will act in a specific situation (Fishbein and Ajzen, 1975).

TAM, has the purpose of describing the individual's rationale towards accepting a new technology or not. This rationale determines how the technology will affect the rest of the processes in an organization. Technology usage has exponentially increased year after year which encouraged the authors to come up with an explanation as to why some individuals accept a new technology and why some reject it. The model relies on two factors explaining the reason why one individual would accept a new technology, namely *perceived usefulness*, and *perceived ease of use*. Thereafter, these two factors shape the behavioral intention which in turn shapes the actual use of the technology (Davis, 1989) (see figure 4).

External variables are the first components of the model. External variables are the determinants that influence the individuals experienced perceived usefulness and perceived ease of use. Variables that could determine these two factors could be several, but some examples could be the design of the system, previous experience, technical support, and the implementation process (Davis, 1989). Furthermore, Al-Gahtani (2008) explored the applicability of TAM in the Arab context by including three demographic factors, including gender, age, and level of education. The authors found that age is a determinant that influences perceived usefulness and perceived ease of use negatively.

Furthermore, the perceived usefulness measures if the individual believes if the technology will be beneficial for the individual's performance. Davis (1989) describes it as *“the degree to which a person believes that using a particular system would enhance his or her job performance”* (p. 320), i.e., perceived usefulness is a factor measuring if it is the individual's perception that the technology will improve the work performance of the individual, irrespective if the individual has a positive or negative outlook on the technology. Moreover, Davis (1989) suggests that it is this factor that influences the actual use the most since even though the individual experiences low ease of use the individual will still use it if the individual perceives the technology as useful enough.

The perceived ease of use measures if the individual perceives the technology as user-friendly, and is defined by Davis (1989) as *“the degree to which a person believes that using a particular system would be free of effort”*(p.320). Therefore, to achieve high actual usage of a new technology, it is imperative that it is perceived as user-friendly and not complicated to understand. When a technology has a high degree of ease of use, it will be easier to achieve the desired outcome in terms of actual usage (Davis, 1989).

Behavioral intention is the factor determined by the two previous factors which in turn determined the actual usage of the technology. If the individual has shaped a strong intention towards using the system, this will lead to high actual usage, and on the contrary if the individual has shaped a weak intention to use it based on the two previous factors the individual will most likely not use it (Davis, 1989). Since behavioral intention is the combination of perceived usefulness and perceived ease of use which results in actual use, the authors of this thesis will not discuss this step extensively but focus on the actual use.

TAM differs from TRA in the sense that the behavioral intention in TAM is explained by perceived usefulness and perceived ease of use, while the behavioral intention in TRA is determined directly by attitudes and subjective norms. Moreover, TRA is a general model describe human behavior, while TAM is more specialized and focus on explaining the reason behind why individuals adopt a new technique (Davis, 1989; Fishbein and Ajzen, 1975).

In this study, perceived usefulness is measured by how much the external auditors believe that BDA can assist in enhancing their performance. Similar views have been presented by previous studies, for example, Janvrin, Lowe and Bierstaker (2008) theorized perceived usefulness as when external auditors believe that the analytical tool is useful in their work

and can enhance their performance. Furthermore, perceived ease of use in this context is described as the degree to which the auditors believe that using analytical tools would be effortless and straightforward. Once again, Janvrin, Lowe and Bierstaker (2008) have theorized perceived ease of use in a similar manner claiming that when external auditors believe that analytical tools are easy to use, they are expected to use them more.

The model has been used, both in and outside the context of audit. Razi and Madani (2013) investigate emerging technologies impact on the audit process by focusing on the audit practitioners' perceived ease of use and perceived usefulness in TAM. They find that the most prominent determinant to understanding how a technology will impact the audit process, originates from the practitioner level and if they perceive the technology as useful and easy to use. Moreover, Razi and Madani (2013) find a discrepancy between older and younger auditors, where younger auditors are more positive towards new technologies in the audit process compared to their older colleagues. Furthermore, and more recently, Al-Ateeq et al. (2022) used TAM as a theoretical framework when addressing the impact of BDA on the audit process in Jordan and how auditors perceive BDA will impact the rest of the process. The authors find that auditors perceived usefulness and perceived ease of use of BDA have a direct impact on the audit process. These studies demonstrate the model's relevance since both factors had a significant impact on the usage of the technology. In section 3.4, the authors of this report give account of how TAM will be used throughout the thesis as well as further, and more thoroughly motivating the choice of theoretical framework.

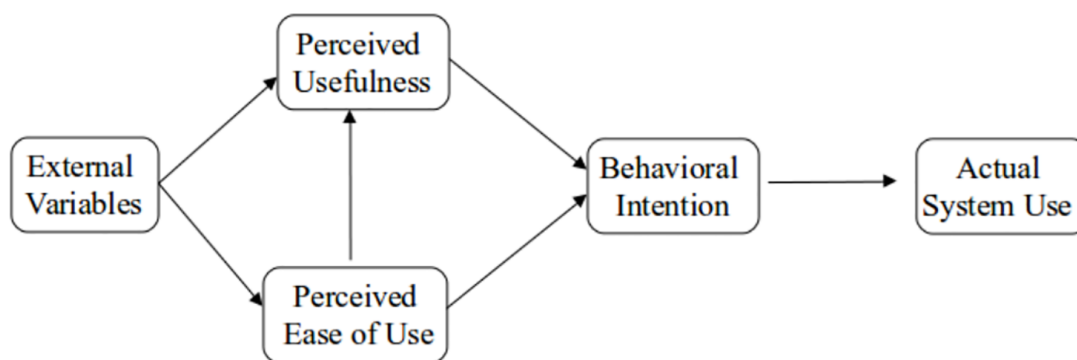


Figure 4: *The final version of TAM of Davis och Venkatesh (1996, pp. 20).*

3. Methodology

This chapter covers the author's choice and motivation of method and additional considerations. The chapter starts by giving account for the choice of design, approach, and method. This is followed by choice of theoretical framework, data collection, and data analysis. The chapter finalizes with reliability and ethical considerations of the study.

3.1 Research design

The choice of research design is to establish the plan on how the authors will proceed onwards to answer their research question, and when formulating the research design of the thesis, the authors have to distinguish whether their thesis should be of descriptive, explanatory, or exploratory design (Saunders, Lewis and Thornhill, 2009).

Descriptive research design is characterized by being quantitative in nature and requires that the author have a clear picture of the phenomenon before the study takes place and thus can be seen as more rigid than, for instance, exploratory design (Saunders, Lewis and Thornhill, 2009). However, the descriptive design is described to be an extension of exploratory research and can somewhat be seen as entangled with the exploratory study. Moreover, explanatory studies are often conducted to investigate cause and effect relationships, and relationships between variables. They are often follow-up studies to descriptive studies, where they make use of the quantitative data to do statistical tests to explain the relationships between variables. In these studies, it is common to use hypotheses to investigate the factors that led to the occurrence of a certain phenomenon (Saunders, Lewis and Thornhill, 2009).

Exploratory design was appropriate for this thesis since the authors aimed to understand a new phenomenon and increase the understanding of a new subject in the societal environment. Additionally, it is appropriate when the researcher's knowledge about the topic is limited, and the researcher's study can be seen as a first step to understanding a new subject. Moreover, it is suitable when the study aims to increase the understanding from people's perception about a certain topic. Unlike descriptive and explanatory design, the exploratory design is known for its flexible characteristics, unstructured approach, and use of qualitative data as the foremost source (Saunders, Lewis and Thornhill, 2009).

Since the study aimed to increase the understanding of BDA as a new phenomenon in the audit environment, and since it is an unexplored topic with limited knowledge, the exploratory research design was seen as most appropriate. The authors have used TAM and conducted a literature review related to audit and BDA to increase the understanding of its impact on audit processes and audit competence. The author's choice of research design turned out not to be unique during the literature review. In De Santis and D'Onza (2021) study about how BDA in the audit methodology affects practitioners, the authors recognize an exploratory design with semi-structured interview questions as appropriate to “*deal with phenomena for which a consolidated knowledge does not yet exist and promote flexible data collection*” (p.1094). In a similar vein, the authors of this thesis argue this design to be the most appropriate to answer the research question of this thesis.

3.2 Research approach

On the spectrum of research approaches, the two extremes of what approach the study can have constitutes either an inductive or deductive approach. Bryman and Bell (2015) stress that when the study is of qualitative character, inductive approaches are mostly used where the authors originate from empirical data to develop theories, and can be seen as a data-driven approach. In the inductive research approach, authors collect the data through interviews, and when the data is collected, the authors analyze and divide the findings into themes. Lastly, the observations gathered during the inductive approach will eventually create a theory (Bryman and Bell, 2015). On the other side of the spectrum, the deductive approach stems from the development of hypotheses to test the relationship between theory and practice. In the deductive approach, the authors originate from existing theories, in order to develop hypotheses and collect data to eventually either accept or reject the hypotheses against the theory, and this approach can be seen as a theory-driven approach (Bryman and Bell, 2015). Using a purely deductive approach would, on this unexplored topic, be improper since the hypotheses developed would be based on a weak empirical foundation.

This thesis has used a mainly inductive approach where the authors based the study on data collections through semi-structured interviews which ultimately have been analyzed to discover themes and patterns and categorize the data. Due to the novelty of BDA in the audit methodology and the lack of empirical evidence on practitioners' perception of the topic, the inductive approach was more feasible. However, the observations did not result in new

theoretical foundations, as proposed by the inductive approach. Moreover, the theoretical choice in this study was not aimed to be tested against the gathered empirical data to be accepted or rejected, as proposed by the deductive approach. Since TAM has the focus on the individual and new novel technological tools, it has helped the authors to understand BDA's impact on the audit process and audit competence from the practitioner perspective.

Additionally, since the topic covers a novel area of research, the authors could not address what theoretical framework that would be appropriate before the data was collected. During the interviews, a common theme among the respondents emerged about the usefulness and ease of use of the BDA tools in the audit process. Hence, the authors chose the theoretical framework TAM after the interviews since it was most appropriate to help answer the research question. Since TAM originates from the practitioner's perspective, and is linked to novel technologies like BDA, the choice of theoretical framework was appropriate for the authors to apply. This approach is necessary and appropriate when studies emerge on novel subjects with deficient research, where the result from the collected data and appropriate theoretical framework for the data could not have been anticipated (Bryman and Bell, 2015).

3.3 Research method

On the spectrum of different research methods, there are two distinct research methods. Research methods could be of quantitative character on the one hand, and qualitative character on the other (Bryman and Bell, 2015). The aim of the study was to increase the understanding of how BDA affects audit processes and audit competence from a practitioner point of view. A qualitative method was the most appropriate research method when the study aimed to increase the understanding of how individuals perceive reality (Bryman and Bell, 2015; Saunders, Lewis and Thornhill, 2009). On the contrary, a quantitative requires a substantial amount of data to find potential correlations (Bryman and Bell, 2015). Since the aim of the study was to provide increased understanding from a practitioner's point of view, of the implications of BDA on audit processes and audit competence, and with the background of the novelty of BDA (Buhl et al., 2015) and its practical effect on the audit process and audit competence, the research method as qualitative was appropriate and motivated (Bryman and Bell, 2015). Additionally, due to the scarce amount of research and lack of empirical data on this topic (e.g. Salijeni, Samsonova-Tuddei and Turley, 2019; De

Santis and D'Onza, 2021), a quantitative method would not be able to proceed due to the lack of data, and hence not be able to answer to the research purpose.

However, Bryman and Bell (2015) criticize qualitative research since they are subjective in nature and that the data collected from the interviews are influenced by the authors' prior understanding and perceptions of the topic which fosters a subjective assessment. In parity with this, and to retain objectivity in the interviews, the authors proceeded with semi-structured interviews to hinder the results from being based on subjective perceptions. Also, semi-structured interviews allow one to gain in-depth knowledge and understand practitioners' thoughts, experiences, and perceptions of this phenomenon. These interviews are also a suitable approach to gather data in qualitative studies (Bryman and Bell, 2015).

3.4 Choice of theoretical framework

As described in section 3.2, the author's choice of the theoretical framework was done after the interviews. This study covers a novel topic, which entails limited previous research, hence, the authors could not predict the answers beforehand and what theoretical framework that would be appropriate. Therefore, the theoretical choice was done after the interview process had started (Bryman and Bell, 2015). During the semi-structured interviews, all the interviewees mentioned the usefulness of BDA tools and how it could facilitate them in their professional practice. The interviewees mentioned that there are twofold perceptions of how the practitioners perceive BDA in the audit process, where some see BDA as very helpful and some as more complex and difficult. Additionally, the respondents' perception decided to what extent they actually use it in their processes. With background in previous literature emphasizing that there is a deficient understanding of how BDA affects the practitioners, TAM as the theoretical choice was appropriate since it emphasizes the practitioner and the individual (Davis, 1989; Al-Ateeq et al., 2022; Razi and Madani, 2013). Moreover, in order to understand how BDA affected audit processes and audit competence, it was imperative to understand how the practitioners perceive BDA, which will affect the impact on the audit process and audit competence. This theoretical framework with the practitioner in focus, additionally allowed the authors to discuss the auditors perception of opportunities and threats regarding BDA. It was revealed during the interviews that the practitioners with a positive mindset towards BDA, perceive opportunities to a greater extent compared to the other respondents with a more negative mindset.

Moreover, during the interviews it became evident that age is an important determinant that influences auditors' perceived ease of use and perceived usefulness, which ultimately affects the actual usage of BDA in the processes. In a similar vein, during the literature review, the authors of this thesis found that Razi and Madani (2013) and Al-Gahtani (2008) used age as an external factor that determines the two central determinants in the TAM model, namely perceived usefulness and perceived ease of use. This is one example that motivates the framework as relevant for the topic of this study. Additionally, it motivates the selection of respondents as one junior and one senior practitioner from every firm (see section 3.5.3).

Literature emphasizes that in order to understand the implementation of new technologies and its impact on business practices, it is imperative to shed light on the practitioner and how they perceive it (Davis, 1989; Al-Ateeq et al., 2022; Razi and Madani, 2013). The practitioner of the BDA system is the one that will determine what effects BDA will have in an organization by either promoting or rejecting the new technology and represents an important determinant to understand a technology's effect on an organization's activities (Davis, 1989). To encompass this perspective, the TAM is appropriate and also well tested in literature, both within as well as outside the context of audit by investigating older analytical tools such as CAAT (Razi and Madani, 2013), but also new tools like BDA (Al-Ateeq et al., 2022). Razi and Madani (2013) stress the importance to focus on the individual's perception about new technologies in order to understand what effect it will have on the organization. Furthermore, the authors show in their study that auditors perception about a new technology is the foremost determinant that affects how technologies will impact the rest of the audit process.

TAM has played an important role in this study. By shedding light on how the practitioners perceive a new technology, like BDA by using TAM, the authors of this study have been able to increase the understanding of how BDA affects the audit process and audit competence. BDA's effects on the process and competence are not a singular process, but are affected by a multitude of perceptions and beliefs from the practitioner which shapes the actual use of the technology in the process. Finally, during the literature search, using this theoretical framework on a similar topic was not unique. Al-Ateeq et al. (2022) utilized TAM as a theoretical framework to understand the BDA impact on the audit profession from the practitioner's viewpoint, which further motivates the theoretical choice of this study.

3.5 Data collection

3.5.1 Collection of data and construction of interview questions

When conducting a qualitative study, the first step is to conduct a review of existing literature, where the authors map out what knowledge that already exists on the topic and what has been done before and eventually discover research gaps in the literature (Bryman and Bell, 2015). Saunders, Lewis and Thornhill (2009) argue that an appropriate starting point is to gather relevant literature and investigate the sources used in this literature to eventually establish the research objective of the report. The gathering of literature was mainly done through databases used at Lund University, for instance, Google Scholar and LubSearch. To facilitate the search, keywords such as *Audit process*, *audit competence*, *professional judgment*, *Big Data Analytics* have been used. In addition to this, the “advanced search” in Lubserch has been used extensively to narrow down the search even more. Additionally, the authors have used sources from the big-4 companies' own reports and publications, which have been carefully assessed since these publications likely appear to be biased towards the firm's views, perceptions, and aims to depict their advancements in BDA in a distorted way. Moreover, to ensure that gathered literature was of sufficient quality, the authors exclusively gathered peer-reviewed articles (Saunders, Lewis and Thornhill, 2009).

Bryman and Bell (2015) distinguish between primary and secondary data, where primary data refers to a collection of not yet existing data, through e.g. own observations and interviews. Secondary data refers to already collected data, available through journals, articles (Bryman and Bell, 2015), and in this study, documents from the different big-4 firms. Since there is deficient literature on the thesis topic, the thesis is dependent on the primary data collected through the interviews, complemented by secondary data through articles, journals, and documents from the companies. The primary data were collected through interviews, exclusively held via Microsoft Teams. Bryman and Bell (2015) emphasize that interviews held online bring in a flexibility to the respondent where he or she could decide on time and location to a greater extent compared to if the interview would have been done physically. However, the authors fell short in capturing the body language and expressions which are important determinants to weigh in (Bryman and Bell, 2015).

When the main source of data comes from interviews, it is imperative to illustrate how the interview questions were formalized. In order to connect the interviews with the literature,

the interview guide was operationalized. Hence, the questions were formulized to fit with the gathered literature. The operationalizing table is presented in Appendix C. When constructing the interview questions, the authors divided them into themes which were divided according to the gathered literature (Bryman and Bell, 2015). For instance, one section in the literature review refers to BDA's impact on audit competence. Questions related to this topic refers to Theme 3 in the aforementioned appendix where the authors aimed to increase the understanding of how the practitioners perceive competence in relation to BDA from different angles. The interview questions consisted of several main questions, and additional sub-questions were assigned to the respondents (see appendix A for the interview guide). The questions originated from the main interview question where the respondents were allowed to describe and discuss his or her experience. Subsequently, the authors asked sub-questions to initiate elaborating answers to get as much possible information. For instance, "*could you tell us more about X*" or "*could you give an example on Y*" were typically asked sub-questions.

In order to test the appropriateness of the interview questions, the authors conducted a pilot-study in order "*to ensure that survey questions operate well*" (Bryman and Bell, 2015, p.262). The authors held two shorter interviews with respondents from the big-4 firms. After the pilot interviews, the authors for instance decided to become more concise about the terms *big data* and *big data analytics*, in which twofold perceptions were discovered of their meaning and difference. During the pilot study, the authors discovered the common denominators about perceived usefulness and ease of use of BDA in the audit process.

3.5.2 Semi-structured interviews and interview guide

In exploratory studies and in order to understand practitioners' perceptions of a phenomenon, semi-structured interviews are most appropriate (Bryman and Bell, 2015; Saunders, Lewis and Thornhill, 2009). As mentioned earlier, the interview questions were based on semi-structured interview questions, which made it possible to deal with a phenomenon, BDA, which lacks a consolidated understanding of the audit methodology. This choice of method is common in literature that aims to investigate a phenomenon in which limited knowledge exists (De Santis and D'Onza, 2021). Having semi-structured questions gave the respondents the possibility to probe their answers, describe, and express their own perceptions and experiences about BDA in which the authors of this thesis also could map out patterns in the different respondents' answers and provide us with more insights (Bryman and Bell, 2015; Saunders, Lewis and Thornhill, 2009). On the other side of the spectrum, if

an unstructured interview approach would have been chosen, the respondents would have had the possibility to elaborate freely about the topic, which consequently would have complicated the process to stick to the themes on which the interview questions were built. In addition to the semi-structured interview questions, the interviewers created an interview guide, divided into themes, which facilitated the control of the interview. Since the thesis purpose and research question aimed to increase understanding of a topic with salient empirical understanding, the semi-structured approach is appropriate and motivated.

Saunders, Lewis and Thornhill (2009) however point out that utilizing semi-structured interviews can cause data quality issues and question the reliability of the gathered data, meaning that an alternative study would have received similar information. The authors emphasize that it is inevitable for the interviewer to not include bias, referred to as “*interviewer bias*” (p.326), where own beliefs and experiences are imposed into the asked questions. Additionally, “*response bias*” (Saunders, Lewis and Thornhill, 2009, p.326), is another shortcoming with semi-structured interviews where the interviewer distorts the answers from the interviewee based on their own perceptions and experiences from the interviewer, which hampers the reliability.

As mentioned earlier, the semi-structured interview questions were divided into themes with main questions and sub-questions, constituting the interview guide. The interview guide provided an overview of the gathered literature in the thesis and the questions asked during the interviews (Bryman and Bell, 2015). Since the study originates from the gathered literature, the themes in the interview guide were divided accordingly. Additionally, to relate the gathered data from the interviews with the literature, the interview guide was operationalized (see section 3.5.1). The interview guide and the operationalizations-table are presented in Appendix A and C. Since the interview questions were of semi-structured character, the initial questions aimed to establish a relaxed environment where the respondent felt that he or she could elaborate and answer transparently (Bryman and Bell, 2015).

3.5.3 Selection of respondents

When selecting respondents, Saunders, Lewis and Thornhill (2009) distinguish between either probability or non-probability selection. Probability selection refers to when the selected respondents are selected randomly and the latter refers to when the selection of respondents from a population is “not randomly”. In this thesis, the respondents were selected

based on a non-probability selection in order to find relevant respondents to fulfill the purpose of the study. The focus of this study has been to increase the understanding of practitioners' perception of BDA's impact on processes and audit competence, focusing on big-4 auditing firms in Sweden, and in order to answer the research questions, the authors decided to interview two respondents from each firm. One of the two interviewed in every firm should have been working with audit for a long period of time to be able to experience the gradual transition towards BDA tools in the methodology. Hence, the authors found it appropriate to interview one partner, manager, director, or equivalent (later called senior) to grasp this perspective. Additionally, since the implementation of BDA tools is a strategic choice, the authors also found it interesting to interview a practitioner in a decision-making position. This approach furthermore motivates the choice of interviewing one senior in every firm. The second respondent was a junior (associate or senior associate) that had been in the audit profession for at least two years. Bryman and Bell (2015) emphasize that it is desirable to have a wide selection of respondents to establish as representative a picture as possible. This motivates the choice of having two respondents with different experiences and ages, in order to grasp the different perceptions on the experience spectrum to help us answer the research questions of the study. In order to gather the most appropriate respondents, the authors contacted friends and colleagues in the different firms, who navigated us to co-workers with the most appropriate knowledge to answer the questions, also known as snowball sampling (Bryman and Bell, 2015). Below depicts a table of the interviewed respondents. One senior (S) and one junior (J) were interviewed from each firm (A, B, C, D).

Participant	Position	Duration	Medium	Interview date	Firm
S1	Partner	71 minutes	Microsoft teams	2022-04-19	A
J1	Associate	51 minutes	Microsoft teams	2022-04-20	A
S2	Manager	68 minutes	Microsoft teams	2022-04-22	B
J2	Associate	65 minutes	Microsoft teams	2022-04-21	B
J3	Senior associate	65 minutes	Microsoft teams	2022-04-27	C

S3	Partner	33 minutes	Microsoft teams	2022-04-28	C
S4	Partner	47 minutes	Microsoft teams	2022-05-03	D
J4	Senior associate	39 minutes	Microsoft teams	2022-05-02	D

Table 1: *List of interviews.*

3.6 Thematic data analysis

Bryman and Bell (2015) emphasize that in a qualitative study, an appropriate way to analyze the gathered data is to structure the data and divide it into themes and patterns in a meaningful and systematic manner by using thematic analysis. The thematic analysis as such is a vague process, and there is no uniform way to conduct this analysis. However, one commonly used approach is Braun and Clarke's (2006) six-step method which the authors of this study have used when analyzing the data. The thematic process is systematic, ongoing, and flexible at the same time, meaning that the authors have followed the six steps logically, but also continuously have been moving back and forth to confirm and revise the interpretation of the result. A thematic analysis was chosen in this thesis as the purpose of the study stems from increasing the understanding how of BDA, from a practitioner's point of view, affects audit competence and processes and how they perceive BDA in their role. The information gathered from the interviewees could eventually be put together into themes and connected to the gathered literature and theory.

The first step in Braun and Clarke's (2006) consists of a transcription of the data, where the authors attained an overview of all the collected data. The second step refers to the coding process where the authors created codes and found common denominators in the respondents' answers. Codes refer to finding interesting and relevant features that the authors will use (see figure 6 for coding example). According to Braun and Clarke's (2006) recommendation, the authors coded the data individually, to compare the codes with each other to find the most appropriate common denominators. Furthermore, in the third step, when the codes were found, the authors sorted the codes into themes followed by comparing the codes to the identified themes. In the fourth step, the authors revised the found themes to see if the chosen themes actually were themes and if they were supported by the respondents' answers. In the

fifth step, the authors gave the themes names (See appendix B). Lastly, in the sixth step, the authors produced the report by using created themes (see figure 5 for the thematic process).

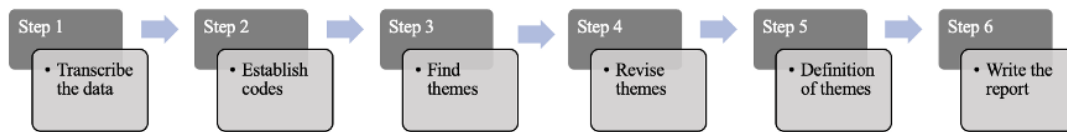


Figure 5. Own representation of Braun and Clarke’s (2006) thematic analysis process.

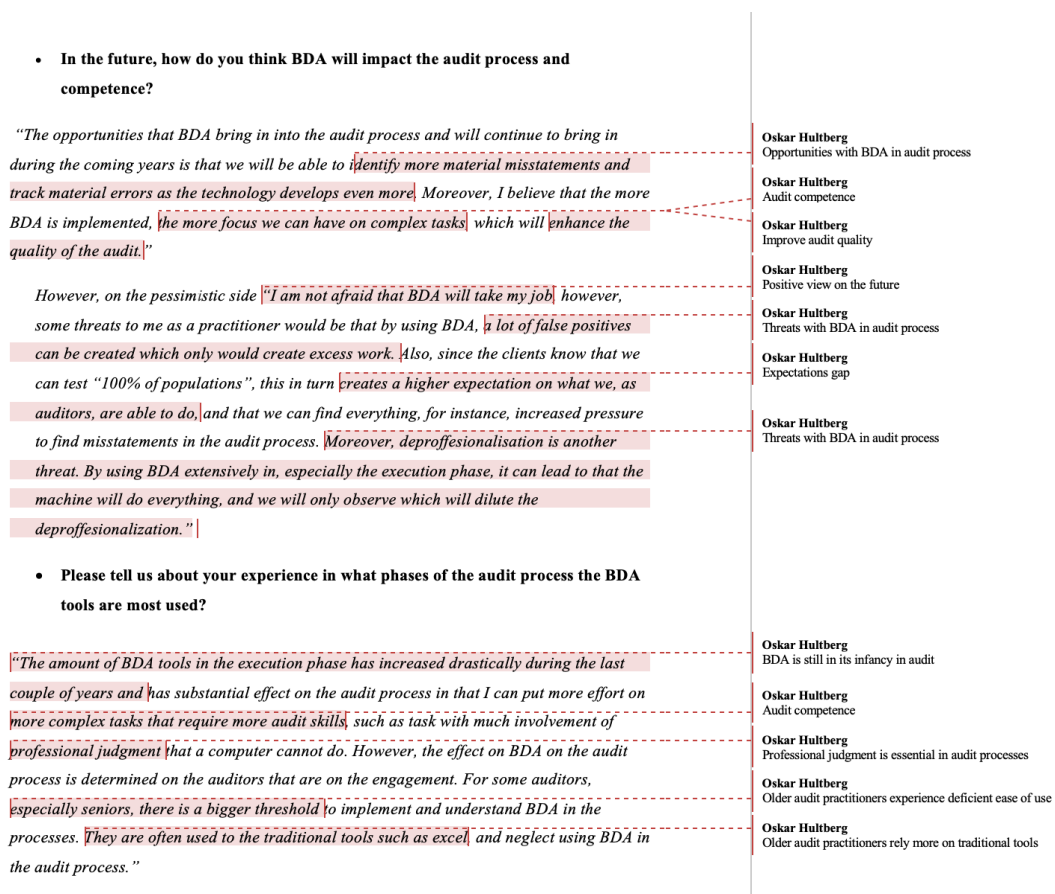


Figure 6: Example of how the authors coded the data.

3.7 Trustworthiness and authenticity

During the writing of this thesis, the authors have complied with the Swedish Research’s Council regarding research studies. Swedish Research Council (2017) addresses four ethical considerations (see section 3.8) and the trustworthiness and authenticity that research studies should apply, which this thesis has considered thoroughly. These considerations are also brought up by Bryman and Bell (2015). Bryman and Bell (2015) emphasize that reliability and validity are pivotal measures when conducting quantitative research. However, when

conducting qualitative research, these measures are regarded as irrelevant. Since the research method is qualitative, the most appropriate measure to assimilate validity and reliability, is to use *trustworthiness and authenticity* instead. Trustworthiness is in turn divided into four sub-groups, consisting of credibility, transferability, dependability, and confirmability (Swedish Research Council, 2017; Bryman and Bell, 2015).

Credibility refers to that the collected data has been interpreted correctly, that the research has followed “good practice”, and that respondent validation is achieved, meaning that the researchers ensure that their findings correspond to what the respondents have revealed during the interviews. After the interviews had been conducted, a transcription of all of the interviews was made, and shared with the respondent. This allowed the respondent to raise any objections against own interpretation of the answers. One shortcoming with qualitative studies is the *transferability*. As mentioned earlier, the study used semi-structured interviews is contextually unique, which means that the transferability of the findings into another context is limited. Accordingly, in order to establish generalisability, the two respondents from each big-4 firm differed in age and experience, in order to establish a broad a picture as possible. *Dependability* refers to that trustworthiness of the findings in the report is assured when the authors apply a research process that bears the stamp of following the ‘auditing approach’ where complete records are kept during all phases of the research process and choices are communicated. The authors of this thesis have met this criterion by describing the different choices that have been made and how the study aimed to be conducted (Swedish Research Council, 2017; Bryman and Bell, 2015).

Additionally, the author’s own perceptions and opinions of this study have aimed to not influence findings, meaning that the findings of the study are based on the gathered data, and the authors have strived to diminish potential interpretations of the findings, also referred to as *confirmability*. Lastly, *authenticity* refers to that the authors depict a fair record of the respondent's answer and “represent different viewpoints of the social setting” (Bryman and Bell, 2015, p.398). This study interviewed respondents operating on two different levels of the firm (senior and junior), thus from a fairness viewpoint, the findings can be considered as fair since different perceptions among the interviewees were presented (Swedish Research Council, 2017; Bryman and Bell, 2015).

3.8 Ethical considerations

When conducting interviews, it is imperative that ethical considerations are affirmed. In this study, the four ethical considerations presented by Bryman and Bell (2015) and Swedish Research Council (2017) have been taken into account, in order to protect the respondents' integrity, namely *harm to participants*, *lack of informed consent*, *invasion of privacy* and *deception*. Prior to the interviews, an email was sent out regarding what respondents' participation would entail in terms of privacy and ethics, and the authors also asked for permission to record the interviews. The purpose of the study has been affirmed clearly and truthfully, both prior to and after the interview, informing the respondents about the purpose of this study, and what their contribution will contribute. Moreover, the authors have affirmed the lack of informed consent by stating that the respondent's participation is voluntary and that they have the right to stop the interview at any given point. Also, the authors stated that the reproduction of the respondent's answers in the thesis would be anonymous and their names or company will not be mentioned in the thesis, which is in parity with the aforementioned literature's consideration, *lack of informed consent* (Bryman and Bell, 2015; Swedish Research Council, 2017)(see Appendix D).

4. Findings and Analysis

During the process of the thematic analysis seven main themes were developed based on the answers from the interviews, the themes are (1) Current state of BDA, (2) Audit processes (3) Opportunities, (4) Threats, (5) Competence, (6) Professional judgment, and (7) Technology Acceptance Model. The first two themes were quite easy to map out since all of the interviewees were allowed to speak freely regarding their opinion of how BDA is used and in what way BDA has affected the audit methodology at the firm. The following two themes are based on what was mentioned as what the auditors believe about BDA tools in the future and what they believe will be benefited from the implementation of BDA but also what challenges they face. Furthermore, since the audit is highly dependent on the ability of the individual auditor, the interviewees gave their opinion on what effect BDA will have on the competence and the professional judgment of the auditors. Moreover, the last theme was constructed to try explaining what could be determinants of whether an auditor will start using a new BDA tool or not.

4.1 Current state of BDA

All of the studied firms have implemented BDA tools to some extent and every interviewee is familiar with the concept, however, there were several differences in how they perceived BDA and new technologies depending on what position the interviewee had at the firm and how involved the individual was regarding the implementation. Furthermore, all of the participants explained that even though BDA tools are implemented within the audit process, there is still a long way to go. It is their view that the BDA implementation is just in its infancy since it is only used to simplify manual and repetitive tasks at present, in the future, they believe that BDA will be able to analyze the data better and generate more and accurate insights. Moreover, the participants all express that BDA could be utilized more within the process than it is today. They explain that the implementation is not optimal since it takes a lot of resources and time to learn a new program and due to time-constraint learning a new program is often overlooked. These answers point out that BDA implementation in the audit process is conceptual, and its practical implication of it remains salient (Salijeni, 2019; Brown-Libur, Issa and Lombardi, 2015; De Santis and D'Onza, 2021).

Another general view that highlights the fact that BDA tools are just in the implementation phase is the fact that the participants say that BDA tools are used in parallel with traditional

tools. Moreover, several participants say that there have been many occasions where the plan was to use BDA tools but they ended up using traditional tools, taking samples for example. Additionally, the auditors explain that they often contact specialists to conduct a thorough analysis and right now, the auditors only perform simple data analysis, when a more in-depth analysis is performed, IT-auditors are consulted. Nevertheless, all of the participants of the study stressed that learning and implementing BDA tools within the audit were of high importance. J1 says *“I think that everyone understands that taking samples and inspecting accounts manually belongs to the past. Now, and more importantly in the future, my job will definitely be highly influenced by different new ways of analyzing the data that we receive”*.

An overall view that was presented by all of the interviewees however was that it is the client that controls to which degree the auditor can use these tools in the audit. Every auditor mentions the fact that it is currently most useful to use BDA tools at larger firms where they can retrieve more and reliable data from the client. S1 says that:

“At larger firms, they have better ERP systems, are more used to working with larger datasets, and basically have more data, which makes it more doable to use these tools. At smaller firms, it is more pragmatic to use more traditional tools, but I believe that these tools will be implemented even more as the technology progress

de Medeiros, Hoppen and Maçada (2020) also mention this, one issue that auditors might have when implementing BDA tools is that the quality of the data is not sufficient. Furthermore, this reasoning is in line with what Cao, Chychyla and Stewart (2015) also suggested in their research, that in order to implement BDA tools on a larger scale much data is needed, if this data cannot be provided the implementation might be delayed. Moreover, a more general picture from the interviews is that it is the junior employees that have more knowledge of how BDA tools are utilized and used within the audit. It is the junior auditors that can give practical examples of how they actually use it while the senior auditors talk more generally about the benefits and opportunities that can be generated by using BDA tools. This is however an expected result since senior employees are not as familiar with these tools and how they are utilized within the process, the senior auditors have a more general view of the complete audit instead of specific audit tests. The previous statement can be summarized by a quote from J2:

“It is the junior auditor that has contact with the audited firm, collects data, and performs the tests in the program. Hence, it is natural that I as a junior employee have more understanding of how these procedures are performed practically”.

Another pattern is that all of the junior auditors mentioned was that when implementing BDA tools, the first year is always the most difficult year. J3 says that:

“When you introduce BDA tools for the first time to a client, it requires a tremendous amount of work to make it work properly. You have to work together with different departments at the firm, writing scripts, and checking if correct procedures can be performed. However, after the first year, you can reap the benefits from the time spent on year one since in year two you can just input the data into the programs.”

J3 also says that time spent during first year might not be profitable if you look at it on a year-on-year basis but claim that you have to consider that these are clients they plan to have for several years. The auditors strive to build relationship with the client and to be able to do that, they stress the necessity spending more resources at the beginning of the relationship.

Cao, Chychyla and Stewart (2015) discuss the problem with data security and that clients might be reluctant to share that much data with the auditors due to privacy concerns. In the conducted interviews, none of the auditors mentioned this as a problem. J2 explained that nowadays they have very secure systems where they can upload data, and therefore, they have a safe platform to facilitate sharing of data. J2 also mentions that receiving data from Swedish clients is actually easy due to the fact that many clients can send SIE-files⁵. Furthermore, J3 says that *“Auditors actually already have access to a lot more sensitive information, so it is not a huge step for clients to share this kind of information”*. The interviewees of course recognize that data security is an important issue when dealing with BDA but they express the view that the firm has put the correct systems and procedures in place in order for both auditors and clients to feel comfortable working with that kind of data. Additionally, J1 says that due to GDPR legislation, for example, clients and auditors feel comfortable working with sensitive data. The clients have a lot of trust in the auditors and do not worry that any auditor would misuse the data that they have received. Therefore, the problem regarding privacy issues that Cao, Chychyla and Stewart (2015) mention is handled and is not really seen as an issue by the interviewees.

⁵ SIE-files is a format facilitating the transfer of accounting data between different software (The SIE file format, 2008)

4.2 Audit processes

PwC (2017) divided the audit process into five different steps namely (i) *Pre-audit engagement*, (ii) *Planning*, (iii) *Audit Strategy and Plan*, (vi) *Gathering evidence*, and (v) *Finalization or report the findings*. Furthermore, PwC (2017) states that it is in the fourth step, also called the execution phase, that audit competence and the professional judgment is exercised the most. Moreover, IAASB (2017) states that it is in the execution phase that is affected the most by the introduction of new BDA tools. This view is also shared by the interviewees who state that it is in the phase where you actually perform the audit procedures that you can utilize the benefits from BDA tools at the current implementation. However, S2, S3, and J4 also say that it is an important consideration to keep in mind during the planning phase. This is due to the fact that they want to be sure in the beginning what kind of methods and procedures that they can use in the later stage of the process and not be surprised having to change the procedures due to not receiving correct data. Additionally, S3 says that she would like it if the firm used it more, and encouraged the employees more to use it within the planning phase. She explained that it could be much better utilized and gives the example of running preliminary batches of data to identify more efficiently where the risks are, hence where they should direct their attention during the audit.

The risk assessment procedures have been affected due to the implementation of BDA tools. In order to conduct an audit of high quality, the auditor has to understand what kind of risks that are present within the organization (Deloitte, 2020; AICPA, 2015; Allen et al., 2006). BDA has given the auditors the opportunity to go from a more two-dimensional process, towards testing and analyzing the structure of the entire risk system. S1, S2, S3, J1, J3, and J4 explain that the implementation of BDA tools has led to a more focused shift within the audit. They rationalize this claim by both stating that they can visualize the transactions and therefore understand the transaction flow by the firm and also that they have the possibility to narrow their focus towards transactions that have shown signs of misstatements. J2 says that:

“By using BDA tools we can divide the population into subpopulations based on patterns. Thereafter we can visualize these patterns which give a holistic view and understanding of the nature of the transactions. However, this way of working is only implemented on a small scale on a small number of assignments, and I believe that this technique could be utilized much more.”

The participants of the study, therefore, give a similar view of what impact BDA has had on risk assessment procedures as the literature (Yeo and Carter, 2017; PwC, 2021). Although, it is not as implemented within the auditors' work and it seems like the literature has quite an optimistic view of the pace of the implementation. Additionally, all of the interviewed auditors say that one of the biggest benefits generated from using BDA tools is that now they can test the whole population of transactions instead of just taking a sample of a couple of transactions, i.e. analytical procedures. S3 says that:

“If you have all transactions from the revenue you can match all of the transactions to see if they are correct. When we have performed this analysis of for example one billion in revenue, we can focus on the risk transactions. So instead of having one billion of revenue to investigate, we now only have 40 million to look further into.”

This improvement is also something that Salijeni, Samsonova-Taddei and Turley, (2019) mention as something that is the main benefit of introducing BDA into the audit process. The authors claim that if you can audit whole populations, the efficiency of the audit will increase, and manual and repetitive audit tasks can be removed leaving the auditors with more time to spend on more qualitative judgments and areas that contain more risks. Therefore, it is evident that the interviewed auditors highlight the same factors that are affecting the analytical procedures within the audit process as the literature (De Santis and D’Onza, 2021; Alles and Grey, 2015; Cao, Chychyla and Stewart, 2015).

In a similar vein, the auditors describe that the substantive testing during the audit engagements has been affected. All of the interviewed practitioners said that the tasks that are simple and repetitive, such as checking bank statements with ending balances are now performed by BDA tools. While other more complicated tasks that require more judgments such as confirming the fair value of an asset or confirming with customers that accounts receivable are correct have not yet been affected to a high degree. S2 says that:

“Now, with help of smart tools we can eliminate many repetitive tasks in the substantive testing phase, but we still have a long way to go when it comes to judgments. Although I think as the technology progresses, we will be able to use these tools more, but it won’t replace the human, rather complement it so the auditor has more evidence for his or her claim.”

In this field, it is apparent that the literature has quite an optimistic view of how fast these tools can be implemented and actually relied upon by audit professionals (De Santis and D'Onza, 2021; Alles and Grey, 2015; Salijeni, Samsonova-Taddei and Turley, 2019). However, S2 expresses the same view as Richins et al. (2017) that the tools in the future will not replace humans but rather act as a compliment.

When it comes to test of controls the literature gives many examples of how it will be implemented within the audit process and improve the work of the auditors (AICPA, 2015; De Santis and D'Onza, 2021). However, according to the interviews, this is not something that has been implemented just yet within the audit process. J2, J3, J4, and S3, mention that they are working closely together with other departments, such as risk departments, but don't really give any examples of how BDA is used when it comes to risk assessment. One explanation for this could be that since all of the interviewed auditors are mainly working with larger clients which means that the clients have large and complex IT-systems. Hence, to be able to understand and assess the risk one must be an expert on the subject and not just have some overview knowledge. Therefore, the auditors are not involved in this process and don't have an understanding of how these processes work. Furthermore, S1 says that when it comes to segregation of duties it is not possible to perform this task with the help of BDA. He explains that the work contains a lot of judgments and manual subjective assessments which require human interaction and does not how a BDA system could perform this.

Based on the discussion above one can determine that it is the manual and repetitive tasks that have been affected the most. Identifying material misstatements that should be investigated more thoroughly can be found in a much more effective way since the auditors can examine all transactions within a few seconds if the data is correct. Another interesting aspect mentioned by J2 is that his firm is currently working on a tool that is facilitating the auditor's ability to evaluate the going concern of the firm. The auditor explains that the tool will compare previous financial statements from the firm and also similar firms within the same industry to determine the likelihood that the firm can continue its operations. This is something that lies in-between repetitive tasks and judgment tasks so at least according to that specific auditor the audit firm is doing more than just eliminating manual tasks.

More interestingly, none of the auditors mentioned that BDA tools increase the quality of the audit report. The interviewed auditors say that it is still the same report that is being presented and the content of the report has not really changed. What has changed is how the auditor can

gather the evidence and can do this more effectively. They mention that even before these tools were introduced, the auditor still needed to have sufficient evidence, one principle that still stands. Furthermore, all respondents say that since the standards and regulations are the same as they were before BDA were introduced, they do not really see how or why the quality of the audit report would change. This view is conflicting with the view that the literature presents. Many authors suggest that due to the implementation of BDA, the quality will automatically increase (De Santis and D'Onza, 2021; Cao, Chychyla and Stewart, 2015; Alles and Grey, 2015) which does not seem to be the view of the interviewed auditors in this study. It is apparent that the shift towards more BDA tools in the audit does not go as quickly as the literature predicts. To this question, S4 stress that the reason for the transition in the audit process taking so much time is because of time shortage *"We do not have time to learn new systems fully, and there is no time to change our contemporary systems to new systems."*

Moreover, IAASB, (2014), (2017) and, ACCA (n.d) emphasizes the increased effectiveness in the audit process due to BDA implementation. However, the respondents stress that today, the engagements are longer and require twice as much time as they did ten years ago. The respondents say that the tasks can be done in a more efficient way, by leaving repetitive tasks to the BDA, however, due to the increased amount of tasks, the time spent on each engagement has increased. S4 stress: *"the checklist we have to follow is much more extensive today because every year, new standards appear that we have to follow, which is in line with that business environments becomes more complex after every year for instance."* Moreover, S4 stress that since the BDA is such a novel tool, we use traditional tools simultaneously to hedge ourselves towards potential shortcomings that can appear in the system, which inevitably makes the process twice as time-consuming.

4.3 Opportunities

First of all, S1, emphasizes that by introducing BDA more into the audit process, the identification of material misstatements and deficiencies will increase substantially. S1 says that since much of the audit processes rely on substantive testing and test of populations, there is a risk that misstatements outside the tested population pass unhindered. Also, S1 mentions, in line with Cao, Chychyla and Stewart (2015), that the more BDA is introduced in the processes, the greater opportunity to detect misstatements in the segregation of duties. For example, S1 says:

“As of today, when we conduct segregation of duties, this is always a manual process. We collect a list of all the clients' employees that have access to do bank payments for instance and manually compare this against the employees who have the authority to create bank payments. Additionally, we have to have meetings with the client who will walk us through how their systems are built so we can ensure that there is no risk of violations against the segregation of duties to occur.”

Contradictory to Santis and D'Onza (2021) and Cao, Chychyla and Stewart (2015), the respondents reveal a more pessimistic view where they do not think that BDA will have enough capacity and reliance to be a substitute in the segregation of duties in the future. They express a hard time incorporating BDA to a full extent in test of this controls, since there is a lot of human hand-laying and judgment needed for this.

Further, J2, J4, S1, S2, and S4 argue that the implementation of BDA will enhance the opportunities to better understand the client's business and associated environment. The above respondents agree, in parity with IAASB (2017) that the more BDA is implemented, the quality of risk assessment will increase, which is of essence in the rapidly changing and more complex business environment. The respondents say that this will be of great help in the risk assessment carried out in the planning as well as the execution phase. S3 stress, in line with Cao, Chychyla and Stewart (2015) that *“Increased utilization of BDA will increase our ability to collect, analyze and process more data from the client which will enhance our work when considering clients environment, business, and inherent risks.”*

Again, S1 and S4 stress that to realize this opportunity, it is dependent on the client's ability to store and provide the auditors with high qualitative data. S4 says that in the best of worlds, the client's system is fully integrated with our system, e.g. that the revenue bookings fulfill the criteria to be used by our BDA system. However, S4 finalizes and says that realization of this possibility is far-fetched and will not be witnessed during the rest of her 15-year career.

Literature emphasizes that the implementation of BDA into the audit process provides auditors with more appropriate and adequate information, enhanced accountability and efficiency in fraud detection, and more credible audit engagements (Alles and Grey, 2015; IAASB, 2014; 2017; Salijeni, Samsonova-Taddei and Turley, 2019). According to all respondents, fraud in audit procedures is extremely rare, and something that 99% of auditors do not encounter in their career as an auditor. Hence, they find it difficult to say how the

implementation of BDA would facilitate auditors to find fraud. However, S1 and S3 mention that since the fraud ratio is extremely low throughout their engagements, an increase of BDA into the processes, could lead to an increase in fraud. S1 says that:

“I see a risk that implementation of a more self-manuevered system like BDA in the audit process could lead to that fraud go undetected if clients learn how to bypass the system” and “since we have many manual processes still in place in the process, I think this makes it even more difficult for fraud to pass through our controls.”

This skepticism of fraud detection emphasized by older auditors sympathizes with Razi and Madani (2013) and Al-Gahtani (2008), that older auditors are controversial and reluctant to adopt new tools since they are unsure they will deliver same results as the old system. Furthermore, when discussing opportunities BDA have on audit quality, all respondents express no change in quality of the reports thanks to BDA in the nearest future. S3 stress that:

“BDA is still in its infancy, and the full benefits of BDA have not yet been realized which makes us see no change in the quality of the reports. At my firm, traditional tools that we have used since I started 20 years ago still constitute a majority of the utilized tools in the process. Since BDA is so new, we use the traditional tools to double-check that the controls and tests are done correctly.”

The respondents stressed that even though the implementation of BDA will lead to a greater focus on complex tasks and tasks with higher risks because the technology can focus on the repetitive tasks (FRC, 2017), they do not see enhanced audit quality as an opportunity with the system in the future. Notably, S2 says: *“Since we still use traditional tools more extensively in the process, and complement the BDA controls with traditional testing, I do not see how it will have remarkable effects on the quality.”*

A consolidated view of the opportunities is depicted among the respondents where all argue that BDA will enhance the audit process in the future, which is in line with the literature findings on the opportunities BDA will bring in (Cao, Chychyla and Stewart, 2015; Alles and Grey, 2015; IAASB, 2014; 2017; Salijeni, Samsonova-Taddei and Turley, 2019). However, there is a skepticism among senior respondents about what BDA will be able to do, for

instance, segregation of duties. This skepticism stems from the lack of trust in the system and does not perceive it as useful, which affects the actual usage of the system (Davis, 1989).

4.4 Threats

All of the respondents stress that in parity with the implementation of BDA in the audit process, and the ability to test 100% of populations, and leave nothing unchecked, this creates substantial expectations on the auditors to find potential misstatements throughout the engagement, which is in line with previous research. S4 mention that there are laws and regulations auditors are obligated to fulfill in the audit engagements, which already is an expectation they have on them, namely to comply with the laws and regulations. According to S4, this creates additional expectations, impossible to fulfill.

Moreover, J3 stress that *“As of today, it feels like we already are expected to find every misstatement in the engagement. With BDA in the process, this expectation would increase to an unproportionate level, impossible to live up to.”*

The respondents express the same problems as literature (Earley, 2015; De Santis and D’Onza, 2021) has described regarding increased accountability. They express a worry that, as technology progresses and society becomes more familiar with modern audit methodology, they will be held accountable for events they cannot control, expanding the array of expectations audit practitioners have on them today. The respondents answer on the follow-up question of how this expectations gap can be mitigated. All interviewees stress the importance of clearly communicating the purpose of the audit and that auditors relate to materiality and audit misstatements posting threshold limits. This perspective is imperative for the clients to be aware of prior to the engagement to mitigate this, the respondents reply.

Furthermore, all respondents mention deprofessionalization as an inherent threat with the increased BDA implementation in the audit process. J1 describes it as a consequence of having the BDA technology doing the work instead of oneself, which might lead to that the profession of being an auditor disappears. J1 further elaborates that giving responsibility to a machine could lead to a loss of understanding of the profession. In a similar vein, S4 stress:

“When I joined the firm 20 years ago, the analytical tools were limited, which forced you to find the answer yourself if you found an anomaly and then track it. Today’s

associates joining the firm, if they encounter anomalies, they see a red-flagged number and a computer that tracks where the anomaly originates from by itself.”

The literature points out that for appropriate BDA implementation, there is a need for change. In parity with Brown-Liburd, Issa and Lombardi (2015), S4 says that for satisfying BDA implementation, auditors must possess knowledge about analytical tools and programming. For example, S4 says:

“This is of essence for mitigating deprofessionalization of my profession since this gives the auditor a proper foundation to better understand what hides behind the green and red light on the screens. It is not long-term sustainable to call IT department every time you do not understand the data.”

For this, the respondent expressed that they work extensively with adapting required competence from their job applicants searching for a position in the audit department. Without the appropriate understanding of what the data means, and what data to use in the analysis, S4 also mentions that this can lead to a lot of false positives. *“There is a risk that the data depicts a substantial amount of inaccuracy and inconsistency, which would lead to extra work for our auditors.”* Similar is stressed by S1 saying that a risk with BDA is that auditors, especially new auditors, are too naive and simple-minded and tend to put too much trust in the data, and that the data that turns up on the screen is correct. Moreover, S4 says:

“The way I see it is that this can cause a severe threat to our audit processes. If we are too faithful towards the data gathered in the processes, fraud makers can put this into system and learn how to circumvent the controls and bypass the controls and commit fraud. Since the associates are the ones most exposed to the client's data and the testing and controls in the engagement, this risk is even greater.”

In addition to this, J3 express that a threat arises around the reliability of the gathered data and ensuring that the data is correct. Contradictory to the respondent, Yoon et al. (2015) argue that data gathered with BDA is of much greater reliability than data gathered with more human imposition. However, the deficient usage of BDA in the audit processes could explain why the respondents answered the way they did.

4.5 Competence

The junior auditors stress that they have adequate competence to deal with BDA in the process. However, they stress that there are areas in which more competence could be developed. J1 stress that on every engagement, there is always at least one moment where he has to contact the IT expert. The auditors stress that in parity with the increased amount of data, the demand for auditors to develop more analytical skills has increased. S3 stress that:

“When I first started at the firm 30 years ago, we did a lot of samples and ticked a lot of boxes, and the work was pretty easy. As BDA integrates more and more into our daily operations, we have moved away from the ticking boxes mentality and now you need to deal with a substantial amount of data that you have to understand, hence, we need people that have good analytical skills to deal with this amount of data.”

Yeo and Carter (2017) stress that in parity with the increased BDA implementation, auditors have to develop new competence in three main areas to cope with the development of BDA in audit, analytical skills, be able to develop new metrics, and have competence to use visualization tools. All the senior respondents stress that after BDA was introduced, the need for the auditors to develop competence in visualization has increased dramatically. For example, S4 says:

“This competence is pivotal when we present the finished engagement for the client. Since everything is much more complex and entangled today, the visualization of the findings is essential to make the client understand what misstatements we have found and what parts of the processes they can improve.”

Additionally, S1 and S4 stress that visualization competence is not only pivotal to possess in the audit context. The respondents stress that the visualization competence is of essence to decrease the rotation of clients as well. S1 stress that:

“Visualization tools most often are used in the assurance⁶ part, where we suggest improvements to e.g. streamline operations and effectivize production processes. If we do a good job here, the clients are very likely to keep using us as auditors in the future, which will gain us in terms of money and workload. This is because the first

⁶ Assurance services refer to procedures aiming to manage and govern organizations and work as value drivers for business success and can be seen as something beyond the financial audit (KPMG, 2016).

one to two years are often unprofitable since we have to learn their processes and operations which often takes a lot of time and requires money.”

S1 stress that in correlation with the implementation of BDA tools, there is a feeling that you need to develop technological skills. He stresses that:

“When we use BDA in our engagements, some of the data has to be coded, and for that, you can not be a “traditional auditor”, but you have to have IT skills to make the data understandable. If you don't have this competence, you have to contact the IT department which often has a lot to do which delays the audit engagement, so you are in other words almost forced to develop this coding competence.”

Despite the prominent need for analytical competencies in the audit process, the understanding of the client's industry is almost more important than IT competence. Additionally, S3 says:

“If we have an auditor that is very good at IT, and can extract data from the files and make the data understandable, but has limited or no understanding of clients business environment and the risks they are exposed to, he or she will make no use. [...] this competence is even more important in parity with that the business environment becomes more complex, and an understanding of the clients business is pivotal to be able to carry out the engagement.”

S2 stress that there is a risk of losing relevant competence when you have a system that does a lot of the working tasks, previously done by the auditor. The senior respondents that are in decision-making positions stress that the company's investments in internal education regarding IT and new technologies have increased dramatically during previous years. Notably, S3 says:

“We have gone from having an onboarding program to having continuous training for all our employees. This training is crucial to maintain competence and develop new skills when new systems are introduced.”

The senior respondents stress that the training focuses both on accounting tasks and analytical tasks. For instance, in the education package, there are analytical tools in excel and Qlik programs. S1, S2, and S4 stress that lately, the discussion of having more programming

education has increased. S2 mentions that: *“We are discussing if we should introduce programming education like SQL, similar to the education that our IT experts have. This would increase the efficiency even more.”* However, the respondents stress that IT experts will still be needed due to that many complex processes exist which require particular knowledge, and there is still a very long way to go before these tools will be fully integrated.

J4 stresses that the education directed to the junior associates has created *“two camps” in our firm where the seniors have less competence related to BDA, whereas the juniors are miles ahead. This might lead to that the seniors are less prone to change in regards to BDA implementation than the more juniors.”*

J3 emphasizes that the best education refers to the education you get in your daily activities. J3 says: *“No matter how many hours you spend in our education programs, you will never experience similar tasks in your daily operations. According to me, the learning by doing mentality is the best way to increase the competence regarding BDA.”* In addition to this, S3 says that the requirements profile when hiring has changed a lot lately. *“Today when I give Human Resources (HR) the task to hire new associates to our office, required competence has a much more focus on IT knowledge. Today, we not only hire Business Administration graduates for instance, but also data scientists, to the role of an audit associate.”*

In parity with Earley (2015), all of the respondents underline the necessity of a changed educational content to better suit the working life, and especially the audit profession. The respondents stress that education must contain courses that go in parity with the working life. The respondents believe that the educational programs are not developed to the highly technological society we live in today. All of the employees that are hired today fall short of relevant competence such as analytical and data competence when they start their first day. This makes Earley (2015) insights even more prominent that the academic curriculum must be more suited for today's business context and provide education beyond traditional accounting rules and understanding risks in the audit related to a transaction. All of the respondents unanimously stress that even though there are hundreds of BDA tools out there, you cannot prepare a student for every system, however, it would be good if the university education provided training on for instance excel, which is a central part in all BDA systems.

4.5.1 Professional judgment

All the respondents stress that professional judgment is the most important skill in an auditors toolbox, and it has become even more important in symbiosis with the increased implementation of BDA in the audit process. They also say, that the judgmental ability constitutes a cornerstone in audit engagements and reveal, in a similar vein as IAASB (2020), that the number of judgmental aspects exceeds the number of accounting standards by far, which marks its centrality. The respondents stress that an appropriate judgmental ability is developed after years of working as an auditor, where the auditor initially follows strict work procedures and schemes, and the more experience he or she develops, the more developed is their judgmental abilities. The senior auditors, that have been in the audit profession for at least 15 years, stress that the implementation of BDA in the audit process has had a substantial effect on auditors professional judgment. For example, S3 says:

“When I first joined the firm in 1999, many auditors would not be familiar with the expression professional judgment. But as time has gone, and more technological advancements have taken many repetitive tasks, professional judgment has never been more central in our role as auditors.”

In a similar vein, S1 stress that the implementation of BDA has contributed to that auditors can be more comfortable when they carry out judgment tasks. For example, S1 says: *“For instance, intangibles like goodwill or valuation of brands bear the stamp of substantial judgmental abilities. Thanks to BDA, I am provided with a better foundation to make a judgment about it and I have better support for my judgments”*. In parity with Brown-Libur, Issa and Lombardi (2015), the authors emphasize the enhancing effects BDA has on the professional judgment because of the providence of more adequate and better data.

On the contrary, S2 and S3 mention that being provided with better and more adequate data comes at the cost of receiving larger data volumes as well. S3 stress that *“sometimes, it can feel overwhelming when we are provided with huge files of data that we have to process, and at first glance, it feels completely undoable to manage all that data.”* This is something stressed by Brown-Libur, Issa and Lombardi (2015), stating that information overload can occur as a consequence of BDA implementation. This, in turn, fosters suboptimal auditing judgments, which undermines the idea of having BDA in the audit process (Alles et al., 2006; Alles, Kogan, and Vasarhelyi, 2008).

The respondents unanimously stress that BDA has led to that more data is available that the auditor has to process. Moreover, since technologies perform a lot of the working tasks now, there is an underlying risk that the auditor actually loses knowledge and abilities to make judgments as the BDA integrates and progresses in the processes. Hence, S2 says: *“It is imperative that auditors develop in parity with new technologies and understand what hides behind the processes and not just trust the system, otherwise deskilling effects can occur.”*

During the interviews, all the respondents were asked if they believe that the implementation of BDA in the audit process could make professional judgment disappear and that the technology eventually would replace this task. All respondents were confident in saying that BDA is a task that not will be able to be carried out by the system in the nearest future, but will rather act as a complementing tool side by side with the auditors, which is in line with Richins et al. (2017). This is based on the manual imposition needed in the judgmental tasks and cognitive ability behind the task, which today's technology is not adapted for.

S4 stress that: *“BDA has no doubt revolutionizing impact on my profession, however, I do not see how BDA can be standardized and replace the cognitive tasks carried out by us. As of today, I believe we are in such an early stadium in the BDA era that we will not witness that transition in the coming 20 years. To give you an example, I do not see how the BDA could recommend a company with a struggling project to give it more time because of the cognitive considerations in such a dilemma.”*

4.6 Technology acceptance model

4.6.1 Perceived ease of use

During the interviews, the two groups of respondents, seniors and juniors, presented a distinguishing view on the perceived ease of use of BDA tools in the audit process. The juniors emphasized that the implementation of BDA tools in their daily work task has a good system design and is well implemented, which influences their actual usage (Davis, 1989). Additionally, the juniors also express that the possibility to contact the IT department, i.e. *technical support* in Davis (1989), makes them much more likely to use the system. All of the J-respondents stress that education programs for their audit-role have prepared them a lot, and they understand how the system works, prior to actually starting working with it. J1, J2, and J4 also stress that they have been working with similar tools at their previous employer which gives them an advantage when they use it now. Additionally J4 says *“ I have been working*

with BDA previously and have a good experience from working with the system and I find it user-friendly.”

In regards to the perceived ease of use, J1 emphasize that the systems they use at his firm are very understandable. There are concrete guidelines on their intranet which are explanatory that everyone has access to if they would find something complicated with the system. J1 further stresses that the BDA technology effectivizes his daily duties to a great extent and that his colleagues who do not share his perceived ease of use of the technology applies other tools throughout the engagement process that takes a lot more time. In parity with the theory of technology acceptance, J1 emphasizes the system's friendliness and that it is easy to understand, and accordingly, this leads to an actual usage of the system (Davis, 1989).

Davis (1989) stresses that users' perceived ease of use of a newly implemented system mirrors the actual implementation of the new technology in the business process. This is clearly argued for by the J-respondents who claim that they feel that the BDA system is easy to use, inter alia as an effect of the system design and previous experience of using the system. The J-respondents perceived ease of use, distinguishes clearly from the older respondents, S-respondents, who express another perception about BDA in the process, which is in line with the literatures findings regarding age as a determinant impacting the actual usage (Razi and Madani, 2013; Al-Gahtani, 2008). S2 emphasizes that:

“Ever since we started to introduce BDA, I have perceived obstacles to actually use the system. There is a big leap to understand it and integrate it into your daily work procedures which have led to that I rather use older versions of systems instead.”

Also, S4 says: *“To understand the system I have to dedicate myself and put myself into the system of how it works to be able to use it in my work procedures and I believe that today's BDA systems are too complicated for me to put myself into and learn.”*

All seniors express this obstacle but also express that it is possible to get over the obstacle by going on different education programs that are assigned to the juniors when they come here on their first day, and thereby learn how the system work. However, S1, S3, and S4 say that this would not be possible due to the workload and other tasks they are assigned to. In addition to this, the seniors stress that they are not involved in the execution phase as much as

the junior co-workers are, hence, they do not think it is necessary to learn the system. Moreover, all the senior respondents stress that when they are doing testing, they are more comfortable using the traditional tools and do sample testing to a greater extent. This is because this technique has been used for as long as they can remember and they know how to do it. J1 stresses that the pessimistic course of action of BDA implementation comes predominantly from his senior colleagues. J1 says that *“this probably is because they have used older methods during all years and they are aware how to use the old-school systems.”*

As presented above, there is a significant distinction between the junior and senior respondents, where the latter perceive it as more difficult to use. What was revealed during the interviews was that this discrepancy comes from the differences in age, as expected by Al-Gahtani (2008) and Razi and Madani (2013), but also based on previous experience from working with the systems, design of the system, and technical support (Davis, 1989).

Since the implementation of BDA in the audit process is a strategic choice the firm makes, and due to the senior auditors perception of BDA being sceptical, it becomes problematic. All the interviewed seniors are in decision-making positions where they can decide to what extent BDA tools should be a part of the audit process. All of the seniors express that at the end of every audit engagement, they always ask the juniors to complement with traditional tools like substantive testing to ensure no mistakes are done in the BDA process. Hence, notable is that their perception of BDA will have direct effects on the extent the technology is implemented in the audit process and the actual use of BDA (Davis, 1989). This could have hampering effects on the technological transition audit firms are experiencing today with new emerging technologies being rejected by senior auditors due to lack of perceived ease of use, in their view. The realization of the benefits with BDA, for the auditors as well as the clients, takes an unintentional turn, where the perceived benefits with the system have to wait until more technological savvy auditors enter the role as decision-maker on the firm. This reluctance to technological change is also one of the challenges when organizations are adopting BDA tools. When firms face this reluctance, especially from people in a decision-making position, this will make it difficult to change the firm's trajectory towards a more data-driven decision culture (de Medeiros, Hoppen and Maçada, 2020).

4.6.2 Perceived usefulness

Moreover, in relation to TAM, how useful the technology is perceived will also determine the actual use of the technology. If the practitioner perceives it as improving the work performance, he or she is likely to actually use the technology in the process (Davis, 1989; de Medeiros, Hoppen and Maçada, 2020). J1 emphasizes that he perceives the BDA tools as very helpful in his daily activities by stating that:

“When I am about to check the accounts receivables I make use of our automated system to find potential anomalies in the client's books by looking at all receivables bookings. If I would do it the same traditional way as my colleagues, they have to take samples of at least 5% of all company receivables and check them against every invoice, obviously, this saves a lot of time and work and enhances the performance.”

The perceived usefulness expressed by J1 is in line with Janvrin, Lowe and Bierstaker (2008) who express that perceived usefulness is created when auditors believe that the analytical tool can assist in enhancing their performance. As presented earlier, all respondents express that the extent to which the audit firm can utilize the BDA tools in the engagements is highly dependent on the technological maturity of the clients. All respondents revealed that a big proportion of clients do not understand why auditors do not use previous methods when conducting the audit, also, they do not see the tools as useful if the outcome will be the same with BDA as with traditional tools. J3 says:

“There are two types of clients. One client who is genuinely interested in improving their processes and is optimistic about all our tools that can enhance their operations for the better, and hence they see BDA as a useful technique to get there. The second client sees the audit process as something that has to be done in accordance with the law, and does not see the value-adding effects BDA can have and hence does not want to adapt to our procedures, and is focused on the audit fees they have to pay.”

The respondents say that the clients who are more skeptical argue that the investments and efforts they have to do to make their data suitable and correct for the auditors systems exceed the usefulness they would gain from it. S1 and S4 emphasize that a common problem in the analytical procedure is the control of revenue where the data often is inconsistent and not can

be applied in their BDA systems. A majority of their clients provide them with revenue data in a “lump sum” instead of providing them with every single revenue sum. For example S1 says: *“When our clients do like this, we cannot use our BDA systems to track potential anomalies, and we are forced to apply older tools and do manual testing, which makes the BDA system unuseful.”*

In a similar vein, the seniors emphasize that they do not trust the BDA system enough to solely carry out a control with the BDA. As stressed before, the seniors often require complement activities with traditional tools when a control has been carried out by the BDA. In relation to TAM, it is indicative that the seniors do not believe in the system in the same way as junior auditors do (Razi and Madani, 2013; Al-Gahtani, 2008). In a similar fashion, the reason for this reluctance can, in parity Romney and Steinbart (2017) findings, originate from the fact that older employees are not practically used to working with the tools which affect their understanding of the system. The belief in a system is what constitutes if the technology will be perceived as useful or not, which in this case is not the case. In accordance with Davis (1989) the seniors have a positive attitude towards BDA, however, it is irrespective if the practitioner has a positive or negative attitude, it is if the user believes the system will be useful or not that determines the actual use.

J1, J2, and J4 emphasize that they believe that the seniors do not see the usefulness of the BDA tools because it would require substantial effort from the seniors to learn the new system. J1 and J2 point out that many of their seniors will retire in the upcoming years, and they believe that the seniors do not think it is worth the time to learn a new system, if they will retire in the coming years. Moreover, in parity with Salijeni (2019) and de Medeiros, Hoppen and Maçada (2020), S4 stress that the BDA systems are very expensive with a high investment barrier, and the respondent stress that one issue is that audit departments have very high profitability KPIs, *“there is no financial space in our budgets to implement these tools with such short notice in the audit process, this transition will take much longer time than we expect, I think.”* Hence, even though senior employees would like to invest time and resources in order to implement BDA, the individual is limited since he or she is also forced to reach KPI targets which in turn hampers the perceived usefulness of BDA.

In relation to TAM, the actual use of BDA in the audit process is not only determined by the perceived ease of use and perceived usefulness by the auditors, but also clients constitute a

central pillar for the use of BDA. Hence, the transition of more BDA implementation in the audit process requires a technological shift, not only in the audit companies but also in the clients businesses. All respondents revealed that they audit many organizations that use technologies implemented at least 15 years ago, which makes it difficult to use BDA tools on since the data is incorrect and inconsistent to use in the BDA. In parity with de Medeiros, Hoppen and Maçada (2020), it is difficult to transform to a BDA environment in firms that do not have appropriate data quality and information architecture. Hence, based on the interviews, there is twofold obstacle to BDA implementation in the audit process and actual usage, referring to older senior auditors non-compliance (Razi and Madani, 2013; Al-Gahtani, 2008), and clients technological maturity. These determinants form the perceived usefulness and perceived ease of use, which have direct effect on actual usage of the technology in the audit process similar to what previous literature has stated (Davis, 1989, Razi and Madani, 2013; Al-Ateeq et al., 2022).

5. Discussion

The fifth chapter entails discussions of the findings from the semi-structured interviews with the audit respondents. The discussion chapter is related to the theoretical framework and give account for various discussions points stemming from the findings chapter.

The adopted theoretical framework identifies that the actual usage of a technology is determined by the perceived ease of use, and perceived usefulness among the practitioners. In parity with literature, junior auditors perceive the BDA systems to be easy to use and helpful. The juniors have experience from previous employers, and close contact with the IT department which facilitates their work with BDA systems. On the other side of the spectrum, the more senior auditors express a pessimistic view towards BDA, where they also argue that there is a big leap to start learning the new systems. Additionally, the actual usage of audit tools is overrepresented by traditional tools. The authors of this thesis believe that the scarce amount of BDA tools in the audit process can be explained by Davis (1989) concepts of perceived ease of use and perceived usefulness among the senior auditors. The senior auditors perception is additionally in line with Razi and Madani (2013) and Al-Gahtani (2008). This pessimistic view can be discussed to be problematic since most of the interviewed seniors are in a position to decide to what extent BDA tools should be implemented or not in audit engagements. This in turn impairs the technological transition in the audit process.

Henceforth, in relation to TAM, the implementation of the BDA tools is not solely determined by the practitioners perceived usefulness and ease of use, but also by the clients perceived usefulness. The auditors express that the clients technological maturity determines how comprehensive the auditors can use BDA tools throughout the engagements, and that some clients are more focused on the audit fees rather than the value adding effects they would gain from it. To this, clients express no perceived usefulness of BDA since the outcome will be the same with BDA as with traditional tools. This highlights the multidimensional obstacle BDA implementation in the audit process faces and the different factors determining the actual use of BDA. Also, it impairs the possibilities to attain a transition towards using new techniques in the audit engagements. Hence, to reap the benefits of BDA systems in the audit process to a greater extent, the authors of this thesis believe that it is imperative for auditors to provide assurance services to their clients to help them develop

their systems to work in symbiose with auditors BDA systems, and persuade the more reluctant audit clients, making them perceive the benefits with a BDA audit engagement.

Based on the collected data, there seems to be a discrepancy between the interviewees view of BDA and the literatures (Salijeni, Samsonova-Taddei and Turley, 2019; Buhl et al., 2013; De Santis and D'Onza, 2021; Alles and Grey, 2015) view on BDA. What was found in this thesis was that the literature seems to have quite an optimistic view on how BDA is implemented and how much it will affect the audit. Nevertheless, the participants express that they believe that BDA will influence the audit a lot, but not to the same extent that several scholars believe (Cao, Chychyla and Stewart, 2015; De Santis and D'Onza, 2021). Further, one interesting note within this subject is that the firms also communicate that they believe that BDA will revolutionize the audit and that they are investing heavily in these projects (KPMG, 2019a; EY, 2021; PwC, n.da; Deloitte, 2016a). However, the audit practitioners at the respective firms depict a contradicting view. One could discuss that this discrepancy could stem from the fact that audit firms aim to establish a credible picture to stakeholders in order to attain commercial goals, and position themselves as leading within technological advancements or as an answer to contextual pressure, which is in line with Curtis and Turley (2007). Whereas the audit practitioners are, first and foremost, eager to fulfill the objective of the audit, namely to establish high audit quality (Mansouri, Pirayesh and Salehi, 2009). The discrepancy between the practitioner's and literature's view on BDA is a unique finding to the best of the authors of this study's knowledge. Previous literature makes the claim that BDA is implemented to a wide extent, and e.g. *“act as a game-changer in innovating audit practice and improving audit quality”* (De Santis and D'Onza, 2021, p. 1088). However, this study brings up the unique finding that this picture is not shared by the audit practitioners.

Moreover, another interesting aspect regarding this subject is that many of the interviewed auditors say that the reason for not using BDA tools is due to time constraints. However, that is something that both literature and the firms' own statements (De Santis and D'Onza, 2021; Alles and Grey, 2015; KPMG, 2019a; EY, 2021; PwC, n.da; Deloitte, 2016a) highlight as one of the main benefits of using BDA, that the audit will become more effective, and auditors will direct their attention towards more qualitative tasks. It seems like this constitutes a barrier since the techniques and tools that promise time-savings cannot be implemented fully due to constant time constraints in the audit. One could argue that the firms are focusing too much attention towards short-term goals instead of actually committing to new techniques

that would facilitate long-term profitability. As described by S4, even though she is a senior employee, she is still controlled by management KPIs and profitability indexes which in turn influence her perceived usefulness of BDA. She further explains that even though management communicates the message of facilitating BDA, it simply is not possible to fully implement BDA and still maintain the required KPIs. One could hence argue that management does not perceive BDA as useful enough for them to implement it more extensively. Meeting short time financial figures are more important, which comes at the cost of limited actual usage of the BDA systems.

One of the shortcomings of the increased BDA implementation in the audit process is that it fosters a greater expectations gap. Although contemporary expectations of the auditors already exist, it is imperative for the auditors to be clear in the communication towards the clients on what is reasonable to expect from auditors, especially along with the rise of more BDA tools in the processes which increases the expectations even more. The expectations on the auditor and their professional ability can be discussed to have deviated from reality. The primary objective of auditors is to establish financial reports with adequate quality and reliability (Mansouri, Pirayesh and Salehi, 2009). However, this view apparently collides with clients' profound expectations of what they perceive auditors should achieve (De Santis and D'Onza, 2021). Finding all potential misstatements in the audit process is unrealistic and the risk of being held accountable for events that the auditors reasonably should not detect increases. It is therefore of essence to discuss the weight of communicating the objectives of the audit procedure to clients, to reduce the risk of misunderstanding.

Another shortcoming refers to the risk of deskilling effects as a consequence of BDA implementation. In the rise of BDA, the practitioners skillset is revised, where the auditors, besides audit competence, should possess technological skills (Brown-Liburud, Issa and Lombardi, 2015). However, the authors of this thesis believe that a potential shortcoming of the increased integration of analytical tools in the audit process and the actual usage of BDA, is that auditors become too confident with the BDA doing the work for them, and accordingly, the professional judgment ability gets hampered. These concerns arrive at Fischer (1996) and Curtis and Turley (2007) arguments about deskilling effects, meaning that auditors risk losing their professional judgment as technology progresses. The auditors inevitably becomes overreliant on the technology, instead of their own capability.

Moreover, it is apparent that the practitioners believe that the required competence needed has, and will change in the future which is something that also previous literature has mentioned (Alles, 2015; Yeo and Carter, 2017). The interviewees claim that young professionals should have much more IT-related knowledge in order to better progress in their careers. One interesting aspect that several of the respondents highlight is that universities should prepare students to a much higher extent when it comes to practical IT-knowledge such as Excel, SQL, and Qlik. They claim that what is taught in business schools simply does not correspond to the abilities that are required at the workplace, but rather focuses on a career in academia. If BDA is going to revolutionize the audit profession (De Santis and D'Onza, 2021), one could discuss that the objective of university education, to prepare students for the working life and develop critical thinking, is inappropriate if the students are not taught the systems that flourish in today's business context. Additionally, if business schools were to invest more in BDA education, one could discuss that this would facilitate audit firms transition towards integrating more technological tools, and the ease of use of BDA systems. Apparently today, audit firms experience a paradoxical situation where firms see the efficiency potential in the systems that promise time-savings, however, due to time and financial constraints there is no room for fully integrating them at the respective firm.

6. Conclusion

In the last chapter, the authors summarize the main findings which result in the conclusions for this thesis. Moreover, the authors highlight the theoretical contributions for academia, as well as empirical contributions. Lastly, the authors discuss limitations related to the thesis and give suggestions for potential avenues for future research. Methodological limitations are announced in the third chapter.

6.1 General conclusion

The rise of BDA in the audit methodology is a new phenomenon that reshapes the way audits are conducted. Previous literature is conceptual on the BDA topic and its effect on the audit process and competence, and the empirical understanding of this topic is deficient. Hence, the aim of this study has been to investigate how the implementation of BDA tools affects the audit process and audit competence from the practitioner point of view. From the practitioner viewpoint, the thesis concludes that BDA affects the audit process in the sense that repetitive and manual tasks can be performed more efficiently, and as a result of larger datasets, auditors can take more well-founded decisions and judgments in the audit engagements. Additionally, BDA impacts the processes by enhancing understanding of clients businesses and their environment, and better identifying material misstatements and deficiencies.

Additionally, the increased implementation of BDA reshapes the required competence possessed by the auditors. For instance, new requirements profiles when hiring new auditors have changed dramatically during the latest years. Competence such as analytical and IT competence in symbiosis with traditional accounting competence is the new set of competencies auditors are expected to possess. In parity with the theoretical framework, concluding is that perceived ease of use and perceived usefulness both are important factors influencing the actual usage of new technologies like BDA. Senior auditors express a greater reluctance towards implementing BDA in the audit process compared to junior auditors, which amongst others stems from their lack of perceived ease of use, resulting in lower usage. The seniors perceive obstacles in learning the new BDA tools, which they find complicated to use, and instead, they promote using traditional tools. Moreover, the seniors are not willing to impair short-term profitability which would be a consequence of implementing expensive BDA tools. Common denominators explaining their reluctance refer

to age, lack of previous experience, and comfort in traditional tools. Additionally, the authors conclude that clients perceived usefulness of the auditors BDA system is a moderating factor that determines how BDA impacts audit processes. A substantial proportion of audit clients question the usefulness of BDA, when the result of the audit more or less is the same as with traditional tools. The investments the clients have to do in order to make their data suitable and correct for the auditors systems, exceed the usefulness they would gain from it.

There are perceived threats as well with BDA implementation in the audit process. The practitioners express a threat against the expanded expectations gap, where BDA will dilute the already comprehensive expectations on auditors, by expecting the auditors will find everything throughout their audit engagements. Deprofessionalization and putting too much trust in the systems are additional threats expressed by the practitioners. Concluding is that these threats underline the imperativeness of close communication with clients, describing the true objectives of an audit, and persuade the more reluctant clients, making them perceive the benefits with a BDA audit engagement.

6.2 Theoretical and empirical contributions

This thesis has contributed to the limited amount of research on the practical implications of BDA implementation and its effects on audit processes and audit competence. The authors contribute theoretically by shedding light on how the technological development within BDA has affected the audit practice within audit firms, which previous literature has neglected. Hence, the authors have answered upon the deficient empirical research on this topic, by increasing the understanding from an empirical point of view, of how the audit process and competence are affected by the BDA implementation.

The thesis also contributes empirically by showing that the actual implementation of BDA tools in the audit process is dependent on the practitioners perceived ease of use and perceived usefulness. Hence, audit firms should invest in education to overcome the implementation barriers that exist in today's audit firms. Additionally, firms have to affirm that clients' technological maturity determines the extensiveness of the BDA usage throughout the engagements. This can guide audit firms on how to enhance the clients technological transition, which would have enhancing effects on the audit firms usage of BDA tools. Also, the thesis provides guidance to audit firms on what competence auditors should possess in order to utilize BDA tools, which could help them when recruiting

appropriate candidates for audit roles. From a societal perspective, the thesis can direct academia curriculum to become more adapted to contemporary technological working life.

6.3 Limitations and avenues for future research

6.3.1 Limitations

Throughout the thesis, the authors have been forced to make decisions that could have had an effect on the conclusions of this study. Despite that the authors have tried to take decisions in order to benefit the thesis's authenticity and trustworthiness, there are some limitations worth mentioning. Methodological limitations are presented in the third chapter.

One of the limitations of this study is the choice of respondents. Firstly, the respondents consisted exclusively of Swedish auditors. If auditors from other countries with differing technological maturity and cultural background would have been interviewed, the results might have altered. Additionally, top management at the firms has not been consulted. A major amount of the empirical evidence points out top management as someone who hampers the implementation of BDA. This conclusion should be taken with caution because if top management would have had been consulted, they might have had another view on the issue. Lastly, some sources have been retrieved from Big-4 websites and internal documents. When studying these documents, the authors have had a skeptical mindset due to the high risk of being biased. Nevertheless, the sources have been used and applied in the thesis which could have had an effect on the results.

6.3.2 Avenue for future research

In this study, mostly perceived usefulness and perceived ease of use have been used to explain the actual usage of BDA. Since these two factors are also determined by external factors it would have been beneficial to investigate how these variables are determined. For instance, what attitudes and norms influence and form perceived usefulness and perceived ease of use. Therefore, the authors suggest future research to originate from this perspective.

Furthermore, this study indicates that practitioners expressed a worry about losing their professional judgment as the technology progresses. As BDA is being implemented, it would therefore be interesting to investigate this subject further and measure this issue quantitatively. For example, by investigating how many judgments that can be overtaken by

BDA compared to previously, and if this has any effect on the ability of the auditors. In a similar vein, it would be interesting to investigate how the audit profession develops as the auditors have the ability to deliver more insights to their clients. In this study, it was highlighted that with the help of BDA, auditors can deliver more non-audit insights that help the clients grow and develop. With more BDA, the line between audit and consulting will diminish, and therefore it would be interesting to investigate where this line should be. Another important consideration in the future will be the question of what the audit should consist of, should an auditor just be an individual who ensures the financial statements, or should the auditor be a person who knows the clients and can assurance services to the client about processes, risks and business considerations?

Moreover, a unique finding from this thesis was that there seems to be a discrepancy between what BDA can do and to what extent it is currently implemented within the audit. The authors of this thesis can only speculate as to what the underlying reason for this is and therefore it would be interesting to actually investigate it more thoroughly if there is a discrepancy between what tools the firms say that they use, and what tools they actually use, and also what the reason for this discrepancy is. Finally, the research was conducted only on Big-4 accounting firms in Sweden. Small and midsized accounting firms constitute a substantial portion of the business environment, and it would be interesting to investigate if these firms experience similar problems. Additionally, since the implementation of BDA in the audit process is dependent on country-specific peculiarities, such as cultural and regulatory environment, it would be interesting to do similar investigation in another country.

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Appendix

Appendix A: Interview guide

Warm-up questions:

- Tell us about yourself and your background in the firm or other relevant work experiences?
→ What is your role at the firm? And what clients do you mainly audit?
→ How has your role altered during your time in the firm?

Theme 1: BDA

- Tell us about your contemporary work procedures. To what extent are BDA involved?
→ Additionally, elaborate on the shift during the recent years to more extensive usage of BDA tools?
- How do your clients perceive the use of BDA in the audit engagements?
- What is your attitude towards the implementation of BDA tools?
- In your opinion, has society's perception of the audit quality changed over time? Do you feel that stakeholders appreciate your output more or less compared to before?
- In the future, how do you think BDA will impact the audit process and audit competence?

Theme 2: Audit processes:

- Please tell us about your experience in what phases of the audit process the BDA tools are most used?
- Are there certain specific phases of the audit process that you think can be enhanced with the application of BDA?
- In your opinion, have any tasks in the audit process been removed due to BDA implementations?
→ If so, what tasks?
- Based on your experience, how have the audit processes changed during your time in the audit field?
- Is BDA improving the reliability of the audit report and the information contained in it? How?

Theme 3: Audit competence:

- Do you feel that you have the correct competence to work with BDA in the process?
Why?
→ Have you been given education on how to manage them?
- What is your opinion if your colleagues have appropriate skills or not?
→ How is your firm taking action to improve employees' skills?
- Tell us about today's situation if you have technical specialists in your team or exclusively traditional auditors?
- How do you think young professionals could be better prepared when they come to you on their first day?
- Have you seen a difference in how audit practitioners' competence has changed during the recent years? Do they develop the correct competence in a faster or slower way compared to before?

Theme 4: Audit judgment:

- In your opinion, how much judgment would you say that you exercise in your daily tasks, could you give an example?
- From your experience, has professional judgment been influenced since the introduction of BDA tools?
- Have you ever had an experience when you were supposed to use BDA tools exclusively but ended up completing the task using traditional tools?
- In your opinion, do you think BDA has an effect on time spent on engagement activities? How?

Appendix B: Thematization

The different themes are highlighted in bold and the different subcategories to each theme are mentioned below every theme. Furthermore, an (X) is put on the different subcategories that each respondent has mentioned.

Respondent	J1	J2	J3	J4	S1	S2	S3	S4
Theme								
Current state of BDA (Theme 1)								
BDA is only in the implementation phase	X	X	X	X	X	X	X	X
Client controls	X	X	X	X	X	X	X	X
Mention that Junior auditors have more practical experience	X	X	X	X	X		X	X
First year is time consuming	X	X	X	X	X			
Data privacy not an issue	X	X	X	X	X	X	X	X
Audit processes (Theme 2)								
Used in execution phase	X	X	X	X	X	X	X	X
Used in planing phase				X		X	X	
Visualization facilitate understanding	X	X		X	X	X	X	
Test full population	X	X	X	X	X	X	X	X
Segregation of duties is not possible with BDA					X			
Audit quality not affected	X	X	X	X	X	X	X	X
Opportunities (Theme 3)								
Find more material misstatements					X			
Understand the business better		X		X	X	X		X
Fraud extremley rare, seniors worried fraud might go undetected					X		X	
Threats (Theme 4)								
Increased expectation gap due to higher accountability	X	X	X	X	X	X	X	X
Loss of understanding leads to deprofessionalization	X	X	X	X	X	X	X	X
Worried about to much trust in data			X		X			X
Competence (Theme 5)								
Say they have adequete competence	X	X	X	X				
Technical skills important and firm put resources on this			X		X		X	
Universities should focus more on IT-skills	X	X	X	X	X	X	X	X
Professional judgement (Theme 6)								
Professional judgment is now more important	X	X	X	X	X	X	X	X
Express worry about the risk of losing professional judgment					X	X	X	X
Not worried about being replaced by computers	X	X	X	X	X	X	X	X
Technology acceptance model (Theme 7)								
High ease of use	X	X	X	X				
Don't have time to learn new programs					X		X	X
Mention that they don't use the programs					X	X	X	X
Have been asked to complement with traditional tools	X	X	X	X				
Usefulness determined by client	X	X	X	X	X	X	X	X
Client have difficulties delivering quality data					X			X

Appendix C: Operationalizing

Example question	Purpose of the question	Literature area	Example of reference
Theme 1: To what extent are BDA tools involved?	Map out status of BDA implementation.	BDA; BDA in audit.	Cao et al. (2015); AICPA, (2014)
Theme 1: In the future, how do you think BDA will impact the audit process and competence?	Discover how practitioners perceive possibilities and threats with BDA in audit.	BDA in audit.	De Santis & D'Onza (2021); Earley (2015)
Theme 2: Have any tasks been removed due to BDA implementation in the audit process?	Map out changes in the audit process due to BDA implementation.	The audit process; BDA impact on audit process.	IAASB, (2010); (2017); PwC, (2017)
Theme 2: How has tasks in the execution phase altered since the introduction of BDA?	Map out historical transition towards more BDA implementation.	The audit process; BDA impact on audit process.	Deloitte, (2020); AICPA, (2015); Allen et al. (2006)
Theme 3: How has required audit competence changed during your time in audit?	Increase understanding of what the audit firms require from their employees.	Competence and professional judgment.	IAASB, (2020); Brown-Liburd, Issa and Lombardi, (2015)
Theme 3: Do you feel that you have appropriate competence to use the BDA systems?	Map out competence level on the practitioners.	Competence and professional judgment; BDA impact on competence and professional judgment.	Brown-Liburd, Issa, and Lombardi, (2015); Salijeni, (2019)
Theme 4: How much judgment is used in the daily tasks in the audit process?	Understand how the auditors use audit judgment in the process.	Competence and professional judgment.	Grout et al. (1994); IAASB, (2020)
Theme 4: How has the audit judgment changed since the implementation of BDA?	Increase the understanding on what impact BDA has had on audit judgment.	Competence and professional judgment; BDA impact on competence and professional judgment.	IAASB, (2020); Alles et al. (2006)

Appendix D: Mail to respondents

Dear XX

We are two students writing our master thesis in accounting and finance at Lund University School of Economics and Management. We are writing about big data analytics impact on audit, and how it affects the audit process and audit competence, and we aim to increase the understanding of this topic from the practitioner's point of view.

The reason for us to reach out to you at XX is because we aim to increase the understanding of this topic by investigating the big-4 accounting firms in Sweden. Hence, it would be very valuable for the progress of our thesis if you, or colleagues of yours, would like to participate in an interview.

Your participation will be completely anonymous, and we will refer to you in the thesis as "respondent 1" or similar. Once we have gathered all the material and analyzed the data, we will provide you with the transcription of the interview, for you to correct potential misinterpretations from our side. Additionally, you will be provided with the thesis once we have handed it in if you would like to observe the result of your participation.

The duration of the interview will be approximately 40 minutes, and the questions discussed during the interview will originate from an interview guide that you will be provided with if you choose to accept to participate in the interview. We are flexible regarding where you would like to have the interview, via teams or in person does not matter for us, as long as it suits you.

We would intimately appreciate your participation in our interview, but we fully understand if you are incapable to take part.

Best regards and happy easter holidays,

Oskar Hultberg and Arvid Wernberg