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Big Data and Audit Quality: Theoretical Study

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ABSTRACT

This paper provides an extensive examination of academic research focusing on the application of big data in relation to audit quality. The literature review is derived from published articles in auditing-related journals. Our review is structured around three primary impacts of applying big data in accounting, auditing, and audit quality. Within each effect, we delve into the findings pertaining to the quality of audits and financial reports. We assert that the limited empirical evidence, coupled with recent technological advancements in information technology, creates opportunities for future research to explore the significant effects of big data application on audit quality and auditing in a broader context.

Keywords: Big data application, accounting, auditing, audit quality, information technology, information technology audit quality.

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INTRODUCTION

In recent years, big data technology has experienced a significant surge in popularity across various sectors, encompassing business, government, and scientific research (Ajana, 2015). The domain of accounting and auditing is no exception, facing an unprecedented influx of semi-structured and unstructured massive data that companies must adeptly handle to stay innovative, efficient, and competitive. While excitement surrounds the potential opportunities presented by big data in various areas (Dagiliene, Kloviene, 2019), it is important to note that big data originates from both traditional transaction systems and newer sources such as emails, phone calls, internet activities, social media, news media, sensor recordings, and videos, among others (Zhang, Yang, & Appelbaum, 2015; Vasarhelyi et al., 2015).

McKinsey (2011) defines big data as datasets that surpass the capacity of specific database software tools to capture, collect, organize, and analyze (Alles, Gray, 2015). Kuurila (2016) characterizes big data as a sizable and diverse pool of datasets that becomes challenging to process using conventional data management techniques or traditional data analysis methods. Key features of big data often include the "3V's" – volume, variety, and velocity. The analytical processes involve gathering, organizing, and analyzing large datasets to uncover patterns and valuable insights for decision-making.

Volume: refers to the overall amount of data contained in a big data dataset and can sometimes pose challenges related to data aggregation, compression, and the strain on storage and computational resources. For instance, financial monitoring tasks may witness a significant increase in data volumes as they transition toward data-centric audit analytics for analyzing financial accounting records (Flood, Jagadish, & Raschid, 2016).

Velocity: pertains to the rate at which data arrives, which can strain network bandwidth and stream analytics. High-frequency firms delivering messages at the technical limits of network latency may pose a significant processing burden downstream (Flood et al., 2016). Velocity describes how frequently data is incoming and changing.

Veracity: focuses on the reliability of the data and how the size and form of data impact its accuracy and quality (Kuurila, 2016). This aspect may present a specific challenge to auditors,

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raising questions about how auditors can attain a suitable level of confidence in a client's big data containing massive amounts of non-financial data.

The implementation of big data in business industries enhances decision-making capabilities, facilitates rapid decision-making, understands customer needs, develops policies for launching new products and services, discovers new markets, improves inventory turnovers, reduces customer complaints, and increases staff productivity and efficiency (Ram, Zhang & Koronios, 2016; Appelbaum, Kogan, Vasarhelyi, 2017).

Audit quality is a crucial indicator of the services provided by auditors engaged by client firms. Companies demand superior auditing quality as they strive for standardization and expertise. Audit quality is employed by companies to attract significant investors and enhance the operational performance of the firm. Consequently, stakeholders and investors place trust and confidence in organizations that prioritize sophisticated audit quality due to the reputation and skills delivered by accounting firms associated with audit quality (DeAngelo, 1981).

According to DeAngelo (1981), audit quality is defined as the auditor's ability to detect material misstatements (technical capabilities or competence) and report errors (auditor independence). This definition serves as a motivating factor for researchers, portraying auditing as a binary process with the auditor's role limited to detecting and reporting violations (DeFond, Zhang, 2014). The definition is closely linked to two-dimensional aspects: identifying misstatements and errors in financial statements and subsequently reporting these material misstatements and errors. This definition is valuable as it encapsulates critical qualities essential for understanding the impact of auditing on financial statement information. DeAngelo (1981) argued that auditors play a significant role in determining audit quality. In this context, the definition suggests that auditors freely report any errors without fear of losing the current audit engagement, thereby demonstrating the importance of auditor independence and competence in determining audit quality.

High-quality auditing plays a crucial role in reducing capital costs by minimizing information asymmetries (Hartarska, 2009; Dechow, Ge & Schrand, 2010; Beisland, Mersland, Strøm, 2015). Previous research findings have indicated that international stakeholders strongly desire excellent audit quality and robust governance when investing in firms (Guedhami, Pittman & Saffar, 2009; Leuz, Lins & Warnock, 2009). Moreover, audit quality is vital for the smooth functioning of capital

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markets, attracting investors quickly by ensuring the accuracy of financial positions and lowering risks (Autrey, Crowley, 2013). Additionally, high audit quality enhances investors' confidence in financial reports (Lin & Liu, 2009; Beisland et al., 2015) and fosters trust among management. Managers are more confident in making accrual adjustments, as high-quality auditing assures them that these adjustments will not be perceived as opportunistic by investors, leading to a greater intent to adjust informative accruals (Mitra, Deis, Hossain, 2009).

Two approaches are employed to measure audit quality: the direct and the indirect approach. The direct approach is based on the theory that the likelihood of detecting and reporting errors and breaches will be evident in audit outcomes, such as financial statement outcomes and audit errors. Various proxies have been utilized in previous studies, including audit fees (Yassin, Nelson 2012), accrual quality (Dunham, 2002), discretionary accruals, the ex-ante cost of equity capital, analyst forecast accuracy, and the use of propensity scores (Lawrence, Minutti-Meza & Zhang, 2011). Other proxy variables for measuring audit quality include audit errors (Colbert and Murray, 1998), abnormal accruals (Balsam, Krishnan, Yang, 2003), and the valuation of earnings surprises (Krishnan, 2003).

The indirect approach, categorized into two types (Kilgore, Harrison, & Radich, 2014), involves using substitutes for audit quality. The first type utilizes factors such as audit firm size, audit tenure, non-audit service provision, and industry experience as replacements for audit quality (Elstein, 2001; Geiger, Raghunandan, 2002). The second type examines attributes of the audit team rather than the audit firm. Notably, this second type adopts a behavioral perspective, measuring audit quality by analyzing perceived qualities of the audit team related to audit quality. These qualities include communication and the quality of the working relationship between the audit team and client management, the level of partner courtesy during the audit, and the knowledge of the audit team. Additionally, audit team attributes encompass the team and partner's understanding of the client's industry, the moral principles of the audit team, and the technical capability of the audit team (Kilgore et al., 2014). Some studies have specifically emphasized audit team characteristics (Chang, Monroe 2001; Duff, 2004; Zerni, 2008).

This article contributes to the existing literature in several ways. Firstly, it provides a comprehensive review of related articles until 2019, offering an extensive examination of the literature on big data application and auditing. Secondly, it attempts to include studies conducted

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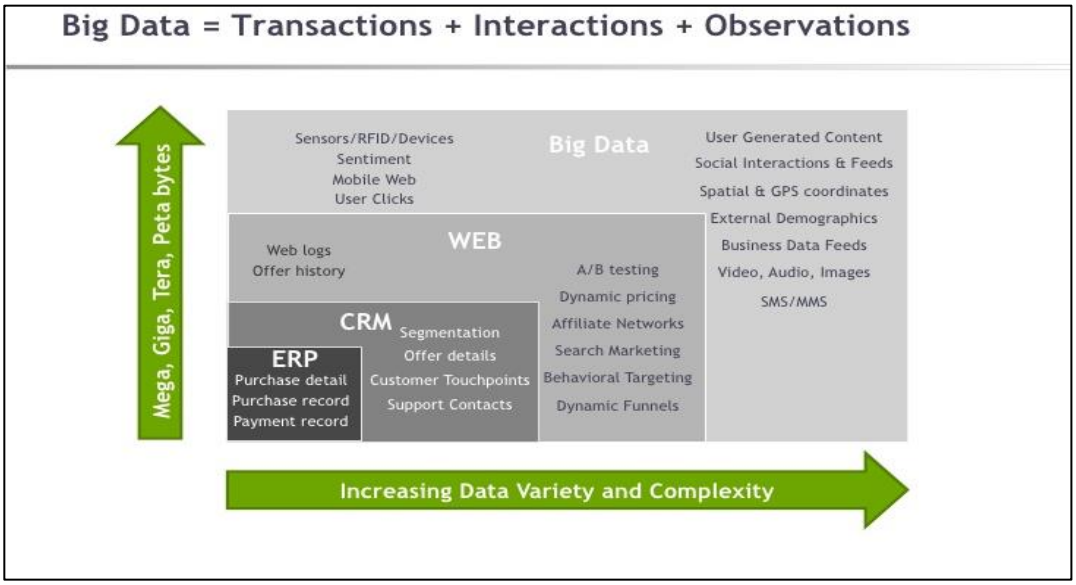
in various international settings, considering the growing impact of global information technology. Thirdly, the article summarizes the literature's findings and proposes directions for future research on the major effects of big data application on audit quality and financial reporting. This information is beneficial for academics interested in big data application, audit quality, and financial reporting, as well as for managers, investors, and auditors.

The remainder of the article is structured as follows: the "Big data framework," "Big data application effects on accounting, auditing, and audit quality aspects," and three subsequent sections discuss relevant previous research. The subsequent section covers prior research findings related to accounting, auditing, and audit quality with big data application. The final section provides conclusions and suggests directions for future research.

Big data framework

As per Alles and Gray (2016), Connolly's (2012) framework proves valuable in the context of big data as it provides a perspective on the data currently utilized by auditors (lower-left corner) and illustrates the significant additional data that Big Data offers to enhance and broaden the input into the auditing process (Alles and Gray, 2015; Alles and Gray, 2018).



Source: (Alles, Gray, 2015, Alles, Gray, 2018).

Where, Connolly (2012) goes on to identify what he sees as seven drivers of Big Data in business:

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Business

1. Opportunity to enable innovative new business models
2. Potential for new insights that drive competitive advantage

Technical

1. Data collected and stored continues to grow exponentially
2. Data is increasingly everywhere and in many formats
3. Traditional solutions are failing under new requirements

Financial

1. Cost of data systems, as a percentage of IT spend, continues to grow
2. Cost advantages of commodity hardware & open-source software.

These drivers are broad and not exclusive to auditing; however, for big data to have a more direct impact on auditing, it is expected to occur primarily through the first two drivers (Alles, Gray, 2015).

Lucas (2012) offers an insightful characterization of Big Data, suggesting that it "divides the world by intent and timing rather than the type of data." He further explains that the traditional approach revolves around transactions, and by the time these transactions are recorded, it's too late to take any corrective actions, resulting in companies constantly "managing out of the rear-view mirror." In contrast, in the new world, companies can leverage new 'signal' data to foresee events and proactively intervene to improve the situation. Examples of this include monitoring brand sentiment on social media (where a significant drop in 'likes' may indicate an impending decline in sales) and employing predictive maintenance through complex algorithms that predict when to replace an aircraft part before the plane faces costly issues on the runway (Alles, Gray, 2015).

Big data and accounting

Changes in the sources and methods of data collection are influencing shifts in the channels through which information is transferred, as well as in the perception of analytically potent data.

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The majority of data currently handled by organizations is unstructured, posing challenges in retrieval and interpretation (Khan et al., 2014; Bhimani, Willcocks, 2014). Moreover, advancements in data, information, and knowledge have significantly impacted outsourcing practices, with digital technologies enabling the execution of organizational activities remotely (Singh, Zack, 2006; Bhimani, Willcocks, 2014). The rapid emergence of cloud computing, fueled by a convergence of technologies, further facilitates the outsourcing of applications, services, and infrastructure over the internet, giving rise to information- and knowledge-based implications that influence the provision of accounting information within enterprises (Bhimani, Willcocks, 2014; Zarban, 2015; Al-zoubi, 2017).

While large companies traditionally generate substantial amounts of data, encompassing accounting and financial information from diverse global businesses, the present trend involves businesses of all sizes producing even more data than in the past (Cockcroft, Russell, 2018). This surge in data poses novel challenges for developers, and the adoption of big data techniques becomes crucial in addressing these challenges (Belfo, Trigo, 2013; Mayan et al., 2014; Chunarkar-Patil, Bhosale, 2018). Accountants, with their specialized knowledge in business intelligence, regulatory compliance, and internal controls, emerge as valuable partners in information governance. In addition to introducing a Big Data life cycle, we outline the specific activities that accountants can undertake to enhance their involvement in information governance. It is important to note, however, that information governance is a collective responsibility, and IT specialists must also enhance their readiness to collaborate with accountants on information system solutions for improved collection and analysis of Big Data (Coyne, Walker, 2017).

Big data and auditing

Presently, the utilization of big data and data analysis involves handling extensive and complex datasets, necessitating advancements in storage, organization, analysis, and visualization technologies (Memon, Soomro, Jumani, Kartio, 2017; Kostić, Tang, 2017; Vassakis, Petrakis, Kopanakis, 2018). This extensive data informs and shapes critical corporate decisions for both internal and external stakeholders, prompting auditors to broaden their existing scope of data analysis (Zhang, Yang & Appelbaum, 2015; Appelbaum, Kogan, Vasarhelyi, 2017). Over the years, auditors have faced the challenge of dealing with an increasing quantity and diversity of data in the market, while industries have explored new technologies. Consequently, the successful

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application of techniques leveraging big data analysis tools has enhanced the competence and effectiveness of audit engagements (Kostić, Tang, 2017).

As a response to this trend, Big 4 firms are strategically targeting applications of big data, considering it not only as an opportunity for their consulting arms but also as an increasingly integral aspect of their assurance operations (Alles, Gray, 2015; Adrianto, 2018). Furthermore, the adoption of big data in audit practices aims to reduce paper usage, align with IT-supported record-keeping, utilize cloud storage, integrate reporting systems, and meet the growing expectations of stakeholders for real-time information. While any one of these factors alone could impact the auditing process, big data has the unique capability to address all of them simultaneously (Salijeni, Samsonova-Taddei, & Turley, 2019). Consequently, audit firms are compelled to incorporate big data applications and other modern technologies into their operations to enhance audit quality (Cao, Chychyla, & Stewart, 2015; Kostić, Tang, 2017). The use of data applications is seen as a means for auditors to gain a more profound understanding of the financial reporting system (Kostić, Tang, 2017).

In the realm of external auditing, big data can be perceived as an additional informational resource that directly impacts the comprehension of a business client's environment and influences the conduct of an audit. Additionally, the integration of big data holds the potential to foster the development and advancement of effective tools for big data analytics, thereby instigating changes in audit processes (Dagiliene, Kloviene, 2019).

Numerous studies have delved into the expansive facets of big data in external auditing, providing an explanatory context for researchers and emphasizing its relevance in terms of overarching issues (Alles and Gray, 2016; Alles, 2015; Earley, 2015). These studies assert that the utilization of big data analytics is not only appropriate but also valuable in ensuring the quality of audits (Dubey and Gunasekaran, 2015). Dagiliene and Kloviene (2019) posit that big data analytics, functioning as an IT tool, can exert a direct influence on the audit process by impacting the engagement phase. Furthermore, it can indirectly affect the audit planning phase, as audit strategies and plans are formulated based on data and information gleaned from the analysis of the client's environment.

Moreover, big data analytics, as an IT tool, may directly affect compliance and substantive testing, as well as evaluations and reports. The decision to employ big data analytics is contingent upon

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the requisites of audit regulatory bodies and business clients, as well as internal technological capabilities and IT-related managerial activities, such as investments in hardware and software, engagement of external consultants, and the like (Tarek, Mohamed, Hussain, Basuony, 2017).

Brown-Liburd, Issa, and Lombardi (2015) explore the impact of big data on auditor judgment, addressing issues such as information overload, relevance, pattern recognition, and ambiguity. Their findings suggest that incorporating big data techniques into the audit toolkit adds value. They emphasize the importance of selecting the most suitable technique and dataset for each situation, underscoring the need for further research in this domain. Yoon, Hoogduin, and Zhang (2015) similarly contend that big data serves as a complementary source of evidence for audits and advocate evaluating its use based on criteria frameworks of sufficiency, reliability, and relevance. Additionally, Moffitt and Vasarhelyi (2013) endorse the utilization of big data for new forms of audit evidence.

Big data and audit quality

Audit firms are urged to incorporate big data applications and various modern technologies into their operations to elevate the quality of audits (Cao, Chychyla, & Stewart, 2015; Kostić, Tang, 2017; Dagiliene, Kloviene, 2018). Moreover, the utilization of data applications enables auditors to gain a more profound understanding of the financial reporting system, contributing positively to overall audit quality and value creation (Kostić, Tang, 2017).

Additionally, the integration of big data applications enhances auditing by providing meaningful patterns. Unlike smaller datasets that may miss unexpected associations, examining the entire dataset increases the likelihood of identifying red flags such as errors, fraud, and suspicious outliers. This approach challenges the traditional sampling methods prevalent in auditing practice (Alles, Gray, 2015; Adrianto, 2018). According to Kostić and Tang (2017), audits can be prolonged, expensive, and inefficient. The adoption of technology solutions, including algorithms and other big data analysis tools, can reduce the time spent on menial tasks, allowing auditors to focus on aspect analysis in professional judgment. This shift towards technology solutions not only streamlines manual analysis but also provides auditors with more opportunities to leverage big data analysis, thereby maximizing the efficiency of the human element in the audit process and ultimately enhancing audit quality.

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Yeghaneh, Zangiabadi, and Firozabadi (2016) investigated the factors influencing the quality of information technology audits. In the realm of information technology and system outsourcing, there exists a substantial body of literature (Kilgore, Mazza, Azzali, Fornaciari, 2014). Various studies have explored topics such as the impact of financial audits, internal controls, and audit quality (Stoel, Havelka, & Merhout, 2012), changes in the role of information system audits and auditors in US accounting firms (Vendrzyk, Bagranoff, 2003; Omoteso, Patel, & Scott, 2010), the influence of information technology on auditors' ability to detect misstatements (Messier, Eilifsen, & Austen, 2004), and the general implementation of technology for auditing (Dowling, Leech, 2007; Curtis, Payne, 2008).

Despite the extensive literature on information technology and auditing, there is a noticeable gap regarding empirical studies that specifically examine the relationship between the application of big data and audit quality. Notably, Curtis et al. (2009) and Ramamoorti and Weidenmier (2006) have called for additional research into information technology audits, citing increased spending and dependence on information technology in business operations, as well as new legislation and professional requirements related to auditing these operations (Mazza, Azzali & Fornaciari, 2014). Yeghaneh, Zangiabadi, and Firozabadi (2015) addressed this gap by studying factors influencing information technology audit quality, finding that the accountability of the audit team, the presence of an audit framework and process, business criteria, audit scope, auditability, planning and operations, access to resources, relationship with the entity and the business environment all impact IT audit quality.

Moreover, Mazza, Azzali, and Fornaciari (2014) examined the relationship between the audit quality of outsourced information technology and information technology audit quality. Their findings indicated a strong and direct correlation, suggesting that improving the audit quality of outsourced information technology controls can be achieved through the evaluation of control design and operating effectiveness by service auditors, as well as direct evaluation by the client at the service provider's location.

CONCLUSION

In the current era, with the pervasive influence of technology, particularly in information technology and computing within business, the significance of big data applications has become

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paramount. The swift ascent of big data applications has consequential implications rooted in information and knowledge, significantly impacting the potential for companies' accounting information provision. Furthermore, auditors are leveraging big data to diminish paper usage, deepen their comprehension of the financial reporting system, and directly influence compliance, substantive testing, evaluations, and reports.

Additionally, the integration of big data applications provides value to auditing, particularly in enhancing audit quality. By affording the opportunity to scrutinize all available data, there is an increased likelihood of uncovering red flags, such as errors, fraud, and suspicious outliers, thereby enhancing audit quality in a more time-efficient manner. Despite these substantial benefits in the realms of accounting and auditing, the body of research on this subject is limited and nearly non-existent, especially in terms of experimental studies.

The research paper followed a structured format, commencing with an abstract and introduction, followed by a review of previous studies and literature exploring the impacts of big data on accounting and auditing. The exploration of these impacts was categorized into three aspects: big data and accounting, big data and auditing, and big data and audit quality. The culmination of these studies enabled us to affirm our conclusion that big data applications play a crucial role in auditing overall, significantly influencing audit quality.

SUGGESTIONS AND FUTURE RESEARCH

While our research was not aimed at generalizing, the findings underscored the evident inclination of audit firms to adopt big data applications and enhance their comprehension of utilizing big data and associated analytics tools in external audits. We would like to stress the imperative for audit companies to integrate audit practices based on big data and big data analytics. This approach not only serves to enhance audit quality but also contributes to the overall efficiency of audits.

There is a dearth of empirical research on the impact of big data on auditing and its potential to improve audit quality. Consequently, further research in this domain holds significance for stakeholders, management, society, and regulators. Such research endeavors can provide valuable insights into the advantages and challenges faced by audit firms in the utilization of big data analytics, aiding a comprehensive understanding of its implications.

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