The Future of Auditing: An Analysis of AI Implementation in the Big Four Accounting Firms

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The Future of Auditing: An Analysis of AI Implementation in the Big Four Accounting Firms

Undergraduate Honors Thesis by Alexander Heye

Advised by: Professor Linda Ragland

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Abstract:

The implementation of Artificial Intelligence (AI) technology has become somewhat of a hot topic within the modern business world. Many companies have chosen to embrace the potential that these systems have on the ways we can conduct business, while others are hesitant to “dip their toes” in the figurative waters of AI research and utilization. Auditing is no different from other industries in that firms are excited to see what potential these new innovations have in store for promoting a faster, more efficient, and more accurate audit. This review peers into how some Big 4 firms have made the first steps toward AI inclusion and what they must do to prepare for a future that features machine automation alongside human reasoning.

Key Words: Accounting, AI, Artificial Intelligence, Audit, Data, Innovation
Introduction:

Many industries are under increasing pressure to stay relevant in the face of new technologies and innovations. Businesses who refuse to adapt to change or take up more efficient systems will find themselves at a major disadvantage against their competition. Accounting is not different from other industries and is constantly searching for new ways to adapt and improve the business model. New technology as a broad term is the answer for many companies, AI specifically has a lot of promise in the audit environment. Public company auditors are tasked with sifting through massive amounts of financial data in order to produce an informed decision. AI could prove to be a massive time saver in its ability to aggregate massive databases to produce risk client assessments, perform repetitive day-to-day tasks, and/or compliment an auditor’s decision making.

The purpose of this thesis is to provide an overview of the topic so that interested readers can more fully analyze the benefits and drawbacks of AI implementation in the Big 4 accounting firms. The firms being evaluated include Deloitte, PwC, EY, and KPMG. To break down the topic I have based my research around these three main questions: Does AI provide a positive cost benefit to Big 4 firms? How are these firms preparing to implement automated labor? What are the key issues standing in the way of AI? These questions will provide a more structured look at AI implementation and what issues remain outstanding.

The method of this thesis is a literature review focused on providing descriptive analysis, chiefly through the utilization of related journal articles and prior studies related to the topic. This will culminate in a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis to provide a clear and concise view into the paper’s findings. The data collected will only come from scholarly sources within the last 15 years. At a glance, the findings from this research
indicate some strong positive potential for AI to be used as a replacement for repetitive and time-consuming tasks within a Big 4 audit. Additionally, AI shows a lot of promise as a tool to manage large databases and organize the results into a more understandable medium. The major drawbacks include a need for more governance procedures to promote transparency and a risk of human bias being implemented into the programming.

**Literature Review:**

In the current study, I explore the viability and potential for AI implementation within the audit sector (in particular, at Big 4 firms). As such, I use a SWOT (strengths, weaknesses, opportunities, and threats) analysis as the basis of how I organize the literature review. While some areas of analysis have more weight than others and are more relevant to the topic, all sections of the analysis are important to examine so that a greater understanding of the subject can be derived. Beginning with strengths: AI is suited for dealing with high quantities of analytical work, repetitive tasks, and performing risk assessments. Under the weaknesses section: there is a high risk of malfunction, not everything can be effectively automated, and there exists a risk of human biases being implemented into the coding. Next on to the opportunities area: AI has potential to complement the existing audit process, students/professionals are being encouraged to become better versed with technological application, and AI can help to alleviate high risk audit areas. Finally, within the threats section: auditors may lack the expertise to work alongside with AI, internal controls and procedures must be updated to keep up with the new technology, and the disruptive impact of AI to the field could render some existing areas of the field obsolete. A more comprehensive outline of this summary can be found in Appendix 1.
Strengths:

When looking at AI strengths, circumstances that require complex analytics cannot be efficiently performed by human reasoning alone. Auditing is particularly suited for AI implementation because it deals with large quantities of company financial and non-financial data sources. Recently Big 4 firms have invested heavily into AI innovation and analytics. Examples of automation within the auditing realm include robotic counting of physical inventory, as well as physical and predictive analytics (Kokina and Davenport, 2017). Other researchers point out that accountants can embrace new AI technology to enhance their ability to process data. Auditors can utilize their extensive knowledge on audit procedures and operations to compliment the data driven analysis that AI systems can provide. Each of the Big 4 firms have implemented an AI tool of some form, many being related to data extraction and analysis. Appendix 2 includes a table of each firm’s implementations and what impact AI has had on their projects (Lin and Hazelbaker, 2019). Other authors suggest that while AI technology may not be advanced enough to run the decision-making process, it can be useful as a data management tool that allows users to sort through large databases (Moudud-Ul-Huq, 2014). Additionally, it is worth noting that the increased reliance on human auditors to analyze and sift through massive amounts of information can decrease their efficiency. Working with large data sets alone without any technical assistance can lead to an increase in ambiguity, misidentification, and suboptimal audit decisions (Issa, Sun, and Vasarhelyi, 2016).

Related, research argues that by utilizing AI technology, firms (predominantly Big 4) can promote higher productivity by replacing repetitive and time-consuming tasks. By augmenting large amounts of work with AI workers can see improvements to job performance and efficiency. Firms will face large changes to how their companies are managed and take these
improvements into account when determining staff needs (Lin and Hazelbaker, 2019). Additionally, other authors propose that machine learning has use within applications that require classification, linear regression, and cluster analysis. As of now, machine learning has limited applications but is useful for conducting repetitive tasks. Even still, this could provide auditors with the ability to cut down on time requirements of data heavy audits and ensure a higher standard of quality. Some of the most current uses of AI in auditing are found at Deloitte and PwC. Deloitte has “Argus,” a machine learning software that can analyze contracts for established trends and identify terms. PwC has utilized its “Halo” system to identify problematic journal entries and flag those with a higher potential for risk (Dickey, Blanke, and Seaton, 2019).

Auditing has always been known as field that relies heavily on evidence to support opinions and assessments of risk. To further compliment this process, deep learning enabled AI can streamline and integrate evidence from a variety of internal and external sources. This can allow for a better way to analyze supporting evidence and highlight existing irregularities within the different data sources (Issa, Sun, and Vasarhelyi, 2016). Other researchers highlight that risk assessment requires a lot of pattern matching and identifying deviations within the data. The potential for case-based reasoning systems to determine internal control risk can be utilized through AI systems to compliment human auditor decision making to arrive at a conclusion for the level of fraud risk (Baldwin, Brown, and Trinkle, 2006).

**Weaknesses:**

Turning to AI weaknesses, the overall tone of concern from researchers seems to originate from lack of transparency and understanding of how the new technology functions. Additionally, there is a worry that there are not enough supervision guidelines put in place to
account for human biases that have made their way into programs. Touching on the transparency issues within machine learning, it can be difficult to understand and apply to decision making if the new technology is not widely understood. This indicates that without understanding and training within the field, AI has limited use (Kokina and Davenport, 2017). Most researchers acknowledge that not every audit task can be automated through AI and not all attempts to implement AI have been successful. While AI has potential to be used in higher stakes areas such as risk or materiality assessments, a firm must consider what the cost of a potential malfunction could do to their reputation (Baldwin, Brown, and Trinkle, 2006). The use of AI assisted judgements holds some potential for error and mistake. However, auditors may need the assistance of modern systems to identify errors that they otherwise would have missed. Auditors must understand that while AI can be used for assistance, their decision should not solely rely on the system (Omoteso, 2012).

While the majority of firms promote funding in AI to improve their productivity, many have been avoiding the investment due to their concerns over the technology being not yet fully developed. However, this seems to be an issue more for smaller regional firms who lack the capital and financial confidence that Big 4 firms wield. While Big 4 firms lead the charge in this area, smaller firms could see future growth in the area if the benefits of implementation outweigh the high costs associated (Lin and Hazelbaker, 2019). Other researchers highlight the idea that the majority of Big 4 AI systems apply to only highly repetitive tasks which are easily completed by human labor, anyway, limiting its application (Baldwin, Brown, and Trinkle, 2006). According to other sources, AI can be very limited in its flexibility. AI learning could require incredibly large quantities of data before being ready to provide systematically accurate findings.
Additionally, the technology relies on repetition, so complex or unique circumstances may be at greater risk of being unreliable or faulty (Nickerson, 2019).

Another concern relevant to AI use regards some of the issues involved with data being limited or inaccurate, as well as the underlying concern regarding human bias being implemented into AI coding (Dickey, Blanke, and Seaton, 2019). Related to this aspect, in Munoko, Brown-Liburd, and Vasarhelyi’s (2020) paper *The Ethical Implications of Using Artificial Intelligence in Auditing*, the authors indicate a concern in the trend that widespread implementation of AI within Big 4 decision making could lead to unforeseen consequences. They urge researchers to further look into if the negative aspects outweigh the positive connotations behind automated outcome technology through insight from ethical frameworks. The paper originates by highlighting the appeal of emerging technologies as a method for improving a historically laborious task through newfound efficiency and speed. The problem with this, as pointed out by other authorities on technology (such as the Association for computing machinery-US Public Policy Council), is that human programmers inherently contain flaws and biases that can overflow into the AI’s computations. Additionally, the authors point out a need for oversight and ethical governance on the part of large firms and regulatory boards such as the PCAOB. As AI technology rapidly adapts and grows, the need to keep up regulatorily will become ever more prevalent. While examining the types of AI implemented by large firms, the authors indicate that PwC has indicated three types of AI that will improve their firm’s productivity. These being Assisted AI systems (supported by human action), Augmented AI systems (supplement and guide decision making through environmental learning), and Autonomous AI systems (adapt and produce actions independently from human interaction). The important distinction between these systems is obviously the increasing lack of supervision on their operation. While it is
much more productive to have a “hands-off” process that works independently of human labor, the risk for potential ethical violations increases exponentially. Figure 2 from the article (see Appendix 3) indicates the comparison of ethical issues contrasted against the AI technology and its respective applications within the auditing profession. The authors conclude that while AI has many promising features for accounting, there are many outstanding ethical issues that will only increase in severity as AI becomes more advanced and permeated throughout the profession (Munoko, Brown-Liburd, and Vasarhelyi, 2020).

Opportunities:

When considering AI opportunities, it is important to consider that as the technology develops further, more firms will find new ways to utilize its benefits. Recent developments in AI technology have led to increased future viability within the auditing field. Specifically, the two primary strategies that firms are utilizing to implement AI are receiving a variety of AI functions from one large vendor or integrating a variety of capabilities across multiple sellers to fit the firm’s needs. As future technology is implemented, accounting as a field most likely will be complemented by AI instead of having human tasks replaced completely. This opportunity will become more relevant when the related technology is further developed (Kokina and Davenport, 2017). The increase of technological developments in the field have pushed the larger accounting firms to implement AI into their integrated audit automation systems. In the last couple decades, complex AI-enabled systems have been developed to help auditors make informed decisions and judgements. The purpose of this technology is to act as an aid to help auditors identify bias and mistakes within the decision-making process (Omoteso, 2012). Additional researchers propose that machine learning relates to the concept of AI in that technology can adapt and learn over time. This has the potential to disrupt many industries and
could revolutionize how we conduct audits. While still within the R&D realm, Big 4 firms are beginning to understand its potential and have begun further development. Future applications for AI include developing models to predict/assess risk and speech/facial recognition for fraud interviews. While Big 4 firms are leading the charge on AI research and implementation, as findings become more conclusive the technology could be spread to smaller firms (Dickey, Blanke, and Seaton, 2019).

Accounting firms have been hiring more STEM focused majors due to their increased reliance on computer analytics and AI improvements. Among these implementations include using robots to count inventory, check fixed assets, inspect contracts, and perform bank audit confirmations. Implementation of new technology has the potential to change how firms choose to hire staff and the skills required to become a CPA. Lin and Hazelbaker (2019) state that “Taking even one semester of computer programming would allow accounting students to evolve from knowing how to use computers to understanding how to make computers solve problems. Knowledge of coding would also help accountants collaborate with IT professionals to develop AI-enabled tools.” Based off of this quote, it is worth addressing that accounting students already face a very rigorous course of study and this extra course load may distract from learning the core accounting principles that firms are searching for. This could indicate a need for firms to address these requirements or onboard new hires in a way that trains them to be more familiar with the technology. Accountants are being motivated to adapt into a “business enhancement” role and improve data managements skills so that they can capably make use of AI software outputs. By improving the knowledge base of more auditors, the technology should begin to appeal to a wider variety of applications and functions. The authors indicate that Big 4 firms may prefer to hire student who have some AI experience, as existing employees may take longer
to adapt to the new skills. Firms can take advantage of additional training, online courses, and workshops to further develop this skill in employees. (Lin and Hazelbaker, 2019).

By analyzing the trend of AI beginning to gain traction within public accounting, new areas that the technology would be most effective to implement can be proposed. Research by other writers suggest that Big 4 firms are heavily investing to implement AI technology to make the audit process smarter and more efficient. These improvements can be realized through auditors having to spend much less time sifting through transactions. By spending less time on the aspects of manual labor, they can prioritize making skilled conclusions off of the results given by AI systems. The authors go into detail surrounding the origin of AI and how its purposes have evolved over time to fit the needs of its users. Furthermore, they indicate the potential for AI to be modified for public accounting utility (Issa, Sun, and Vasarhelyi, 2016). According to Nickerson (2019), “Large CPA firms, including most of the Big 4, have made substantial investments in AI while they look to cut human time spent on complex audits and other data-analytics-based engagements.” Some researchers have looked into the problems associated within the traditional accounting industry and where there are opportunities for AI to alleviate these issues. They provide insight into the nature of the modern auditing environment, chiefly highlighting high uncertainty and litigation risk. Related, they propose several examples of AI approaches that could be useful for audit tasks including genetic algorithms, neural networks, fuzzy systems, and hybrid systems. These researchers conclude by restating the need for accountants and AI experts to “bridge the gap” between their professions and working together. This could provide future possibilities of creating auditor programmer collaborations that focus on AI (Baldwin, Brown, and Trinkle, 2006).
Threats:

Some of the major threats associated with AI that are discussed in this section include concerns that the technology will be passed over by companies, auditors will lack the proper training to cooperate with AI, or that traditional audit guidelines will not align with the technology. Lack of proper training for auditors is an issue relating to employees being able to understand and cooperate with AI technology. Some authors argue that the issue regarding the majority of people researching the implications for AI in accounting are accounting majors without a background that understands the technology. This could be a threat to the accounting workforce, as many could be unqualified and/or lack the training required to work alongside automation (Baldwin, Brown, and Trinkle, 2006). This is an issue that is addressed by other authors in different sections of the paper, some advocate for increases in training through accounting education, while others support firm training and upskilling of their own employees. Due to the technology being limited in its ability to operate autonomously without any human interaction, an expert is required to maintain the AI-enabled accounting system. Without human maintenance the system is at increased risk of malfunctioning, which could lead to heavy losses. This points to the need for AI experts to be hired at the firm level, rather than training existing personal into the role. (Moudud-Ul-Huq, 2014). Other researchers argue that those in the accounting field do not have the necessary experience to meet the requirements need to operate AI. While artificial intelligence is being widely used by Big 4 firms such as EY and Deloitte for data review and processing, other accountants are concerned that they are under skilled in the subject of AI and will not be able to improve upon its value. This inclines that these firms may need to implement experts in AI, rather than tasking existing auditors with AI related technical implementation (Moll and Yigitbasioglu, 2019).
Some researchers argue that it will be important to address inherent bias within applications to address the lack of objectivity. This is a problem that could continue to develop and change as AI becomes more permeated throughout regular audits (Kokina and Davenport, 2017). While AI can provide some new benefits, due to the models learning from present data there is always the risk that human prejudice will contaminate the results and render the findings ineffective. This calls for the need for users to understand the possibilities and take action to prevent the input of these biases (Moll and Yigitbasioglu, 2019). In a similar vein, other researchers highlight the need for auditors to reassess how they view audits and the data that flows to them before they can begin to reap the benefits that AI complemented accounting can provide. Traditional audit guidelines may not correctly align with new AI capabilities. Another challenge is how to maintain internal controls while assessing the validity of data sets. This can include working with cyber security experts to ensure that client data is secure and resistant to manipulation. This makes data security incredibly important to ensure that data sources are reliable and maintain their integrity (Dickey, Blanke and Seaton, 2019). Other authors point out that auditing is incredibly standard driven, inclining that firms could be hesitant to adopt breakthrough AI tech if it has not been approved by regulatory boards or adjusted their ethical standards (Issa, Sun and Vasarhelyi, 2016). Independent review boards such as the PCAOB have historically been able to effectively regulate the accounting field, however the use of AI creates a whole new level of issues related to analytics and assisted decision making. If AI has the possibility to produce ethically dubious or compromised results, it is ultimately the responsibility of everyone who considers utilizing the technology (auditors, managers, CEOs, etc.) to promote and uphold professional skepticism while making their decisions (Nickerson, 2019).
Adding to the prior literature, some authors conclude by stressing that accounting firms will not be able to use a “wait-and-see approach” with AI, its highly disruptive nature has the potential to leave nonreactive firms behind. While AI is a force for increased productivity and utility, it can hurt traditional accountants who cannot adapt (Lin and Hazelbaker, 2019). Others suggest that some areas will become obsolete after AI implementation. The authors discuss thoughts on whether employees audit work will be complemented or replaced by AI innovations. They discuss the options that AI implementation might take, workforce replacement or workforce supplementation. Based on their findings, the authors assessed that routine work has the most risk, as it can be the most easily replaced by AI implementation. They continue that initially many auditors can utilize big data to complement their decision making and work together. As AI gets more innovative and the technology grows, complex processes can be broken down into more repetitive concepts creating a larger threat of replacing auditors (Issa, Sun and Vasarhelyi, 2016).

**Research Questions:**

In order to facilitate a discussion on the viability and potential for AI implementation within the audit sector (in particular, at Big 4 firms), I ask three questions in hopes that they will provide a framework to base future research on the implications that auditing can have within the field and the industry.

1) **Does AI implementation seem to provide a worthwhile cost-benefit to Big 4 firms?**

2) **How are Big 4 firms preparing themselves and their auditors for a future that heavily relies on automated labor?**

3) **What outstanding issues stand in the way of utilizing AI?**
Question #1: *Does AI implementation seem to provide a worthwhile cost-benefit to Big 4 firms?*

This question can be analyzed by consulting prior research studies to identify whether the traditionally high costs associated with advanced AI technology overshadows the potential financial benefits. Additionally, this paper looks into whether large firms are preparing to utilize this new technology or view it as a passing novelty that has little impact on their business structure. Firms must measure the high system costs for implementation and balance them against the time saving potential that an AI accounting system could produce. Ultimately it is an investment in an area that is still developing and improving as more firms test out the technology for themselves.

Question #2: *How are Big 4 firms preparing themselves and their auditors for a future that heavily relies on automated labor?* This question coincides with whether firm training programs and university-level education are up to par on the subject of AI within the field. Proper training is of the utmost importance if firms want to reach the maximum efficiency associated with usage of the new technology. To clarify, auditors may need to be trained so that they can work alongside AI and be able to understand the benefits that they provide, however AI experts would most likely be the ones implementing the code. Firms would have to accommodate to hiring additional technologically savvy experts that can produce/maintain the systems, while ensuring that their auditors are capable of coinciding with the new technology. This raises the issue of whether auditors have the capability to incorporate technical education alongside their already heavily demanding accounting course load, ultimately it depends on how the firms choose to incorporate AI and the expectations that the firms have for their employees. This question can be addressed by researching papers that have studied this kind of preparation and have rated the level of technological savviness among the accounting population. It is worth noting that as the
trend of AI inclusion becomes more prevalent, accounting education may also have to adapt to be able to properly prepare their students for their full-time careers. While some previously stated researchers have pointed out that incorporating some technically focused classes could help improve data and AI related skills, this extra inclusion may dilute the already extensive accounting course regimen and distract from the core accounting basics that the Big 4 firms desire. An extra class to improve technical knowledge may be worth something as the field develops, but the focus should remain on accounting. Ultimately, it is up to the firm to decide whether these additional skills should be nurtured as new technology becomes more prevalent in the field. Rather than adding to the large existing curriculum requirements, firms can choose to include basic technical training in their onboarding for new hires so that they can better grasp the concept and choose to further develop these skills if need be.

Question 3: What outstanding issues stand in the way of utilizing AI? Finally, this 3rd question heavily relates to the existing issues and concerns associated with AI use. Many research articles heavily touch upon this topic, as it is a major consideration for companies considering automated systems. By reviewing this research, we can get a better idea of what challenges stand in the way and the best way to overcome them. Some of the major issues that seem to stand out have been the risk of human biases incorporating themselves into the systems, the risks associated with malfunction that could heavily impact the firms good name, or the need for improved internal controls to monitor AI incorporated systems and flag any potentially unethical results.

Methodology:

This report is descriptive in nature therefore it references literature that discusses AI potential within Big 4 auditing. Additionally, any collected/analyzed data has been pulled through
accredited academic journals and scholarly sources. Only studies within the window of the last fifteen years have been utilized. This is so the analysis on modern AI will be relevant and from a time period that supports concrete AI implementation. The data is compared and contrasted to different sources to highlight patterns and trends within the industry. The Big 4 firm’s degree of preparedness, the steps taken so far, and the challenges included with future automation are focused on while cross referencing to other papers. A formal SWOT analysis of the related strengths, weaknesses, opportunities, and threats associated with AI are included. The end goal being to provide a comprehensive overview of the topic to provide those interested with the knowledge necessary to make informed decisions.

**Findings**

This paper covered the topic through the SWOT analysis and the included research questions so that any results could be clearly communicated and explained. The SWOT analysis indicated within the strengths category that AI is suited for analysis of large pools of data and incorporating the results into a form that is beneficial to auditors. Additionally, AI performs well in highly repetitive tasks that take up lots of time during rigorous audits. Finally, the technology also shows promise as a way to measure risk and flag potentially mistaken data points. Under the weakness’s category, a risk of mistake or error was definitely an outlying concern as well whether the systems are capable of doing non-repetitive tasks. Additionally, the risk of bias is a huge weakness in the technology that has potential to create massive ethical hazards and offset the legitimacy of the data produced from effected systems. The opportunities section shows that as more firms begin to incorporate AI systems and automation continues to grow, more uses will develop and improve the existing technology base. Additionally, as accounting professionals become more aware and skilled with the subject, the possibility for more AI enabled partnerships
within the field can occur. Finally in the threats section the paper discussed whether there is a possible need for accountants to require more training with AI before they can properly benefit from it, as well as whether it should come from an increase in education or firmwide training. There also exists the threat that as audits become more permeated with AI assistance there will be a need for more internal controls and governance procedures. The final threat to AI implementation is the concern that as the technology develops further and is capable of replacing more complicated processes, more auditors may be replaced or substituted by the more efficient technology.

The three questions that were stated in the previous section also hold some important insight into the topic. Question one indicated that firms must pay a high cost and invest into a technology that is not fully developed. However, the cost may be worth the improvements to efficiency, data analysis, and the replacement of menial repetitive tasks. Ultimately, the firms must decide if the technology is worth developing further and has worthwhile use to their daily activities. Question two showed that firms will probably rely on internal training programs to upskill their employees so that they can understand the benefits of AI, this will most likely result in the employees getting a base look at the technology. AI experts would need to be hired and accommodated by the firms to maintain the technology and ensure its proper operation. Finally Question 3 indicates that some of the major outstanding issues include the risk of malfunction, internal biases, and inadequate internal controls.

**Conclusion:**

The purpose of this thesis was to layout a guideline depicting the conflicting pros and cons the topic so that readers can better understand the concept of AI implementation and what it could mean to the Big 4 firms. The previous sections have outlined the resolutions to the three
main research questions, as well as the outstanding issues and complexities that relate to their answers. In combination with the existing SWOT analysis, these questions have served as a more concrete way to express the main takeaways about artificial intelligence under the Big 4 public accounting lens.

This thesis was structured as a literature review for its method to synthesize some of the existing research and come to conclusions based off of the existing data sources. The paper also heavily focused on the SWOT analysis and research questions to create a clear dialogue around the results. The data collected has only come from scholarly sources and journals within the last 15 years. In conclusion, the research shows potential for AI in repetitive roles to save time on data heavy audits and improve firm efficiency. There are also great opportunities to use AI as a data management tool that communicates client results in a more comprehensible way to auditors. The outstanding issues associated with the subject are a need for internal controls and regulation to monitor AI use so that it remains unbiased and ethical.

Ultimately there is no definitive answer to whether firms should embrace or shun AI technology. Individual firms must weigh out whether the risks and high start costs are worth the long-term rewards. Both the regulation and technological environment still need to develop before advanced applications can be realized. However, repetitive tasks and risk analysis automation have already begun to be utilized, indicating potential for future advancements.
References:


## Appendices:

### Appendix 1

“Summary of Related SWOT Analysis”

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suited for <strong>sorting and analyzing high quantities of technical and financial data.</strong></td>
<td><strong>Risk of mistake or malfunction</strong> could have long standing impacts on a firm’s credibility and/or client relationships.</td>
<td>As the technology is further developed and has seen application in other environments, the potential for AI to <strong>compliment the audit process</strong> will increase.</td>
<td>Auditors may lack the training required to work alongside and utilize AI. This is due to the intensive requirements associated with studying accounting, limiting the time for technical skills training and application.</td>
</tr>
<tr>
<td>Capable of efficiently <strong>conducting repetitive or time-consuming tasks</strong>, cutting time down on data heavy audits.</td>
<td><strong>Not every task can be successfully automated</strong>, limiting the capabilities and potential for widespread use.</td>
<td>Many business professionals and students are being <strong>encouraged to take on a “business enhancement” role</strong> to be able to engage with data management and technological application.</td>
<td>Audit guidelines and ethics frameworks may have trouble keeping up with new technology, citing a need for new governance procedures and internal controls.</td>
</tr>
<tr>
<td>Able to <strong>perform overall risk assessments</strong> to identify probability of incorrect journal entries and measure errors.</td>
<td><strong>Risk of human biases</strong> being implemented into the algorithms. Creates the need for a transparent environment that provides ethical oversight.</td>
<td>The nature of accounting as a field that deals with great amounts of uncertainty to arrive at a reasonable conclusion can be <strong>alleviated by machine learning data analysis.</strong></td>
<td>AI has the potential to be a highly disruptive force to the industry and raises concerns about some areas of accounting becoming obsolete.</td>
</tr>
</tbody>
</table>
## Appendix 2

“Examples of AI Applications in Accounting” (Summarized)
Source: Exhibit 2 in Lin and Hazelbaker (2019)


<table>
<thead>
<tr>
<th>Firm</th>
<th>AI Projects</th>
<th>Benefits/Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deloitte</td>
<td>Uses AI-enabled document review process to sift out necessary information.</td>
<td>Reduced time spent viewing various kinds of documents by up to 50%</td>
</tr>
<tr>
<td></td>
<td>Working alongside IBM Watson to provide more technologically advanced client solutions.</td>
<td>Developed LeasePoint (end-to-end leasing portfolio) and the Automated Cognitive Asset Inspection (improves asset inspection).</td>
</tr>
<tr>
<td>EY</td>
<td>Uses AI analyze lease contracts.</td>
<td>AI makes highlighting key information easier</td>
</tr>
<tr>
<td></td>
<td>The Australian branch has implemented AI complimented audit technology.</td>
<td>50% of bank audit confirmations are held using AI-enabled system</td>
</tr>
<tr>
<td></td>
<td>Started project to use automated viewing technology in drones to audit inventory.</td>
<td>Drones used to count and communicate inventory counts</td>
</tr>
<tr>
<td></td>
<td>Uses deep learning tech to assess unstructured data sources</td>
<td>Reduce time spent reviewing documents</td>
</tr>
<tr>
<td>PwC</td>
<td>Working alongside H20.ai to develop GL.ai system to analyze and prepare documents.</td>
<td>GL.ai is being trained on audit data around the world</td>
</tr>
<tr>
<td></td>
<td>Invested heavily in natural language processing (NLP), to quickly analyze unstructured data</td>
<td>Can analyze a variety of documents and derive conclusions</td>
</tr>
<tr>
<td>KPMG</td>
<td>Uses AI tools (KPMG Ignite) to compliment decision making.</td>
<td>Developed the Call Center Analytics Engine, the AI Anomalous Event Predicting Tool, and the Document Compliance Assessment Engine</td>
</tr>
<tr>
<td></td>
<td>Working alongside Microsoft and IBM Watson to develop more AI focused analytical tools</td>
<td>To work towards goal of improved audits</td>
</tr>
</tbody>
</table>
Appendix 3

“Ethical Principles at Risk with AI” (Summarized)
Source: Fig. 2 in Munoko, Brown-Liburd, and Vasarhelyi (2020)