An investigation of artificial intelligence application in auditing

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Abstract.
The auditing profession is changing due to the advent and enforcement of artificial intelligence (AI) in its field. The implementation of artificial intelligence is introducing the advantages of taking over manual processes and promoting effective value-added decision making by the auditors. This chapter discusses the development and use of artificial intelligence in auditing from the prospects of education, profession and ethical implications. It is not sufficient for the auditors to have professional knowledge only but to also develop the acumen for the implementation of artificial intelligence. Undergraduate and postgraduate degrees are being revamped to include knowledge of AI. Additionally, auditors are catching up on AI developments through professional development courses. The audit process benefits from AI due to the coverage of all the transactions instead of relying only on a sample to make a judgment. Auditing firms are investing in contract analysis software to go through complex documents. However, the ethical implications of AI are new and regulatory authorities are still in the process of providing adequate coverage towards the use of AI. The bottom-line of implementing AI processes is that it is complementary to the function of auditing and not a replacement.

Keywords: Artificial Intelligence, Auditing, Education, Ethics.

1   Introduction

The role of an auditor and audit process is evolving through breakthrough innovation in artificial intelligence (AI), big data, data analytics and workflow automation. These developments are eliminating tedious and labour intensive manual process in audit, and enabling auditors to powerful insights. The innovative technologies are supporting in enhancing audit quality for the various stakeholders which involve the clients, auditors, investors and capital markets (Raphael, 2017). Tiberius and Hirth (2019) surveyed German auditing professionals for the expected auditing practices in the wake of technological developments. The study concluded that new technologies would not replace auditors but would provide relief and support in the auditing process. Additionally, the annual audit was expected to revolve around a continuous audit approach.

Artificial Intelligence (AI) is characterized as digital intelligence or intelligence of the technological advances, which resembles intellectual functions. It encompasses a range of interlinked innovations including data processing, deep learning, voice recognition, image recognition and an interpretation of emotions.AI consists of two components i.e Artificial and Intelligence. Artificial that is formed by humans and intelligence is the ability to interpret, motives etc. The behavior of AI can be coded as an automated system that enables a user to replicate, create or illustrate human consciousness.

The accelerated digitalization is posing significant challenges to every industry and auditing firms are expected to also experience an impact. In the wake of these challenges, firms would have to use their foresight to enable early warnings, improve long-term planning, innovation process and decision making, and be agile to environmental changes (Iden et al., 2017). The firms also need to think ahead in developing competitive advantage (Anderson, 1997) and overall profitability (Rohrbeck and Kum, 2018) by forecasting the impact of digitization in auditing.

Machine learning, which is a key subset of AI, has demonstrated a significant impact on the way audits are performed. Auditors are able to avoid the tradeoff between speed and quality with the implementation of machine learning in the profession (Raphael, 2017). While new advancement in technology has had an immediate impact

on the elimination of manual and routine tasks, there is still a little appetite for a human free audit. Automation in audit supports in reducing errors and spotting patterns, thereby the role of an auditor as an independent challenging voice with skills of communication, empathy and persuasion continue to remain secure (McGhee and Grant, 2019).

Figure 1.1 describes the advantages artificial intelligence has brought to the auditing field. It is crucial to note that mundane and repetitive tasks are managed by the AI systems whereas the accountants and auditors can focus more on the core business and decision making. AI has changed the focus of these professionals to an interpretive mode thereby requiring a new set of skills that can harness the benefits brought about by the new technology.

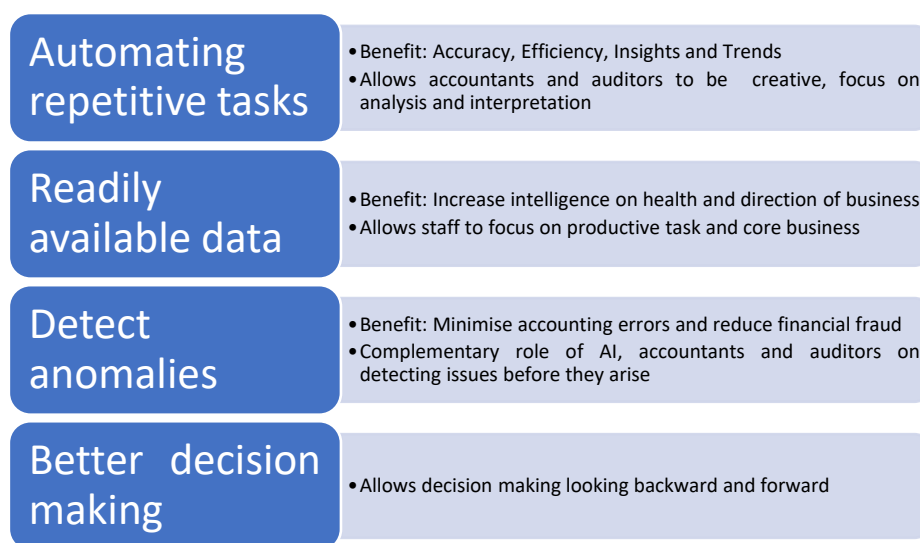| Automating repetitive tasks	• Benefit: Accuracy, Efficiency, Insights and Trends • Allows accountants and auditors to be creative, focus on analysis and interpretation
Readily available data	• Benefit: Increase intelligence on health and direction of business • Allows staff to focus on productive task and core business
Detect anomalies	• Benefit: Minimise accounting errors and reduce financial fraud • Complementary role of AI, accountants and auditors on detecting issues before they arise
Better decision making	• Allows decision making looking backward and forward

Fig 1.1: Role of Artificial Intelligence in accounting and auditing (Source: Interpretation from Govil (2020))

The chapter aims to provide an insight into the impact of artificial intelligence on auditing education and profession. It also investigates the ethical implications and risks associated with AI before implementation into the auditing profession. To address these objectives the chapter provides a detailed literature review on AI aspects already established for the auditing field.

This chapter is organized to discuss the impact of artificial intelligence on auditing education. This is followed by an insight into how artificial intelligence is having an impact on the auditing profession. Section 2.3 discusses the ethical implications of artificial intelligence on auditing. Section 2.4 presents the risks related to artificial intelligence. The final chapter provides the overall conclusion in terms of the findings made from the literature review and the progress of AI in auditing.

2   Literature Review

2.1   Artificial Intelligence and Auditing Education

The field of Artificial Intelligence in Education (AIED) is innovative and derivative. It contains related methodological approaches such as AI, cognitive science, and education. AIED essentially comprises of two main complementary elements: the development of AI-based learning tools and their use to understand learning. AI is rising rapidly in the educational sense that is expected to become a market value of approximately 6 billion dollars by the year 2024 (Bhutani and Wadhwani, 2020).

In particular, students primarily focus on accounting courses, to develop their knowledge and skills in accounting, auditing and technology. Preparedness and acceptance by students in emerging technology disciplines

are thus primarily influenced by the effectiveness of accounting curricula in providing educational skills in these areas. While ongoing development and application of cognitive machine technology are unavoidable in accounting and auditing, academic research is inadequate that examines the impact of AI on higher education in accounting and the future of accounting technology (Siau, 2017). On the other hand, numerous researches have investigated the AI effect on accounting and auditing (Kokina and Davenport, 2017).

An efficient expert system provides numerous benefits when applied to audit, including the automatic understanding of audit task operations and increased transferability of knowledge (Omoteso, 2012, Lombardi and Dull, 2016). Universities and colleges must establish strong relationships with professionals in the field so that students can access valuable opportunities (Maginnis and Wagaman, 2019). Improving education in accounting and auditing is important to give students with a better possible understanding of job opportunities and gain experiences.

Based on emerging technologies, such as artificial intelligence, the accountants will continue to succeed and develop through more specialized consulting services, helps client integration with Artificial Intelligence and customer awareness instead of being solely concentrated on measuring financial data (Ovaska-Few, 2017). Training and retraining are required in some cases.

A financial audit involves stressful, labor-intensive analysis into the financial statements and its business. The audit objective is to gather evidence that allows the auditor to express an opinion as to whether, in all significant respects, the financial statements represent the company appropriately. Throughout the audit process, the use of AI technology strengthens the audit profession but does not replace it. AI increases the efficiency, efficacy and accuracy of audits. The experts in accounting and auditing will study and be thought leaders, transferring specialized expertise to senior management. Furthermore, ensure that businesses embrace AI, that offers the best customer services to clients.

AI's assistance in research and testing provides auditors with more time to analyze the factors behind AI 's trends and anomalies. AI will accomplish various repetitive tasks and make the auditors act as an advisor, thereby improving efficiency and confidence in the audit, while simultaneously reducing risks. Auditors must remain active and efficient to plan for the deep implementation of AI. The auditor now is expected to have the characteristics of being tech-savvy, strategic thinker and a good communicator. While deep knowledge and know-how in traditional audit areas will continue to be required even with AI, auditors must be responsive to their changing climate. It is advisable for students who want a position in this field to educate by incorporating technology and research as an ideal candidate in addition to their accounting basis. The field of an audit is evolving rapidly as a result of AI growth.

Auditors will have to re-focus on the technology associated with AI acquiring the skills related to higher-value tasks involving intuitions, decisions, communication skills expertise. Murphy (2017) advocated the need for such competencies as it encourages companies to develop organisation environment which is coupled with intensive training. ACCA research presents insights into future skills and how they can change, and the requirement of "digital quotient" (McGhee and Grant, 2019).

The report by McGhee and Grant (2019) also identified the most important competency area and mentioned that there is a large gap of skills in all specialised futuristic finance professions including the traditional technical skills and range of quotients such as Intelligence (IQ), Digital (DQ), Vision (VQ), Experience (XQ), Technical skills and ethics (TEQ). ACCA and CA ANZ provide education and knowledge-building skills to improve the technical & technological capability of students and the members. It also ascertains financial and non-financial information that recognizes the professional and ethical requirements that have to be met through the use of data technologies. Forbes and KPMG (2017) articulated that in order to attract the interest and thoughts of young individuals, accounting needs to be seen as forward-looking, innovative and high-tech. The 'hybrid skills' required for potential auditors, on the other hand, can make the audit profession more appealing for people from various backgrounds. Auditing is still a profession that requires teamwork, and it is important to combine the right skills in the team.

2.2 Artificial Intelligence and Auditing Profession

AI is a concept with interlinked technologies that involve data mining, machine learning, speech recognition, image recognition and sentiment analysis. For the auditing profession, artificial intelligence provides the benefits of advanced methods that support in understanding ledgers, detecting material misstatements, and reporting the underlying risks to the clients (Colthart, 2019). Both the auditing firm and client will find its amount of work considerably reduced due to AI-based systems as it analyzes complete ledgers with minimum questioning of the client. AI parses information that will flag transactions that deviate from the data set which would not be caught by traditional testing practices (Colthart, 2019).

With the proliferation of financial transactions, auditors must decide on the sample that is representative of the population. This would enable them to make conclusions that are generalizable beyond the sample. This is where machine learning steps in and resolves the dilemma of sampling as it reviews the entire population and provides assistance to the auditor for testing the items that are beyond the norm (ACCA, 2019). PwC (2017) discusses an example of machine learning in audit at a US firm according to which, the machine searches for the peer group of Company A which is being audited. A set of peer group ratios are calculated and compared against Company A performance to identify unusual trends. This data is then shared with the auditors to investigate if the variance is an anomaly and the reasons for the same. The auditor's decision and reason are then fed into the machine for responding to similar variances in the future. Thereby, machines would identify unusual patterns instantly and support auditors in detecting fraud. Another practical example of the deployment of machine learning is the tie-up of Deloitte with Kira Systems in 2014 whereby a contract analysis software was introduced (Kepes, 2016). The platform was trained to read complex documents, extract and structure textual information for analysis. Boillet (2018a) also advocates that AI tools are able to accurately extract information from lease contracts based on pre-defined criteria thereby improving the precision over human review. This enables value addition to the audit process as better queries and interaction can be established with the CFOs, audit committees and board of directors.

Taylor (2020) suggests that sentiment analysis is a popular tool that scans and processes employee sentiment by evaluating pieces of text. This would identify if the tone of the employee was positive, negative or neutral with reference to the topic and be the potential to mitigate future risks and combat fraud. The intelligent communications monitoring are built with bankruptcy prediction algorithm that analysis the employee textual communication along with the financial statements calculations. This supports scanning early indicators for any financial problems and mitigating its associated risks.

Artificial intelligence use in analysing the audit proposals through the use of Coh-Metrix Text Principal Component scores has supported in identifying strategies to be adopted for communication by the auditing firms (Chang and Stone, 2019). Auditing firms market their services through well-drafted auditing proposals, thereby attracting potential clients. The audit proposal quality will result in competition intensification to obtain audit engagements (Broberg et al., 2013) and establish unique selling points for differentiating themselves (Hodges and Young, 2009). Auditors are guided for improving their written communication materials in terms of clarity, conciseness, simplicity, consistency and coherence through the use of linguistic-based studies (Fakhfakh, 2015). Chang and Stone (2019) advocate that training auditors based on linguistic methods and tools would improve their overall communication success as a firm. Thereby auditing firms can use the Coh-Metrix tools to identify the textual features needing improvement in the audit proposals or audit reports and serve for its larger communication and marketing purpose.

2.3 Artificial Intelligence and Ethical Implications in Auditing

    a. Ethics and AI

There are two common types of ethics, they are "instance-based ethics" and "principle-based ethics". The former is related to the observation of any matter and note that there is something wrong, while the latter is "related to

the application of values consistently to reach appropriate decisions, regardless of the particulars of the situation". Principle-based ethics are more related to AI which needs it needs designed ethics to control all related issues (Chartered Institute of Internal Auditors, 2019). The ethical study of AI, as a part of emerging technologies, is considered still in its early stages. The importance of emerging technologies and the need to have ethical analysis related to it has been realized recently, then the need to have theories and methodologies to deal with it is still novel (Brey, 2012).

b.   Futuristic approach and AI

The deal with ethics within the emerging technologies, and consequently AI, can be proceeded through one of three approaches. First: ignorance, under the belief of keep innovation and do not stifle it. This approach is not practical as it would only lead to deferring problems. Second: conservative approach, according to it, ethical issues will be addressed only when they materialize or when they are reliably predictable. This approach would also not practical for AI as its more dynamic and its' adaption is proceeded at a pace faster than other types of technology and its' related issues are more complicated and unfeasible to change when the technology being in use (Munoko et al., 2020). The concerns about the two approaches support the third approach which called "futuristic approach". This approach aims to forecast what the ethical implications will be of using emerging technology in the particular field of auditing (Brey, 2012). The ethical analysis of emerging technology implicitly contains uncertainty related to many perspectives such as future devices and applications (Sollie, 2007). The question is, when there is no certainty about future technologies, how the ethical analysis be done? The deal with this problem can be done through one of two approaches, the first is more conservative and reliable while the second is more uncertain and speculative.

The first approach is called "generic approach", it focusses only on ethical issues that can be predicted reliably or fully known. These issues are predicted to appear with any future use of technology, and they are unavoidable. These issues are related to the characteristics of the technology itself or characteristics related to possible applications. The development of genetic technology was correlated from the beginning with the need of having modification of genetic material. Hence, this approach deals with these generic ethical issues expected from the technology progresses. The second approach is more speculative, it's called "the forecasting approach". This approach predicts different devices and implications the emerging technology (including AI). It explores ethical issues that would present themselves if these forecasts were to come true (Brey, 2012).

c.   Ethical approaches to AI

Although many forecasting approaches to technology are followed, ethical approaches to technology that involve forecasting are only a few, these approaches developed only during the last decade. These approaches are: i) ethical technology assessment (eTA), ii) ethical impact assessment approach, iii) the techno-ethical scenarios approach and iv) ethical assessment of emerging information and communication technologies (ETICA).

Ethical Technology Assessment (ETA) approach has elaborated by Palm and Hansson (2006). Technology developers participated significantly in the development of this approach. It assesses practices and provides negative ethical implications related to the development of technology (Palm and Hansson, 2006). ETA takes place via indicating ethical concepts in technology-related matters which are even projected features of technology or/and anticipated social consequences of technology usage through. It relies on an ethical checklist includes nine issues related directly or indirectly to the ethical emerging technologies even in a conventional sense or in a broad sense. This approach may indicate that this approach is more suitable to assess the ethical issues related to the technology in the long run only, while in the long-run (Brey, 2012).

Wright (2011) initiated the second approach which is called the 'Ethical Impact Assessment Approach' (EIAA) to ensure that ethical issues are taken into consideration when IT developers develop any new technology-related initiative. Wright's approach ensures ethical IT issues via an extended checklist contains a wide range of ethical values and principles. The answer to these questions was collected from all stakeholders through many platforms, such as expert workshops, consultations and surveys. Wright's approach is more suited for the ethical assessment of the already existing and known IT projects rather than the broad ethical assessment of emerging IT and its' related uncertainty issues.

A third recent approach is called "Techno-Ethical Scenarios Approach" (TESA) elaborated by Boenink et al. (2010) to anticipate ethical controversies regarding emerging technologies for the emerging technologies which help policymakers. This approach relies on scenario analysis anticipating the "mutual interaction between technology and morality" via the ethical assessment of the new technologies from a moral perspective. Taking a moral perspective into consideration may increase the validity of the emerged technology in society.

Finally, the fourth approach called the "Ethical Information Technology Assessment" (ETICA) approach provides a comprehensive overview of ethical issues that emerging technologies may play in the following few years (medium-term). ETICA aims to forecast the consider multiple possible futures using different methods to identify the anticipated impacts for having emerging technologies. Further, it anticipates the different constraints and social impacts of these emerged technologies (Stahl, 2011).

Mechanisms, strengths and limitations of each ethical approach are summarized in table no. 1.

Table No 1: Mechanisms, strengths and limitations of ethical approach

Ethical approach	Mechanism	Strengths	Limitations
Ethical Technology Assessment (ETA)	Ethical checklist includes nine issues related to emerging technologies.	Although Palm and Hansson's approach is a good initiative it can be followed with emerging technologies	-Misses the details of the knowledge needed to be acquired and the method of its' acquisition -There is a lack of clarification about the method of performing the analysis of ethical matters -The limitation of the nine issues included in the checklist.
Ethical Impact Assessment Approach (EIAA)	An extended ethical checklist contains: -Range of ethical values -Range of questions related to values and principles	-It contains many questions related to the ethical aspects of new technologies. -It elaborates procedures for involving stakeholders in ethical analysis.	-Lack of clarity about how forecasting takes place using expected artifact, applications and social consequences. -Lack of clarity about how participants capability on answering questions related to the ethical checklist on the basis of the knowledge that they have.
Techno-Ethical Scenarios Approach	Scenario analysis	-It anticipates the mutual interaction between technology and morality. -It focuses on detailed scenarios. -It pays attention to moral change.	-It is a descriptive and predictive approach, rather than normative and prescriptive. -It does not describe moral issues ought to emerge from an ethical point of view. -It misses ethical issues that are unlikely to collect much public attention but that are nevertheless important. -It may identify moral controversies that may emerge in public debate

Ethical approach	Mechanism	Strengths	Limitations
			that are based on a false or misguided understanding of the technology or its social consequences.
Ethical Information Technology Assessment (ETICA)	Multiple methods implemented to identify the followings for emerging technologies: -projected artifacts -projected applications -Capabilities -Constraints -Social impacts	Considering a wide range of technological properties, artifacts, applications, and ethical issues. And it aims to make use of state-of-the-artwork in futures studies.	-First, its claim to adopt a futures studies approach is somewhat dubious, as the main sources for locating ethical issues that have been used in the ETICA approach are texts which are not based on futures research. -A second weakness is that many of the ethical analysis undertaken in the ETICA project appears to refer to generic properties of the technologies that are studied.

Source: (Brey, 2012, Brey, 2000)

2.4   Risks associated with artificial intelligence and auditing

Despite the advantages AI introduces to any work, there are significant risks to be managed. The risks are specific to the AI application and to the type of business adopting it. The following are some of the risks posed by AI (Boillet, 2018b):

   a. Programming errors: The AI applications are based on algorithms and any errors in constructing these would affect the results and overall conclusions.
   b. Algorithm bias: AI application algorithms detect the patterns of data and codify it based on predictions, modeling, rules and decisions. The machine algorithms are built on data and experience, which might suffer from interaction, latent or selection bias. This in turn would result in outcomes that reinforce existing patterns of discrimination.
   c. Overestimating AI: Deep learning performs statistical techniques for identifying patterns in large amounts of data, but it cannot be expected to have an understanding of the same as humans do. If the input data is incomplete, biased or of poor quality, AI will produce outcomes that are not reliable.
   d. Threats from cyberattacks: Hackers can use machine algorithm hacking methods or botnets for accessing the network and sensitive data. This poses a security threat to the people and the government.
   e. Lack of legislation: While the adoption of AI technologies is unabated around the world, the legislation dealing with the same are just coming to force. There is a strain on the existing laws and regulations to deal with the emerging challenges posed by AI. Most governments are adopting a 'wait and see' approach as the AI use and abuse is not clearly known (Walch, 2020).
   f. Reputational Risk: As AI deals with sensitive and confidential data, if the algorithm is biased, error-prone or hacked, it could have the reputational risk to the organization that owns its.

3   Conclusion

The advancement of new technologies demands that the auditing firms and their teams become more agile (Newmark et al., 2018). In addition to the knowledge of accounting and auditing rules, auditors will be required to have a new skill set that demonstrates an understanding of the information systems, data science and general business. The implementation of artificial intelligence in the auditing field is yet to be proven and it is difficult to estimate how the audit process would undergo a change with machine learning, it would be useful for the auditing firms and auditors themselves to consider implications on future client engagements.

The preparation towards AI for auditing firms involves not just investment into the AI systems but also acquiring or developing the skill set necessary for using the same. While the firms would benefit to hire computer programmers, it would be useful for the accountants and auditors to have knowledge of coding to collaborate with the IT professionals more effectively in building the algorithms.

While the growth of AI is proliferated in all fields, there is a need to be vary of its ethical implications. (Munoko et al., 2020) advocates a proactive approach rather than a reactive approach for the ethical implications of AI. Ethical governance is required by the firm implementing AI and regulatory bodies need to update their regulations to accommodate the risks associated with AI implementation.

AI has demonstrated benefits for the auditing profession however it is also warranting for caution in its use. AI algorithms are fed by humans and it is important to note that the expectations have to build on its performance based on the data and experience that goes into the system. Any work or profession can only use AI systems as complementary to the expertise in their respective fields.

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