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The Unrealized Potential of Artificial Intelligence, Big Data and Analytics, and Blockchain in Accounting: A Literature Review

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Abstract:
Digitalization is a popular topic, not only in the media but also, of late, in academic discourse. In the context of this article, digitalization specifically refers to artificial intelligence (AI), big data and analytics (BD&A), and blockchain (BC) technologies. The emergence of digitalization has the potential to influence the role and relevance of the accounting profession in the future. While there is a fair amount of discussion about digitalization in the accounting literature, there appears to be relatively scant empirical data on the use of digitalization in accounting practice. This article contrasts the potential of the above digitalization technologies, as recounted in the academic literature, with the paucity of empirical research and data on the use of digitalization technologies by accountants in practice, on the global scale. The article recommends extensive empirical research on the use of AI, BD&A, and BC technologies to help researchers and practitioners appreciate the realized benefits of these technologies as compared to their unrealized potential benefits.

Keywords: Digitalization; Accounting; Literature review.

Introduction:
This article aims to provide a comprehensive review of academic literature exploring the application of digitalization in accounting in practice. The emergence of digitalization has the potential to influence the role and relevance of the accounting profession in the future. Digitalization has been defined in the literature in different ways. Brennen and Kreis (2016, p. 1) defined the term...
broadly as “the adoption or increase in use of digital or computer technology by an organization, industry, country, etc.” Möller et al. (2020, p.1) defined the term as “the use of digital technologies to change a business model and provide new revenue and value-producing opportunities”. Studies related to digitalization have recently been conducted in various business sectors such as supply chain and sales (Qamari et al., 2022; Suroso et al., 2021). In accounting, digitalization can encompass “integrated systems”, “software robots”, “cloud solutions”, “blockchain technology”, artificial intelligence, and “smart digital technology” that has the potential to change “the workflow and processes of accounting” (Leitner-Hanetseder et al., 2021, p. 541). The impact of digitalization and automation can significantly affect accountants in the future (Zhang et al., 2017). Leitner-Hanetseder et al. (2021, p. 541) also include the “use of vast amounts of complex and timely data” generated by “digital technologies” to “increase efficiency as well as accuracy in accounting” within the ambit of digitalization in accounting. They emphasize the availability of “big data” and the use of “smart big data analytics” in digitalization (Leitner-Hanetseder et al., 2021, p. 542). In this article, digitalization refers to artificial intelligence (AI), big data and analytics (BD&A), and blockchain (BC) technologies (auditing is considered to be part of the accounting practice).

Many authors have touted the benefits of digitalization and predicted that digitalization will transform the accounting and auditing functions. While recognizing the significance of digitalization in accounting and auditing, some point to the gap between the potential benefits of digitalization and its realized benefits, primarily due to the limited use of digitalization in the accounting practice thus far. For example, a survey of Fortune 1000 companies on the use of Big Data and AI showed that while “97.2% of [the] companies” undertook “big data or AI initiatives”, in most cases, the investment in such initiatives was “relatively small” (Moll & Yigitbasioglu, 2019, p. 6). Moreover, from the results of the survey, “little is known about how these firms measure the success of such initiatives, how they integrate different kinds of data, and how they analyse big data to increase innovation” (Moll & Yigitbasioglu, 2019, p. 6).

This article seeks to advance understanding of the use of AI, BD&A, and BC technologies in accounting practice. To meet this objective, we conduct a literature review of empirical research into the use of digitalization in accounting practice on a global scale. While this study is not the first literature review on digitalization, it is the first, to the best of our knowledge, that reviews the use of digitalization technologies in accounting practice based on the empirical research published in the literature. This article begins by describing how the literature search was conducted. The article then discusses articles promoting the potential benefits of digitalization technologies, specifically AI, BD&A, and BC, and those presenting empirical data on the use of digitalization technologies in accounting practice. Based on a discussion of these articles, the article shares its findings and provides recommendations for future research.

**Literature Search:**

To identify relevant papers from the literature to be reviewed for this article, a search of the literature was conducted using the Scopus database. For this search, we identified relevant keywords and search strings as well as inclusion and exclusion criteria. To identify articles that relate to digitalization as defined in this article, the following keywords were used: digital, big data, analytics, cloud, cyber, mobile, social media, robotization, automatization, artificial intelligence, blockchain, platforms, and internet of things (Knudsen, 2020). These keywords were joined using an “OR” operator to form the first part of the search string. The second part of the search string comprised keywords that limited our search to the field of accounting. This set of keywords included
“accounting”, “accountant”, and “accountancy”, which were joined using an “OR” operator to form the second part of the search string. The first and second search strings were thereafter combined using an “AND” operator to form the search string used for this research. The search was limited to journal articles and book chapters published in English. The search excluded disciplines irrelevant to the field of accounting. For example, articles published in unrelated disciplines of computing and engineering were excluded. The detailed string, with the exclusion and inclusion criteria, has been presented in the Appendix.

The first round of searching was performed in October 2021. From the first round of literature searches, 313 likely relevant articles were identified. These articles were divided evenly among the authors of this article. Following a review of the titles and the abstracts of these 313 articles, 30 articles were selected for a detailed review.

The second round of literature search was undertaken in May 2022 to update the literature search. This round used the same search string that was used in the first round but limited the search to articles published between October 2021 and May 2022. Following this search, 28 articles were identified. These were again divided equally among the authors. Following a review of these articles, 11 articles were selected for a detailed review.

Findings:

There is an ongoing academic debate on the influence and impact of digitalization technologies on accounting practice. One school of scholars argues that digitalization has the potential to improve accounting practice through the application of AI, BD&A, and BC technologies (e.g., Moll & Yigitbasioglu, 2019; Rikhardsson & Yigitbasioglu, 2018; Lacity & Willcocks, 2015). The other school (e.g., Korhonen et al., 2022; Quattrone, 2016) believes that “digitalisation or automation” in accounting practice “does not necessarily mean more efficient processes” (Korhonen et al., 2022, p. 272). Instead, digitalization in accounting practice may involve “high risks if not used with caution” (Korhonen et al., 2022, p. 254). The latter school of scholars suggests that digitalization can lead to a disaster if “human labour is prematurely replaced” with digitalization technologies without careful due diligence as well as “the recognition that human and computer intelligence are profoundly different” (Korhonen et al., 2022, p. 254). Further, while digitalization does open new possibilities in accounting practice, every accounting process may not be digitizable and human intervention may still be required.

A discussion of the literature on likely benefits of digitalization for accounting follows.

Potential Benefits of Digitalization in Accounting

This section details the potential impact of digitalization on accounting practice, as noted in the literature. Based on a “comprehensive overview of the literature on digitalization in accounting”, Knudsen (2020, p.16) suggests “potential implications” of digitalization for accounting. They delineate how digitalization influences accounting in ways different from integrated information systems by comparing the two concepts (Knudsen, 2020, p. 16). For instance, Knudsen (2020, p. 17) concludes that while accountants are “expected to deliver reliable, high-quality inputs for decision making”, with increased digitalization, “they might be expected to include more externally generated data, which is associated with risks related to [the] veracity and [the] representativeness” of such external data. Accountants, therefore, need to “analyze the trustworthiness” of data (Knudsen, 2020, p. 17) produced from digitalization.

Also, Tiberius and Hirth (2019, p. 1) remark that “auditing firms and auditors are potentially affected” by the progress of information technology, especially progress in “big data analytics”, “artificial intelligence”, and “blockchain
technology”. They note that “rapid advances in digitization involve the potential automation of cognitive tasks, in a similar manner that machines replaced physical labor during the industrial revolution”, adding that such developments would inevitably impact the auditing industry (Tiberius & Hirth, 2019, p. 1).

The following sections discuss the potential benefits of digitalization, specifically, pursuant to the expected adoption of AI, BD&A, and BC technologies in accounting practice.

Artificial Intelligence
Despite acknowledging that “the use of AI-based digital technologies is in its infancy”, Leitner-Hanetseder et al. (2021, p. 540-41) predict that the “future of automation in accounting could be seen in the increased use of self-learning AI-based integrated systems, which access actual data in real time and, based on this, independently develop solutions, suggestions, forecasts and trends”. This is an example of the optimism surrounding digitalization in the accounting profession, optimism that is not necessarily based on empirical data or evidence.

Big Data and Analytics
Ibrahim et al. (2021, p. 11) argue that “big data can overcome the data limitations of several accounting techniques that depend on data, such as financial reporting, performance measurement, and audit evidence” and will “reshape accounting because data is the heart of accounting”. They propose that “big data adopters are more likely to provide high-quality financial reporting, measure and manage performance more effectively, provide more sufficiently and appropriately audit evidence, manage risks more effectively, experience less budgeting variances, and conduct activity-analysis more effectively than non-big data adopters” (Ibrahim et al., 2021, p. 11). However, Ibrahim et al. do not provide any empirical evidence for these propositions and even acknowledge the lack of empirical data (2021, pp. 11-12). Their arguments are based only on their views and a review of the literature (Ibrahim et al., 2021, p. 12). The authors however concede that notwithstanding “the argued benefits of big data, some challenges and risks should be taken into consideration”, given that “risks associated with big data are still under-investigated” (Ibrahim et al., 2021, p. 11). This is yet another example of the optimism about the potential benefits of digitalization to accounting practice.

Similarly, Warren et al. (2015, p. 397) propose that big data can improve “managerial accounting, financial accounting, and financial reporting” by enhancing “management control systems and budgeting procedures”, by improving “the quality and relevance of accounting information” (thereby “enhancing transparency and ... decision making”), and by facilitating the refinement of “accounting standards”. However, they do not provide empirical evidence.

Despite conceding that, while “many organisations and individuals are interested in big data analytics, only [a] few actually engage in the practice at this point”, Al-Htaybat and von Alberti-Alhtaybat (2017, p. 863) nevertheless conclude that big data is an important development in corporate reporting. The authors add that “Big Data provides corporate reporting with the opportunity to change its approach to corporate reporting, first regarding timing, but also with regard to accuracy” (Al-Htaybat & von Alberti-Alhtaybat, 2017, p. 868). Although based on empirical data, i.e., interviews, the study by Al-Htaybat and von Alberti-Alhtaybat has limited practical value as “the technical and practical aspects of Big Data analytics were not experienced by many [of the interview study] participants” (2017, p. 863).

Blockchain
Although BC technology is still in its “infancy”, academic papers have already predicted, without evidence, that it will become “the most important disruptive technology” since the internet (Abdennadher et al., 2022, p. 54). For example,
Desplebin et al. (2021, p. 752) suggest that BC technology has the potential to contribute to the transformation of a firm’s accounting environment. Abdennadher et al. (2022, p. 55) summarize the potential benefits of BC technology for the accounting profession from their review of the literature as follows:

“Kwilinski (2019) claims that the development of this new technology will lead to the cessation of traditional double-entry accounting as the legitimacy of accounting will be fully automated. Indeed, blockchain technology will permit accounting records to be synchronized between contractors. Triple entry accounting will take place and, by providing a tertiary destination that automatically verifies transactions for bookkeeping, will become fundamental to the accounting industry. Repetitive tasks, related to the firms’ daily operations, can be performed by smart contracts and this will save time and allow accountants to focus on value-added work (Karajovic et al., 2019). Dai and Vasarhelyi (2017) argue that blockchain technology provides real-time, verifiable information disclosure and progressively automated assurance. However, the authors see that the implementation and the development of such technology will be challenging for both accountants and management. Tan and Low (2019) discuss the potential effects of blockchain technology on accounting information systems (AISs) at the database engine level where data are compiled. In turn, this can reduce honest errors and discourage fraud. Numerous reports have discussed one of the major benefits of blockchain technology being the increased auditability of accounting information is (Fanning and Centers, 2016; CPA and AICPA, 2017; Association of Chartered Certified Accountants, 2017; O’Leary, 2018). Indeed, as blockchain technology provides a real-time audit trace, financial audits will be significantly simpler and cheaper (Fanning and Centers, 2016; Deloitte, 2016; CPA and AICPA, 2017; EY, 2017; PwC, 2017).”

This optimism is however not backed by empirical data on the benefits of BC technology. The next section introduces the potential gap in the literature between a discussion of the claimed benefits of digitalization and the realized benefits of digitalization in accounting.

**Potential versus Realised Benefits of Digitalization in Accounting**

Many accounting and finance practitioners and consultants, as well as c-suite management professionals, promote the potential benefits of digitalization for the finance and accounting functions (Möller et al., 2020, p. 2). Academics also appear to be enthusiastic about the potential benefits of digitalization (Liew et al., 2022; Leitner-Hanetseder et al., 2021; Tiberius & Hirth, 2019). However, in the academic domain, most of the papers highlighting the potential benefits of digitalization are “largely conceptual” only (Möller et al., 2020, p. 2).

For example, Leitner-Hanetseder et al. (2021, p. 543) note in their summary of a literature review on digitalization that “accounting will be subject to changes in the use of new (smart) technologies and big data which will require different tasks and the upgrading of the qualifications as well as new forms of collaborations and interactions (in particular human–machine interactions)” but do not support this claim with evidence. Some papers explicitly call for such empirical evidence. For instance, Knudsen concludes that the “extent to which data-driven decision making is used [in accounting] remains unclear” and notes that “there is a clear need for more qualitative studies that unravel how accountants and decision makers perceive data-driven decisions based on algorithms” (2020, p. 16). Therefore, a discussion of the empirical evidence regarding digitalization is appropriate to understand its realized potential.

**Empirical Evidence of Digitalization in Accounting**
This section presents empirical research on the use of and the impact of digitalization technologies, specifically, AI, BD&A, and BC, by and on accountants and auditors in practice. Tiberius and Hirth (2019, p. 2) conducted a two-stage online Delphi study to understand the impact of digitalization on auditing, specifically, “changes in auditing practices expected by German auditing professionals within the next five to ten years” (2019, p. 1). The Delphi method questions participants over at least two rounds using a standardized questionnaire and provides structured feedback to participants about the results from the first round to enhance the participants’ consensus (Tiberius & Hirth, 2019, p. 2). Their study included AI, BD&A, and BC technologies within the realm of digitalization (Tiberius & Hirth, 2019, p. 1). In the study, “20 projections about the future of auditing related to automating digital processes were developed and evaluated by a panel of German auditors, university professors of auditing, regulators, and IT experts of auditing software” (Tiberius & Hirth, 2019, p. 11). The projections address, among other things, participant perceptions regarding the impact of digitalization on “auditing, the auditor–client relationship, regulations, structural and procedural changes for auditing firms, and the profile of the auditing profession” (Tiberius & Hirth, 2019, p. 1).

Tiberius and Hirth (2019, p. 1) found that participants do not expect any “far-reaching changes” to the auditing process from digitalization over the next five to ten years. Further, participants of the study “believe that new technologies will not replace the auditor, but rather will provide relief and support” to the auditor, and do not expect “disruptive effects in auditors’ workplaces” due to such technologies in the “near future” (Tiberius & Hirth, 2019, p. 1). For example, 93 percent of the participants expect digitalization to “lead to a reduced workload for simple auditing routines” and give “auditors more time to concentrate on more complex and demanding tasks” (Tiberius & Hirth, 2019, p. 10). Most participants therefore expect digitalization to positively impact the work of auditors (Tiberius & Hirth, 2019, p. 10). Also, the majority of participants “expects specific auditing knowledge and skills rather than IT knowledge” to “dominate” the auditor’s job in the near future (Tiberius & Hirth, 2019, p. 11).

Further, the majority of the participants did not expect “a higher degree of trust” in automated auditing procedures over manual auditing procedures” while 41 percent of the participants took the opposite view (Tiberius & Hirth, 2019, p. 9). Some participants “also probably believed that a completely automated auditing process cannot be faultless” (Tiberius & Hirth, 2019, p. 11). Moreover, while 61 percent of the participants expect that automation will impact extant auditing service pricing models, 39 percent held the opposite view (Tiberius & Hirth, 2019, p. 9). However, most of the rejecting participants work in Big-Four firms, which may potentially have “greater pricing power than smaller firms” (Tiberius & Hirth, 2019, p. 9).

In addition, 97 percent of the study participants rejected the proposition that automated audits will replace manual audits (Tiberius & Hirth, 2019, p. 9). Similarly, 96 percent of the participants rejected the projection that “new auditing standards could be set by AI rather than by a human regulatory authority” (Tiberius & Hirth, 2019, p. 10). Also, 90 percent of the participants expect that certain aspects of the auditing standards will continue to afford discretion to auditors in the near future (Tiberius & Hirth, 2019, p. 10). In this context, the majority of the participants “did not expect that AI will be able to make decisions on auditing issues involving a high degree of discretion” (Tiberius & Hirth, 2019, p. 11). For instance, asset valuations may be too complex and involve a fair amount of discretion to be suited to automated processing (Tiberius & Hirth, 2019, p. 11). Also, many participants “do not expect clients to digitize their
accounting as fast as their auditors” may achieve (Tiberius & Hirth, 2019, p. 11).
The following section discusses the literature on empirical evidence of the use of AI in accounting practice

Artificial Intelligence
Leitner-Hanetseder et al. (2021, p. 541) conducted a Delphi study to explore the “roles and task[s] of human or AI-based actors in accounting”. The study also “enquires about the changes in tasks as well as related skills in existing professional occupations in accounting through subsequent expert workshops on AI-based digitalisation”.
Leitner-Hanetseder et al. (2021, p. 541) took a qualitative approach using the Delphi study and subsequent expert workshops to develop in-depth insights based on diverse perspectives and experiences. They first “identified roles and tasks in an AI-based accounting of the future” in the first round of the Delphi study and then “allocated [them] to AI and/or human actors in professional accounting occupations in subsequent expert workshops” (Leitner-Hanetseder et al., 2021, p. 543).

While conceding that it is “not possible yet to assess the net effect of AI” as a whole, Leitner-Hanetseder et al. (2021, p. 552) nevertheless conclude that “a new human–machine symbiosis appears to be on the horizon in a future that requires critical and continuous insights from research”. They add that “tasks and skills for existing professional occupations in the broader accounting context will be subject to major changes in the next 10 years due to (AI based) digital technologies” (Leitner-Hanetseder et al., 2021, p. 539). Leitner-Hanetseder et al. (2021, p. 539) note further that “while ‘core’ roles and tasks will continue to exist in the future, some will not be performed by humans but by AI-based technology” and that “humans will need to make informed use of digital technologies and, to some extent, collaborate with AI-based technology” in some of the accounting roles that may emerge in the digitalized future.
Leitner-Hanetseder et al. (2021, p. 544) also claim that “AI-based technologies such as smart robots, automated feature tools and business intelligence” software are not only expected to “have the biggest impact on [the] roles and tasks of accounting employees” but may also “have the power to replace humans as an actor and change processes in accounting” practice.
More specifically, their study predicts that “the demand for bookkeepers doing routine tasks will be much lower in 10 years due to extensive enhancements in the use of digital technologies”, as exemplified by the below narrative (Leitner-Hanetseder et al., 2021, p. 547):
“In the future, most companies will use business-to-business (B2B) transactions, a worldwide used digital data exchange format or AI-based technology, such as optical character recognition (OCR) technology, and provide digitalised invoices to consumers. Machine learning algorithms will categorise and interpret the digitalised data and post them to the correct account. Furthermore, smart bots are used to reconcile and make checks to avoid accounting errors. To guarantee compliance and that only authorised people can read the files, the digitalised data are set with a permission and every action is tracked in an audit trail, which improves the transparency. Thus, smart software robots will not only automatise tasks but also improve the quality of financial data by AI-based checks.”
Leitner-Hanetseder et al. (2021, p. 547) suggest instead that bookkeepers will be “responsible for ensuring that all business transactions are accounted for by smart accounting software” and may “take a key role in the implementation phase of AI-based accounting software”. For example, bookkeepers may be tasked “to train the AI” and

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“intervene in special cases when the digital technology is not able to process” given tasks (Leitner-Hanetseder et al., 2021, p. 547). Leitner-Hanetseder et al. (2021, p. 551) also predict that “severe and foreseeable disruptions in future AI-based accounting may lead to new roles and tasks”. They add that “AI will also bring about an increased need for highly skilled workers” and “may also create as many jobs as it replaces” (Leitner-Hanetseder et al., p. 551). Their research thus contradicts “the prevalent notion that AI as an actor is going to replace human actors and rather recognise that AI is going to collaborate with humans and supplement human decision-making” (Leitner-Hanetseder et al., p. 551). Leitner-Hanetseder et al. (2021, p. 551) propose that AI can “drive innovation and enhance traditional roles” and may boost “productivity and overall employment rather than reducing it”. According to the authors, “AI’s greatest impact” may therefore “not come from replacing jobs” but instead “from changing what people do” (Leitner-Hanetseder et al., 2021, p. 551). While these findings, based on empirical research, reflect the thoughts of research participants, the findings do not reflect research participants’ use of AI technology.

In other research on artificial intelligence, Kokina et al. (2021) employed a multi-case study to understand the impact of robotic process automation (RPA), which is expected to incorporate AI, on the accounting practice. “RPA technology creates software robots (bots) that emulate the actions of a human interacting with digital systems” (Kokina et al., 2021, p. 153). Kokina et al. (2021, p. 155) used “semi-structured interviews with experienced professionals” to understand the “actual experience” of professionals with “RPA implementations”. Participants in the study described the use of RPA for “accounts payable matching and accounts receivable cash application” and “the automatic creation of fixed assets and leases within … Enterprise Resource Planning (ERP) system” (Kokina et al., 2021, p. 157). In the participants’ experience, RPA frees accountants “from performing mundane and routine tasks and devoting hours to preparing data for analysis” and enables accountants to focus on “providing their organization with important insights” instead (Kokina et al., 2021, p. 161).

The findings on the benefits of digitalization vis-à-vis simple rather than complex tasks in Kokina et al. (2021) are similar to the findings of Tiberius and Hirth (2019). However, these findings differ from the findings of Leitner-Hanetseder et al. (2021). It is to be noted however that the findings of Kokina et al. (2021) and Tiberius and Hirth (2019) are based on the experience of research participants, whereas the findings of Leitner-Hanetseder et al. (2021) are based on the perceptions of research participants of the potential benefits of digitalization.

The next section discusses the literature on the use of BD&A in accounting practice.

**Big Data and Analytics**

Liew et al. (2022, p. 1) “explore the implementation of data analytics in the Big-Four accounting firms” in New Zealand, including “the extent to which a (sic) digital transformation is changing the work of financial auditors, why it is doing so and how these firms are managing the transformation process”. They “adopt an interview-based approach … to understand how the use of data analytics” impacts the financial audit practice of Big-Four firms (Liew et al., 2022, p. 4). The authors interviewed “financial auditors who are tasked with reviewing financial statements produced by client organisations and providing their professional opinion as a (sic) third-party examiners” to such clients (Liew et al., 2022, p. 4). They conducted “23 semi-structured, face-to-face interviews with 20 participants from three of the Big-Four firms operating in New Zealand” (Liew et al., 2022, p. 4). These semi-structured interviews covered the following topics in the context of audit: “(1) the specific technologies that are used...
in the firm; (2) the types of skills that are needed, including how new skills are acquired; (3) the types of training and development that are provided; and (4) the hiring practices for new graduates and experienced hires due to changes in technologies or markets” (Liew et al., 2022, p. 5).

Liew et al. (2022, p. 1) found that Big-Four auditing firms have “positive attitudes” towards “new technology” and seek to implement such solutions firmwide. Specifically, they determine that “there is a push to adopt and increase the usage of data analytics in the Big-Four firms” to increase the effectiveness of the compliance aspect of financial audits (Liew et al., 2022, p. 13). Data analytics also enhances the ability to “provide deep business insights to clients and to present them in impressive ways” (Liew et al., 2022, p. 13). Liew et al. (2022, p. 13) suggest that “the combination of more effective assurance and novel business insights is deeply attractive to both the auditors and the audited”, and urge the adoption of data analytics.

Liew et al. (2022, p. 14) however note that “deficiencies in a client’s IT system can lead to data integrity issues that may harm audit quality”, leading to the “full potential of data analytics” left unrealized “unless the quality of IT systems improves” proportionately for both the client and the auditor. These deficiencies and a mismatch between client and auditor IT system capabilities can and often do lead to duplication of work (Liew et al., 2022, p. 14). Liew et al. (2022, p. 14) therefore urge that “clients need to make changes in the quality of their IT systems to facilitate better outcomes” and to realize the full potential of data analytics tools.

Still, Liew et al. (2022, p. 14) conclude that “there is extensive technological transformation occurring in financial audit” and that this transformation is “driven by the enhanced capabilities of the new IT tools and their potential to add greater value for audit clients”, for example, through the “extensive adoption of data analytics” in financial audits.

Limitations of their research are a narrow scope that includes only the financial audit function of Big-Four firms and restriction of interviewees to those from Big-Four firms only (2022, p. 14). For instance, the authors acknowledge the importance of the “views of auditors in medium-sized and smaller audit firms” to complete a comprehensive evaluation of industry-wide adoption of data analytics and other new age digitalization tools (Liew et al., 2022, p. 14). Because small and large companies possess varying levels of technological efficiency (Chang et al., 2015), the perspectives of professionals in small companies may differ from those in large companies. Consequently, these differences in perspectives highlight the need for further empirical studies specifically focusing on small or medium-sized companies.

In another qualitative study, Spraakman et al. (2021, p. 127) conducted interviews of management accountants in Canadian organizations “to understand how the tasks of management accountants (MA) are affected by data analytics (DA)”. They define data analytics as “the use of information technology tools to perform data analyzes” (Spraakman et al., 2021, p. 127). The authors suggest that “DA involves financial and nonfinancial information and a wide variety of techniques from simple descriptive reporting and data presentation to more advanced drill-down functionality, trend analysis, forecasting and predictive modelling” (Spraakman et al., 2021, p. 130). The authors deduced, based on empirical data, that “DA supports inference, prediction and assurance in management accounting tasks by simplifying the analytical process and eliminating complexities inherent in advanced analysis and the presentation of [such] results” (Spraakman et al., 2021, p. 137).

From their review of literature on data analytics in the context of the accounting profession, Spraakman et al. (2021, p. 130) found that “there is a need for empirical research on DA in the practice of management accounting” as not much is “known about how DA gets used by MA, what
tools are used, the types of analyzes performed, and the skills required”. They add that empirical research that discusses the impact of DA on MA is “scarce” (Sprakman et al., 2021, p. 130). For example, Sprakman et al. (2021, p. 131) note that “Rikhardsson and Yigitbasioglu (2018) in a review of top accounting and information systems journals, found little research on the impact of DA on the practice of management accounting”.

Sprakman et al. (2021, p. 127) conclude that “MA have not taken charge of the data analytic opportunities” and that “their activities remain largely focused on descriptive and financial data analysis rather than more complex activities using external data, operational data and modeling”. In most cases, “DA was restricted to accounting data, but a few of the sampled organizations used non-financial and operating data” as well (Sprakman et al., 2021, p. 135).

Sprakman et al. (2021, p. 135) also observe that “IT was nearly missing with some of the sampled organizations, actively pursued by others and highly integrated at an advanced level with a few” organizations. Consequently, some organizations “developed extensive expertise with DA” while others “made much less progress” (Sprakman et al., 2021, p. 141).

Further, while “most of the DA involved internal data; little macro or external data was being used by MA”, except “for analyzing trends and for developing predictions” (Sprakman et al., 2021, p. 142). Therefore, “interviews [with MA] revealed that predictive analytics is still in its infancy and that many organizations are still not aware of it” (Sprakman et al., 2021, pp. 139, 141). The authors also concluded that “the responsibilities of MA are not expected to change with the introduction of DA” in their scope of work (Sprakman et al., 2021, p. 140).

Also, via a survey, Youssef and Mahama (2021, p.686) “investigate the role of business intelligence and analytics (BI&A) in mediating the relationship between enterprise resource planning (ERP)” and management accounting practices. The researchers surveyed listed firms in the UAE to understand how BI&A modules enable ERP to support the management accounting practices of budgeting, costing and performance evaluation (Youssef & Mahama, 2021, p. 690). The study’s findings show that BI&A modules improve the analytical abilities of ERP and enhance its use in management accounting (Youssef & Mahama, 2021, p. 697).

In addition, based on a case study of a Nordic firm, Andreassen (2020, p. 209) studied the impact of digital technologies such as big data and machine learning on the role of management accountants. The study shows that digital technologies contribute to “a new, narrow role [of management accountants] as technical experts who oversee system integrations and information flows between systems” (Andreassen, 2020, p. 229). “This technical role appears to be distanced from decision making and corporate strategy” (Andreassen, 2020, p. 229). The case study also found that digital technology “influences intra-organizational competition between professions and thus contributes to changes in management accountant roles” (Andreassen, 2020, p. 211). For example, the management accountants in the studied firm faced “competition over jurisdiction from other groups of employees”, particularly, from the analytics, product, customer relationship management, and pricing divisions (Andreassen, 2020, p. 229). The case study showed that some of the roles of management accountants were also taken over by professionals from these other divisions (Andreassen, 2020, pp. 229-230).

Another case study examined the role of big data in management accounting (Abdullah et al., 2022, p. 41). This study, conducted in a Malaysian manufacturing company, shows that “big data facilitates and improves the implementation of strategic management accounting practices on competitors’ and customers’ analyses and costing by streamlining the analysis process, decreasing time spent searching for data, increasing data accuracy, and assisting in the decision-making
process” (Abdullah et al., 2022, p. 41). For example, one of the interviewees in the case study illustrated the benefits of big data for controlling production costs as follows:

“Big data assists us in estimating the production cost, how much they fully utilize and bringing down the wastage. By identifying customer’s needs, product demand and the best suppliers to supply quality raw materials, we are able to reduce our cost, determine the price and target profit margin.” (Abdullah et al., 2022, p. 52).

Another interviewee shared the use of big data in providing competitor information as below:

“Big data supports our competitor analysis by providing us with competitors’ details. For example, their sales growth and new product line launched[.] This data helps us to appraise and monitor our competitors’ activities and cost assessments”. (Abdullah et al., 2022, p. 54).

The above discussion of the empirical literature on the use of BD&A in the accounting profession shows that while BD&A has been used within the accounting practice, its use has been limited thus far, for example, due to technological limitations related to the client’s information technology infrastructure. The use of BD&A in accounting is therefore still in its infancy. Further research may throw light on new developments in the use of BD&A by accountants. The below section discusses the literature on the use of BC in accounting practice.

**Blockchain**

Early adopters of BC technology include Big Four accounting firms like PwC, EY, and Deloitte. For example, in 2019, PwC launched a solution to audit cryptocurrency, including “blockchain, bitcoin and ripple” (Abdennadher et al., 2022, p. 54). This launch was likely informed by PwC’s survey in 2018 of 600 executives (Abdennadher et al., 2022, p. 54). The survey reported that 84 percent of the surveyed executives indicated that their organizations “had at least some involvement” with the BC technology (Abdennadher et al., 2022, p. 54).

Abdennadher et al. (2022, p. 53) “analyze the perceptions of accountants and auditors toward the implementation of blockchain technology in the UAE after the government decided to transform 50% of government transactions into the blockchain platform by 2021”. They interviewed “19 accountants, internal auditors and financial auditors with experience in the profession varying from 5 years to more than 18 years” - 10 of these accountants were certified public account (CPA) holders (Abdennadher et al., 2022, p. 57). The research undertaken by Abdennadher et al. seeks to “provide an analysis of the implications of blockchain technology from an integrative perspective that combines the viewpoints of the accountants with those of the auditors”, specifically, the perspectives of such professionals regarding “the risks and benefits resulting from the adoption of blockchain technology” in their practice (2022, p. 67).

“Most of the interviewees agreed that blockchain technology ensures authenticity and reduces the risk of fraudulent transactions” (Abdennadher et al., 2022, p. 60). “Additionally, all the interviewees agreed that blockchain technology reduces the costs of maintaining and reconciling ledgers to enhance and provide absolute certainty about the ownership and history of assets” (Abdennadher et al., 2022, p. 63). However, in response to the question: “From an auditor/accountant perspective is it more easily (sic) to keep track of transactions that happen on a blockchain software than the transactions that happen in an accounting software like opera and why?”, “many of the interviewees could not give a clear answer because they were unfamiliar with blockchain technology” (Abdennadher et al., 2022, p. 63). This unfamiliarity of the interviewees with BC technology raises questions and concerns regarding the predictions made by these interviewees about the benefits of BC technology for the accounting practice.
On the challenges associated with BC technology, interviewees agreed that the “lack of flexibility” with respect to fixing mistakes, for example, data entry errors, is a limitation of the technology as it does not allow for correction of errors (Abdennadher et al., 2022, p. 64). Other limitations include slow performance (which is linked to the decentralized BC database), information overload, and significant energy consumption (Abdennadher et al., 2022, p. 66). Abdennadher et al. (2022, p. 67) conclude that “there is a sense of pessimism” surrounding the “development of assurance services to clients engaging in blockchain and cryptocurrency activities” and “how blockchain technology will affect the accounting and financial auditing firms’ operations”. Despite this pessimism, they however conclude that “by providing a low-cost and decentralized audit process and automated audit evidence, blockchain technology has great potential in supplementing traditional auditing” (Abdennadher et al., 2022, p. 68). Nevertheless, the authors note that “accounting of the companies will not be changed but it will be automated with the development of cryptocurrencies and blockchain activities” (Abdennadher et al., 2022, p. 68). They add that “blockchain technology will be developed in assurance services through the awareness and involvement of accounts (sic) and auditors” (Abdennadher et al., 2022, p. 68). However, the unfamiliarity of the interviewees with BC technology constrains the practical value of the authors’ research and their findings.

On the other hand, in the two-stage online Delphi study conducted by Tiberius and Hirth (2019, p. 10), 82 percent of the participants in the study rejected the proposition that BC technology can “make audits completely obsolete within the next five to ten years”. The above discussion suggests that the adoption of BC technology in accounting practice may take time.

**Discussions:**

The literature shows that notwithstanding the importance of digitalization, academic research on the topic is limited, especially with respect to the use of digitalization technologies. Möller et al. (2020, p. 2) argue that despite “the practical relevance of digitalization”, academic research into digitalization is limited. They point to “a large gap between theory and practice”, with academic literature barely discussing “the effects of digitalization on the finance function” despite digitalization being a top agenda item for practitioners (Möller et al., 2020, p. 2). The authors mention that “digitalization is only about to enter the scholarly debate”, notwithstanding the volume of academic publications on digitalization (Möller et al., 2020, p. 2). Similarly, based on a detailed literature search and the review of over 60 academic papers to understand the impact of business intelligence and analytics (BI&A) on management accounting, Rikhardsson and Yigitbasioglu (2018, pp. 37, 49) conclude that “a relatively low number of papers focus on applications of BI&A in management accounting” and that many of these papers are “conceptual and do not address key tasks in management accounting”.

Rikhardsson and Yigitbasioglu (2018, p. 49) point out that, of the “limited number of studies that have been published, none have adopted a critical research perspective”. The authors add that papers on big data present “an optimistic view” and concede that “very few studies focus on what outcomes BI&A applications in management accounting lead to”, for example, outcomes such as “organizational performance as well as changes in decision quality, resource use, and [the] perceptions of managers” (Rikhardsson & Yigitbasioglu, 2018, p. 49). Also, Rikhardsson and Yigitbasioglu highlight “privacy concerns, data security, micromanagement of employees, stifling of employee creativity and potential negative behavioral effects” as issues of concern related to big data.
applications (2018, p. 49). For instance, there is a growing concern that big data “infringes on privacy” and enables “new forms of social surveillance” that may be used to influence political and economic decisions (Andrew & Baker, 2019). Big data surveillance, also referred to as “data capitalism” or “surveillance capitalism”, can also be used, for example, for “predictive profiling” and “anticipatory governance”, thereby “producing unequal outcomes for different social groups” and “influencing popular thinking around matters of public concern”, which can undermine democracy (Andrew & Baker, 2019).

In addition, the discussion below paints a contrasting picture of potential benefits of digitalization (as advocated by some researchers) vis-à-vis its realized benefits in accounting.

**Potential versus Actual Benefits of Digitalization in Accounting**

The following discussion compares the potential benefits of digitalization, as discussed in the literature, with the benefits of digitalization implementation in accounting practice. Regarding the implementation of digitalization in accounting and finance, Möller et al. (2020, p. 5) conclude that “[m]ost finance functions in large companies are not as advanced in their digitalization efforts as the commonplace c-suite rhetoric and the high expectation of change might suggest”. They refer to “empirical evidence that digitalization in the finance function, despite all the lip service and high expectations, is still in its infancy” (Möller et al., 2020, p. 5). Möller et al. also note that “only in a minority of [their] observations” data analytics has been found to be used for “financial planning and analysis” related activities (2020, p. 5).

Möller et al. (2020, p. 6) suggest reasons for the slow pace of adoption of digitalization in the finance function. The first is that “processes of fundamental change take time—at least when the changes are to be sustainable and more substantial than merely scratching the surface” (Möller et al., 2020, p. 6). Another is the approach of top management to “prioritize areas that directly add to corporate value creation, such as marketing and supply chain” and deprioritize internal service providers, such as the finance function, leading to the slow pace of adoption of emerging technologies such as AI, BD&A and BC by accountants (Möller et al., 2020, p. 6).

Also, the complexity of digitalization necessitates significant investment in such technologies. For example, Dai and Vasarhelyi (2017, p. 16) note that “the technical complexity of the solutions, the requirement of substantial investments of financial and time resources, the difficulty to expand the technologies to business partners, and the demand for business and process changes could all hinder the adoption of such technologies” in practice. For these reasons, implementation of digitalization technologies in accounting may take time. In addition, while empirical research that is not based on the use of AI, BD&A, and BC in accounting practice appears to be optimistic about the potential benefits of digitalization (Leitner-Hanetseder et al., 2021), empirical research that studies the use of digitalization in accounting is more circumspect. For example, the Delphi study by Tiberius and Hirth (2019) showed that participants do not expect digitalization to bring significant changes to auditing in the next 5 to 10 years. Also, the qualitative study undertaken by Spraakman et al. (2021) revealed that management accounts have not yet exploited data analytics beyond descriptive analysis and that predictive analytics is still in its infancy. Further, interviews conducted by Abdennadher et al. show that most of the research participants were not familiar with BC technology (2022), likely due to their not having used BC technology in accounting practice.

Moreover, some digitalization technologies, for example, BC, have not yet been fully adapted for use in accounting and most organizations do not have the required information technology...
capabilities to support digitalization technologies such as data analytics (Liew et al., 2022) by digitizing their accounting data and related processes (Tiberius & Hirth, 2019).

In addition to the slow adoption and implementation of digitalization, technologies such as AI, BD&A, and BC come with their own challenges, some of which are discussed below.

**Challenges of Digitalization in Accounting**

A limitation of digital technologies comes from applying such technologies without fully understanding how they work, as illustrated by (Moll & Yigitbasioglu, 2019, p. 9) below:

“[W]hile AI may offer significant cost savings by automating and accelerating decision making, machine learning introduces new risks. Because AI learns from existing data, the learning process is influenced by the inherent biases and prejudices in the data that humans generate and capture to train the system. ... Thus, if users do not understand the technology and adopt a black-box approach, biases will creep into decision making and potentially contaminate future data.”

Also, although claims of the benefits of big data have been made, concerns regarding big data have also been raised. Arnaboldi et al. (2017, p. 769) best explain these concerns as below:

“The performative role of accounting and big data creates and sustains a paradox in practice. It increases the belief in the possibility of improving rational decision making through better measurement and representation – a dream of full control where distance is cancelled, and databases and statistical models are relied upon to enhance transparency, predict individuals’ wishes and steer future actions. Simultaneously, it augments uncertainty through the spurious correlations and incomplete connections that may emerge from the large amount of data that organisations collect and store.”

Arnaboldi et al. (2017, p. 767) also raise concerns about the quality of big data as below:

“First, social media is used by only part of the population and it can be difficult to understand who is using a specific network. Second, and most importantly, providers of social media such as Facebook and Twitter, although offering public interfaces to download data (named Application Public Interface) do not guarantee that the entire population of data is available. Hence analysis made through Twitter, Facebook and Instagram data may provide weak signals of variations but cannot be relied on for a strict numerical approach. The issue of non-exhaustiveness is particularly relevant here.”

Arnaboldi et al. (2017, p. 767) therefore conclude that social media data is not representative. On BC technology, Dai and Vasarhelyi (2017, p. 16) note that “mainstream blockchain mechanisms ... are highly demanding of storage and computational power in order to ensure the security of data, even though the data stream of transactions may not be terribly large”. Thus, “the adoption of blockchain technology in large corporate systems will depend on the projected development of larger storage systems, wider bandwidth for data transmission, and substantial expansion of computational power” (Dai & Vasarhelyi, 2017, p. 16). Hence, the authors argue that “requirements of substantive resources could impede the popularization of this technology, especially among small and medium enterprises (SMEs)” (p.17). Hence, “a special blockchain scheme is still needed to provide reliable and accurate accounting information at reasonable storage and computational cost” (Dai & Vasarhelyi, 2017, p. 17). Moreover, BC “algorithms and operating paradigms require substantial system and security knowledge” (Dai & Vasarhelyi, 2017, p. 17). Such knowledge is critical given concerns about the security of BC technology. For example, Moll & Yigitbasioglu (2019, p. 9) caution that “many known and unknown vulnerabilities remain” in the use of BC technology.

To the best of our knowledge, there is currently no existing study that has conducted a comprehensive
cost-benefit analysis or simulation to evaluate the outcomes of implementing digitalization in the field of accounting. While various studies have highlighted the potential benefits and costs associated with this application, a direct comparison of these factors for an organization is lacking. This absence of comparison may stem from the challenges involved in quantifying the diverse range of benefits and costs associated with digitalization. Undoubtedly, conducting a cost-benefit analysis holds significant value in assessing the effectiveness and viability of implementing digitalization in accounting practices. Therefore, this area presents an opportunity for future research. By undertaking a detailed examination of the potential benefits and costs, researchers can contribute to a deeper understanding of the implications and outcomes of embracing digitalization in accounting.

Our review of academic publications on digitalization therefore shows that despite the excitement about the potential benefits of AI, BD&A, and BC technologies, there is little empirical evidence of the realization of such benefits in practice. Further, notwithstanding the potential benefits of AI, BD&A, and BC technologies, there are limitations and even potential downsides to the use of such technologies. However, only some of the publications reviewed for this article acknowledge such limitations and downsides by presenting a balanced account.

Moreover, our qualitative analysis suggests that academic research has a long way to go in engaging with empirical data related to the practical implications of AI, BD&A, and BC technologies for the accounting profession. While academic researchers have identified the “disruptive” potential of such technologies, limited empirical research has been conducted to understand the impact of these technologies on accountants. Available empirical data shows that the use of digitalization is still in its infancy. Also, literature reveals limited realization of the benefits of AI, BD&A, and BC technologies. Empirical research also highlights the limitations and downsides of such technologies and suggests the need to overcome such limitations and downsides to improve the adoption of the AI, BD&A, and BC technologies.

The gap between the disruptive potential of AI, BD&A, and BC technologies and their realized benefits in practice suggests the need for further research to help understand the reasons for this gap, especially for small and medium-sized companies. For example, future research should study reasons for the limited use of AI, BD&A and BC technologies in accounting practice, despite their disruptive potential. Also, researchers should collect empirical data on practical challenges related to the adoption, integration, and application of AI, BD&A, and BC technologies in the accounting practice. For instance, case study-based research and in-depth interviews of the early adopters of these technologies may show the impact of digitalization on accountants and the accounting practice.

Conclusion:

This study makes valuable contributions to the discourse on digitalization in accounting research and practice. First, the outcome of the study suggests that the use of digitalization, as reflected in the accounting and auditing practice, specifically, vis-a-vis artificial intelligence (AI), big data and analytics (BD&A), and blockchain (BC) technologies, is underexplored in the literature. Second, this study shows that there is a significant gap between the expected potential of AI, BD&A, and BC technologies, and their realized benefits in accounting practice, as reflected by academic research. This study suggests that empirical research can help researchers and practitioners understand the realized benefits of technologies as compared to unrealized potential benefits that are often highlighted in research papers. Third, the literature review undertaken for this study shows that articles predicting the benefits of digitalization (not based on empirical research or data)
outnumber papers researching the practical benefits of digitalization technologies in accounting practice. There is thus a need for empirical research to balance the narrative in the literature on the benefits of AI, BD&A, and BC technologies.

Appendix:
Search String:
( TITLE ( accounting OR accountant OR accountancy ) AND ABS ( "DIGITAL" OR "BIG DATA" OR "ANALYTICS" OR "CLOUD" OR "CYBER" OR "MOBILE" OR "SOCIAL MEDIA" OR "ROBOTIZATION" OR "AUTOMATIONIZATION" OR "ARTIFICIAL INTELLIGENCE" OR "BLOCKCHAIN" OR "PLATFORMS" OR "INTERNET OF THINGS" ) ) AND ( LIMIT-TO ( DOCTYPE, "ar" ) ) AND ( EXCLUDE ( SUBJAREA, "COMP" ) OR EXCLUDE ( SUBJAREA, "ENGI" ) OR EXCLUDE ( SUBJAREA, "ENVI" ) OR EXCLUDE ( SUBJAREA, "EART" ) OR EXCLUDE ( SUBJAREA, "MATH" ) OR EXCLUDE ( SUBJAREA, "AGRI" ) ) AND ( EXCLUDE ( EXACTSRCTITLE, "Journal Of Advanced Oxidation Technologies" ) OR EXCLUDE ( EXACTSRCTITLE, "Journal Of Quantitative Spectroscopy And Radiative Transfer" ) OR EXCLUDE ( EXACTSRCTITLE, "Physics In Medicine And Biology" ) OR EXCLUDE ( EXACTSRCTITLE, "Analysis And Metaphysics" ) OR EXCLUDE ( EXACTSRCTITLE, "BMC Genomics" ) OR EXCLUDE ( EXACTSRCTITLE, "International Journal Of Innovation Creativity And Change" ) OR EXCLUDE ( EXACTSRCTITLE, "Journal Of Chromatography A" ) OR EXCLUDE ( EXACTSRCTITLE, "Acta Academica" ) OR EXCLUDE ( EXACTSRCTITLE, "Anesthesia And Analgesia" ) OR EXCLUDE ( EXACTSRCTITLE, "Australian Journal Of Basic And Applied Sciences" ) OR EXCLUDE ( EXACTSRCTITLE, "BMC Medical Imaging" ) OR EXCLUDE ( EXACTSRCTITLE, "BMC Medical Research Methodology" ) OR EXCLUDE ( EXACTSRCTITLE, "Body Image" ) OR EXCLUDE ( EXACTSRCTITLE, "Chemical Engineering Transactions" ) OR EXCLUDE ( EXACTSRCTITLE, "Cogent Arts And Humanities" ) OR EXCLUDE ( EXACTSRCTITLE, "Colloids And Surfaces B BioInterfaces" ) OR EXCLUDE ( EXACTSRCTITLE, "Convergence" ) OR EXCLUDE ( EXACTSRCTITLE, "Estudios De Economia Aplicada" ) OR EXCLUDE ( EXACTSRCTITLE, "Journal Of Security And Sustainability Issues" ) OR EXCLUDE ( EXACTSRCTITLE, "Journal Of Sustainable Tourism" ) OR EXCLUDE ( EXACTSRCTITLE, "Journal Of The American Society For Mass Spectrometry" ) OR EXCLUDE ( EXACTSRCTITLE, "Kuram Ve Uygulamada Egitim Bilimleri" ) OR EXCLUDE ( EXACTSRCTITLE, "Macromolecules" ) OR EXCLUDE ( EXACTSRCTITLE, "Malaria Journal" ) OR EXCLUDE ( EXACTSRCTITLE, "Materials" ) OR EXCLUDE ( EXACTSRCTITLE, "Microbial Genomics" ) OR EXCLUDE ( EXACTSRCTITLE, "Molecular Vision" ) OR EXCLUDE ( EXACTSRCTITLE, "Neuroimage" ) ) AND ( LIMIT-TO ( LANGUAGE, "English" )

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References:


