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THE ARTIFICIAL INTELLIGENCE REVOLUTION IN ACCOUNTING AND AUDITING: OPPORTUNITIES, CHALLENGES, AND FUTURE RESEARCH DIRECTIONS

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Abstract:

This study aims to provide an overview of the increasing role of artificial intelligence in accounting and auditing. This is supported by the expertise of the accounting and auditor profession which has evolved with advances in technology from the use of pencil and paper to calculators, and eventually spreadsheets and accounting software. This study uses a conceptual approach and semi-systematic review in analyzing published relevant articles. The main results of this study explain that interdisciplinary collaboration is a must with respect to research conducted in the field of AI in accounting and auditing. Wider application of AI in the accounting and auditing professions is expected to deliver greater efficiency, productivity and accuracy benefits while burdening with the challenges of income and wealth inequality, traditional job extinction and an unskilled workforce. Careful preparation is needed on the part of educators, regulators and professional bodies by overcoming paradigm shifts and preparing future students, policymakers and professionals to face the challenges of a world full of big data, blockchain technology, artificial intelligence to deliver success in facing the fourth industrial revolution.

Key Words - *Accounting, Artificial Intelligence, Audit.*

Objectives:

Artificial Intelligence (AI) or artificial intelligence is currently one of the technologies that is developing rapidly. According to a 2019 CIO survey conducted by Gartner, Inc., one of the leading research and advisory firms, the percentage of companies implementing artificial intelligence grew 270 percent in the last four years. What's more, it has tripled in the past year, rising from 25 percent in 2018 to 37 percent in 2019. Thus, global spending on artificial intelligence in 2019 will be $37.5 billion and is expected to reach $97 .9 billion in 2023 (Zemankova, 2019). The origins of artificial intelligence date back to 1956 at the Dartmouth Conference on artificial intelligence. John McCarthy, Minsky, Shannon and Rochester initiated the study of artificial intelligence which is based on the assumption that every feature of intelligence can be described in such a way that a machine can be created to simulate it (Cordeschi, 2007). Since then, there have been significant developments in artificial intelligence technology leading to its enormous potential in the millennium.

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In the current era of digitalization, the application of artificial intelligence technology can be found in the surrounding environment. Major companies such as Tesla, Apple, and Google are trying to reinvent the auto industry by leveraging artificial intelligence technology in building driverless cars. In marketing, e-commerce media and entertainment, artificial intelligence is used to analyze customer choices and behavior. Based on this analysis, Netflix, Amazon and other similar services are able to facilitate greater customer satisfaction (Hasan, 2022).

In the accounting field, the accounting profession has an important role in big data and data analytics because accounting is related to recording, processing information, measuring, analyzing and reporting financial information (Liu & Vasarhelyi, 2014). Accounting practitioners around the world have emphasized the value of big data in accounting and finance. For example, the Association of Chartered Certified Accountants (ACCA) and the Institute of Management Accountants (IMA) argue that big data, cloud, mobile, and social platforms are changing the landscape for accounting and finance professionals, and they must adapt to the challenges posed by world crime. cyberspace, digital service delivery, and artificial intelligence. Similarly, the Chartered Global Management Accountant (CGMA) emphasizes the importance of big data, arguing that it poses a significant challenge to the future role of accounting and finance. Accountants, who specialize in providing financial accounts for reporting past performance, can be sidelined if they don't accept these changes and appreciate the new technology. Alternatively, they might seize the opportunity to become big data champions as a source of evidence to support decision making and help reinvent the way business is done (Bose & Bhattacharjee, 2022).

In the area of auditing, the Big 4 Public Accounting Firms have made and continue to make significant investments in artificial intelligence for advisory and assurance practices (Issa et al., 2016). In assurance practice, artificial intelligence is used to perform auditing and accounting procedures such as reviewing ledgers, tax compliance, preparing paperwork, analytical data, cost compliance, fraud detection and decision making. Artificial intelligence promises the ability to review unstructured data in real-time and provide concise analysis of numerical, textual and visual data. In dealing with big data (relevant and irrelevant), intelligence systems can effectively direct auditors to high-risk areas (Brown-Liburd et al., 2015). However, as companies and auditors rely more and more on artificial intelligence, there are some underlying assumptions they may make. One assumption is that the system is always accurate; the second assumption is that artificial intelligence systems will always behave within desired limits; the third assumption is that divergences from the desired constraints will be detected and corrected. This assumption is not always valid, resulting in ethical, legal, and economic implications.

There are projections that 30% of corporate audits will be carried out by artificial intelligence by 2025 (World Economic Forum, 2015). Omoteso *et al*. (2009) interviewed accounting firms, including the Big 4, and observed that technology is indeed reshaping the role of auditors. They found that continuous auditing and artificial intelligence were some of the technologies anticipated to gain more prominence in the profession. It has not yet been determined whether the results from the large-scale rollout of artificial intelligence replace (or complement) professionals in accounting and auditing environments, and the resulting effect on audit quality. However, a

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morally justifiable form of technology is necessary when this technology influences human action (Verbeek, 2006).

This study aims to examine how artificial intelligence technology influences the fields of accounting and auditing with several research questions, namely as follows:

a. Can the profession of accountants and auditors be influenced by artificial intelligence technology?
b. Are there any changes in the academic literature related to the effect of implementing artificial intelligence technology in the accounting and auditing fields?
c. How has artificial intelligence technology changed accounting and auditing practices in the real world?
d. Have countries in the world, especially Indonesia, taken the right steps in implementing artificial intelligence technology?
e. How can intelligence technology provide new opportunities for future research in accounting and auditing?

This research contributes academically and practically. Academically, this research can provide an overview of research developments regarding literature trends related to the influence of artificial intelligence technology on the field of accounting and auditing studies in Indonesia and compare research results with those abroad. In addition, this research can be a reference in developing research on the influence of artificial intelligence technology on accounting and auditing in the future. Practically, this research contributes to researchers to develop study opportunities on the influence of artificial intelligence technology on the field of accounting and auditing studies. In addition, this research also contributes to the industrial world to find out how to wisely develop artificial intelligence technology so that it can provide benefits in the fields of accounting and auditing studies.

Artificial Intelligence (AI) Definition:

The concept of AI has evolved and has various definitions from various perspectives. Zemánková (2019) defines AI as the ability of a system to accurately understand external data, machine learning, and apply what it has learned to meet specific goals and jobs through flexible adaptation. Zhang et al. (2021) defining AI is slightly different by saying that AI is the result of the successful use of big data and machine learning technologies to understand the past and predict the future using large amounts of data. Lee & Ta (2020) said that AI allows machines to learn from their mistakes, adapt to new inputs, and carry out jobs like humans.

Huge amounts of data can be analyzed thanks to AI technology, making patterns in data easier to spot. Chukwudi et al. (2018) share the perspective that artificial intelligence is the ability of devices to perform tasks normally performed by the human brain. The capacity for knowledge and the ability to acquire it are two of those tasks. Other abilities include the ability to judge, understand relationships, and generate new ideas. Brown dan O'Leary (1995) in trying to broaden the analysis of the definition of AI, said that AI can be seen from several perspectives. The four of these perspectives are intelligence, research, business, and programming perspectives. Crevier (1995) refers to AI as a "multidisciplinary science". He also points to the fact that the various AI disciplines do not have a unified language, values, or standards of achievement. Other branches of science have standard disciplines that

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act as artificial intelligence, according to Chukwudi et al. (2018), is the study of how to make computers do tasks better than humans.

Huang dan Rust (2018) describes four levels of intelligence that an AI system can demonstrate. Although AI is not a new technology, considering its conceptualization in the 1940s (Copeland & Proudfoot, 2004), AI is still considered a new technology because the techniques used to implement it have evolved radically (Stahl et al., 2022). One of the Big 4 KAPs projects that continued investment in AI by businesses will result in increased global productivity of up to $6.6 trillion by 2030. As such, artificial intelligence (AI) is believed to provide fast results and accurate output. This instant output increases the timeliness of the information and assists the user in making decisions.

Artificial Intelligence in Accounting:

Artificial intelligence (AI) is the simulation of human intelligence in machines. This allows machines to think, learn, and solve problems in ways similar to human brains buatan (Bose & Bhattacharjee, 2022). The use of artificial intelligence enables machines to perform required tasks by imitating the behavior of human intelligence. Several companies around the world are implementing AI in their accounting functions and analysis. For example, according to a recent survey of 3,000 accounting professionals globally conducted by software vendors. 66% of accountants believe they will invest in AI to automate repetitive and time-consuming tasks, while 55% say they will use AI to improve their business operations (Huang & Rust, 2018).

Artificial intelligence (AI) was first introduced into accounting more than 30 years ago (Abdolmohammadi, 2005). In particular, AI was employed in financial accounting and auditing in the early 1990s (Etheridge & Sriram, 1997). After this period, significant advances were made in other areas of accounting and finance. Companies around the world are reaping huge benefits by integrating AI into accounting tasks, which can be classified as internal or external. For internal purposes, AI is used in the accounting function to produce more accurate and acceptable finances. AI can offer information faster than humans because of competence and consistency in analyzing and interpreting accounting data (Bose & Bhattacharjee, 2022). As a result, accounting functions performed by AI can provide fast results and accurate output. This instant output increases the timeliness of accounting information and assists users in making decisions.

AI that has been properly trained to achieve accuracy, has been programmed to follow accounting rules, so it will be more accurate and consistent. In line with this notion, incorporating AI in the accounting function can eliminate accounting errors and human error when preparing financial reports. Furthermore, several companies around the world have adopted AI with a predefined "trained principle", and these companies have benefited in the increased comparability of financial reporting. Accounting firms are now also integrating AI into the audit function to ensure compliance and reduce intentional errors by managers. This will limit the manager's ability to use certain financial function formulators. Despite the fact that only a few accounting firms have AI in their audit function, most of them use AI to manage audit risk (Zhao et al., 2004).

Additionally, the most prominent benefit of incorporating AI into a company's accounting function is minimizing future costs. In the long run, reliance on AI will reduce dependence on human operations and increase the

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efficiency and accuracy of corporate financial reporting. Primarily, there are certain fixed costs associated with the design, development, and implementation of AI in the accounting function of a company, as well as some indirect costs associated with monitoring and confirming AI performance. Moreover, another significant cost of AI is its dependency on the entire system because if a system is hacked or attacked and there is no human backup available, it will be a liability rather than a benefit for the company (Bose & Bhattacharjee, 2022). For this reason, proper maintenance of AI systems is an important function of companies before implementing AI.

Artificial Intelligence in Audit:

Etheridge et al. (1997) provides an analysis of different AI techniques that can be used to assess the viability of a company's business. They illustrate how AI can study the relationship between various independent variables/financial ratios to determine the financial health of a company. Another possible use of AI in auditing is monitoring the client's automated internal controls (Hunton & Rose, 2010). Finally, AI techniques such as speech and facial recognition can enable AI to conduct interviews. Guan et al. (2020) concluded from previous literature that AI is successfully used to detect deception in speech or nervousness in facial patterns. This ability can be useful in fraud interviews.

Davenport and Raphael (2006) provides an example of Deloitte's 'Cognitive Audit' strategy, which involves first standardizing the audit process, after which the standard process is digitized. Then the digital tasks are automated, followed by the use of advanced analytics for audits. Finally, cognitive technology (augmented) is used to transform auditing. Despite AI's growth in auditing, Chan and Vasarhelyi (2011) observed that the use of AI maybe limited to complex judgments requiring professional skepticism. An example of a complex audit task is the evaluation of management estimates. However, they open up the possibility that advances in AI may one day make it possible to automate complex tasks.

Projecting into the future, as AI technology matures, routine low-level auditing tasks will become AI functions. An example of such a low-level audit task is the creation of a request for evidence from an audit client and the documentation of that evidence. Many of the functions currently performed by staff-level auditors will be taken over by Augmented AI, the results of which will be reviewed by the auditors. On the audit client side, the evidence requested by the auditor's AI can be generated by the client's AI Assisted or Augmented. Once the technology matures, the AI systems on the auditor and client side can communicate directly. After a few rounds of use, the need for human review can be reduced, shifting this usage from an Augmented level to a more Autonomous level.

Our projections are in line with Huang and Rust (2018), which reviews the emergence of AI in the service industry. Initially, artificial intelligence (AI) replaced some job service tasks as a transitional stage which was considered an improvement, and then continued to evolve to fully replace human labor when AI could take over all job tasks. In an ideal situation, the auditor would know what kind of AI artifact to use (assisted, augmented, or autonomous), and what the benefits and risks are. Auditors will not relinquish their responsibility to technology. However, they will regard technology as complementary to their professional judgment and display a suitable level of skepticism.

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In response to the rapid adoption of technology in auditing practice, the International Auditing Standards and Assurance Board (IAASB) established a technology working group to elicit feedback from various stakeholders (regulators, regulatory bodies, accounting firms, academics, and professional bodies, among others). . Stakeholders observed that "data is used differently from previous audits" resulting in "legal and regulatory challenges" (IAASB 2018, p. 7). Although stakeholders do not consider current standards to be "broken", there is consensus that "practical guidance" (IAASB 2018, p. 6) needed to reflect the digital age the profession is currently experiencing, with regulators calling for revisions to standards in a "way that reflects today's technology" (IAASB 2018, p. 9).

Artificial Intelligence Technology in Accounting and Auditing:

Companies can use many tools to identify their financial performance and position from several angles. Organizations can process their data by using the following accounting data analytics tools.

a. **Microsoft Excel**

Microsoft Excel is an application that is widely used by businesses around the world. It has various features such as data calculation, summarizing numbers, pivot tables, graphing tools, etc. Microsoft Excel can perform statistical analysis such as regression modeling. Microsoft Excel is one of the most significant and powerful data analytics tools on the market, and improves the efficiency and effectiveness of user expectations.

b. **Business Intelligence Tools**

Accounting professionals may benefit from business intelligence tools that help them to identify ongoing and predictive insights from specific data sets. Using a variety of business intelligence tools, companies can clean data, model data, and create easy-to-understand visualizations. This visualization provides a detailed understanding and helps identify areas that need further development. The tool generates some shared features that can be easily accessed and understood by other group members. There are various business intelligence tools like Datapine, Tableau, Power BI, Business Intelligence SAS, Oracle Business Intelligence, Zoho Analytics, Good Data etc.

c. **Proprietary Tools**

Proprietary tools are tools designed by companies for their own use. Companies internally develop and use these tools to manufacture and sell products and goods/services to users and customers. Large companies usually introduce proprietary tools such as Interactive Data Extraction and Analysis (IDEA). IDEA is a software application that enables accountants, auditors, and financial professionals to interact with data files.

d. **Machine Learning**

Machine learning is a data analysis technique in which software models are trained using data. It is a field of artificial intelligence based on the premise that systems can learn to train data, identify patterns, and make judgments with minimal human interaction. Several companies around the world use the most advanced and sophisticated tools in their data analytics in accounting procedures such as "R" and "Python". This programming language is mostly employed by companies to perform highly customized and sophisticated statistical analysis. Python was originally developed as an object-oriented programming language for use in

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software and web development but was later expanded for use in data research. Python can do a variety of research on its own and integrate with third-party machine learning and data visualization software. On the other hand, R is a popular statistical programming language that statisticians use for statistical analysis, big data analytics and machine learning. Facebook, Uber, Google, and Twitter use R for behavioral analysis, advertising effectiveness, data visualization and economic forecasting. Both of these programming languages are used to generate various algorithms that perform regression analysis, detect clusters of data and perform other programming tasks.

Research Method:

The analysis using a systematic review aims to identify many research trends related to AI in accounting and auditing. However, researchers only select issues that we think are relevant based on how AI is currently being used, especially in Indonesia. In the following sections, we provide a summary of the issues related to AI features that have a direct impact on the accounting and auditing professions. Data sources were obtained from national accounting journals indexed by Sinta 2 and 3. Sinta 2 and 3 were chosen because they had passed a strict selection process in journal accreditation and managed to get scores between 60-80 from the *Akreditasi Jurnal Nasional* (Arjuna).

This analysis aims to further examine the research on artificial intelligence in the fields of accounting and auditing. Where from 2014 to 2023, there were 32 studies in Indonesia that discussed the application of artificial intelligence in accounting and auditing (See Figure 1).

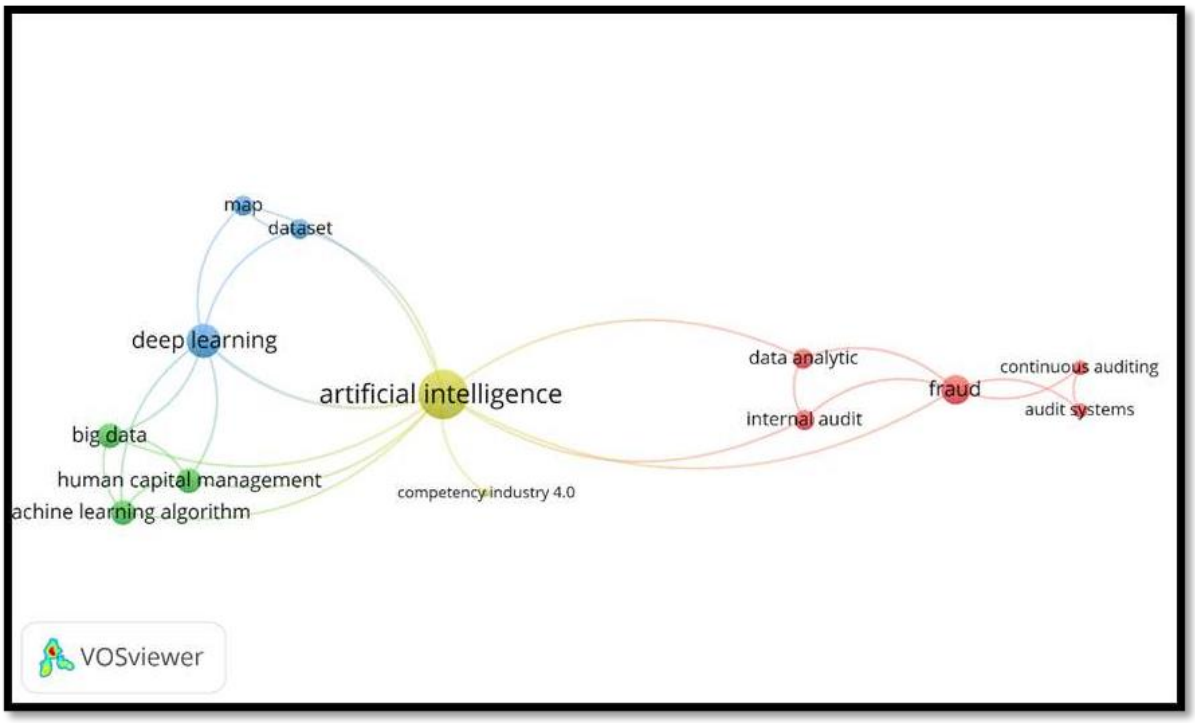

Figure 1. ***Mapping Artificial Intelligence Research Themes in Accounting in Indonesia***

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Result and Discussion:

The results of this study indicate that the themes of artificial intelligence research in accounting and auditing are classified into several discussions, namely data analytics, industry 4.0, machine learning, big data, and deep learning. These studies also focus more on the accounting and auditor profession, especially in dealing with the 4.0 era and preventing fraud in companies.

In this case, research using the theme of artificial intelligence in Indonesia is still relatively small because there are only 32 studies over 10 years. Therefore, this can be a future research opportunity to enrich the literature on artificial intelligence and its components in all areas of accounting such as management accounting, tax accounting, cost accounting, and so on.

The widely used AI technology:

Based on existing literature studies, the most frequently mentioned application fields are but not limited to the following:

a. Genetic algorithms/programming, as mentioned, are mostly used to predict bankruptcy or similar audit assignments, reducing the risks associated with traditional bankruptcy risk models that only operate under certain model assumptions. However, algorithms can be used in a broader sense, economical evaluation and within time and resource constraints.

b. Fuzzy system, the advantage is the possibility to explain qualitative factors explicitly. Rosner, Comunale and Sexton (2019) point out the main uses of fuzzy logic for the purpose of assessing materiality. The fuzzy system allows the auditor to rate materiality on a continuous scale from 0 to 1 rather than with a binary decision

c. Neural networks are largely associated with risk assessment, helping auditors perform risk assessment tasks in a more systematic and consistent manner, thanks to the ability of neural networks to study, generalize and categorize data, both complete and incomplete. Calderon and Cheh (2012) mention further options on how to use neural networks: for initial information risk assessment, control risk assessment; determine errors and fraud, financial distress and bankruptcy and form a going concern audit opinion.

d. Hybrid systems, a combination of the technologies mentioned above, can be used when both quantitative analysis and qualitative assessment are required. Davis, Massey and Lovell (2017) built a prototype hybrid system, integrating expert systems and neural networks. The expert system part ensures the efficient use of known control variable relationships, while neural networks provide a part way to recognize patterns in a large number of control variable relationships, some of which are impossible to express as a set of rules.

The Benefits of Applying AI in the Field of Accounting and Auditing:

Several studies as cited in Omoteso (2009) shows the various positive sides of applying AI in accounting and auditing. These benefits include but are not limited to—efficiency and effectiveness, consistency, audit task structure, better decision making and communication, better staff training, skill development for beginners and shorter decision time. Chukwuani & Egiyi (2018) argues that AI will impact accounting by reducing the likelihood of fraud, improving the quality of accounting information and promoting traditional accounting and

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auditing reforms. Mohammad et al. (2022) identified that by keeping pace with the continuous improvement of AI in accounting and auditing, accountants and companies will ultimately be able to reduce accounting costs, adding value to the accounting industry by shifting the focus of accountants from existing monotonous tasks to data-driven and analytics decisions. Agusti *et al.* (2022) menunjukkan bahwa pada tingkat metadata, dokumentasi sumber, pemrosesan documents, conference calls, emails, press releases and news media from both internal and external sources can all be evaluated and compared, facilitated by AI- driven automation. Those who embrace and apply AI broadly and are prepared to take entrepreneurial risks to turn a product or service breakthrough into a global commercial success story will continue to gain significant competitive advantages.

Challenges of Using AI in Accounting and Auditing:

Several studies as cited in Omoteso (2009) shows the various weaknesses of implementing AI in accounting and auditing. These risks or drawbacks include but are not limited to prolonged decision-making processes as a result of exploring more alternatives, enormous costs to build, update and maintain the system, inhibition of novice knowledge base, inhibition of skills development in conducting professional judgments, risk of tool switching to competitors and the possibility of the tool being used against the auditor in court for overrelying on decision aid evidence. No matter how efficient AI technology may extend to accounting and auditing tasks, it cannot replace human abilities to practice reasoning, express emotions, exercise professional skepticism and use professional judgment. They also discussed the possibility of "technological unemployment". As such, it has the potential to supplement or completely replace a profession, making the latter's long-term survival doubtful. According to one Ernst & Young (EY) source, the number of new hires each year could halve as a result of the emergence of AI, drastically changing the industry's employment model. According to Luo et al. (2019), some of the problems associated with implementing AI in accounting include lack of initial experience, slow return on high investment, lack of required professional skills and qualities. One of the obstacles to using AI in practice, highlighted by Huang (2018) is that there are frequent changes in laws and regulations requiring that AI systems also be updated. An example is the case of changes to the tax law. Zemánková (2019) pointed out that the application of AI in accounting and auditing may result in possible income inequality, reduced labor requirements, jeopardize financial security, etc. In addition, AI applications run the risk of making algorithms exploitative, deceptive, internally biased or contain human logical fallacies or embedded human biases. Makridakis (2017) lists possible negative consequences of implementing AI that include increased unemployment, wealth inequality, end of human supremacy, and approaching technological singularity. Mohammad et al. (2020) argued that the main challenges facing AI adoption include developing effective strategic policies for AI, mobilizing skilled manpower, lack of motivation and commitment to AI from top management.

Many countries have competed in recent years for the research and application of artificial intelligence, and the push for its use is becoming stronger in academia (Luo et al., 2019). Accounting firms are also deploying their resources to explore developing AI-based service solutions for their various clients. The big four accounting firms are expected to be the ones leading the AI implementation revolution in accounting and auditing.

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AI Research Opportunities in the Field of Accounting and Audit in the Future:

Big 4 PAFs reveals two distinct trends in the use of AI technology. First, the accounting profession is progressively investing in AI and its integration into its core business. Second, the Big 4 confirms that AI is an important determinant for future accounting success (Zhang & Tao, 2021). Companies that do not adapt to changing times risk being left behind. As technology eventually catches up with accounting, it is now critical for organizations of all sizes to keep up with technology trends to stay competitive.

Since this field is still relatively new, most of the AI in accounting and AI in auditing literature revolves around understanding concepts, figuring out use cases, potential impact, and so on. There are studies looking at AI implementation in certain industries in certain countries, but no studies have looked at the determinants of AI implementation. In addition, there is still a lack of research linking the application of AI to company performance or efficiency. The lack of such studies is justified by the fact that AI applications are not yet widespread. To enrich the AI literature in accounting and auditing, more case study type research needs to be done. Organizations based in many developed countries are increasingly offering and engaging in AI-based solutions. Their success and failure stories along with the contributing factors need to be properly documented and presented to a wide range of stakeholders so that a wider awareness of the phenomenon can be achieved which can ultimately contribute towards greater application of AI in accounting and auditing disciplines. Future research studies should focus more on interdisciplinary collaborative approaches. In doing so, the following issues can be further discussed:

a. Research different kinds of bias in AI (e.g. data-driven bias or interaction bias)
b. Case study assessment of AI implementation success and failure in various industries in accounting and auditing.
c. Determinants of the application of AI in the field of accounting and auditing in the functions of business organizations.

Conclusion:

Based on the results of research conducted, AI in accounting and auditing has enormous potential for efficiency, reducing errors and giving accountants and auditors more time to focus on more complex and value-added tasks. Anything that can be turned into data, according to some technology analysts, will eventually be taken over by machines. It is capable of leaving imagination and judgement, which are exclusively human domains and often what distinguish one organization from another. AI, like spreadsheets and databases, is a tool that is only useful if people know how to use it to streamline business processes.

Accountants and auditors, especially external auditors cannot be replaced by artificial intelligence in terms of training human creativity and judgment. Shifts in technology, regulations, and the economy will continue to test the profession's historical approach and way of thinking, which is a good thing. The market response to these changes will ultimately influence how audits are conducted. Accountants and auditors need to be able to respond quickly to changing user demands and the creation of new and emerging organizational performance metrics outside of traditional financial reporting. Centralization and standardization are necessary because the auditing

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profession requires deeper specialization. Accountants and auditors will see a variety of changes in the coming decades, with great opportunities for individuals entering the profession to drive innovation and progress.

The important concept at the heart of auditing is increasing the confidence of information will remain unchanged. However, as technology and analytics advances, the way teams engage with auditing will change. Auditors' capacity to exercise professional judgment and skepticism will become more important than ever as they embrace new technologies. In accounting, AI is not going to replace accountants; instead, it will distract the accountant's focus. No matter how much disruption to the AI profession in the future, it is unlikely that the need for human professionals will ever disappear. Therefore, as a society, we must continue to use AI to ensure that value and efficiency always come first.

There are various topics regarding artificial intelligence that could be researched in the future, such as how to analyze the costs and benefits of artificial intelligence projects, the extent to which audit assessments can be automated or whether the audit population is a large enough sample for deep learning. Although future research may present new problems and dangers, it will surely bring more innovations, possible opportunities and effective solutions.

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