

Artificial intelligence in accounting

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Abstract

The paper looks at the aspect of artificial intelligence in the accounting industry. Ideally, artificial intelligence entails the development of computer hardware and software that enhances the human performance in the day to day activities. Artificial intelligence is changing the organizational activities and in the accounting industry in particular. It is changing how the accountants are performing tasks by providing techniques that enhancing the operation efficiency. For instance the cognitive techniques enhance the decision making process, the execution of tasks using the algorithms, development of risk management models, and propelling innovation in the firms. More so, it allows the accounting firms to conform to the accounting standards and principles. The benefits of artificial intelligence are evident in the Big Four Firms that embraced this aspect earlier. For this reason, the role of accountants in the firms is changing. Nonetheless, the artificial intelligence cannot replace the human element. They have to work together since the cognitive technologies require human input to operate successfully. As many organizations acknowledge the potential benefits of adopting artificial intelligence in the operations, there will be increased need of the systems in future.

Keywords: Artificial Intelligence, auditors, accountants, cognitive technologies, Big Four Firms.

ARTIFICIAL INTELLIGENCE IN ACCOUNTING

Introduction

The purpose of this paper is to show how Artificial Intelligence can assist accountants, CPAs, and auditors in accounting, financial reporting, and auditing. The field of Artificial Intelligence is fascinating. Apart from changing our daily lives, it makes business more convenient and comfortable. Artificial Intelligence is a branch in computer science that study and create computer systems which can learn new concepts and tasks, and reason and draw useful conclusions about the problems experienced in different fields. Thus, with time, some many people have come to identify Artificial Intelligence as a group of systems that mix sophisticated hardware and software which contain elaborate knowledge-based processing and database models to show characteristics of effective human decision making. This way, Artificial Intelligence eliminates human-related risks in many applications used in businesses. In accounting, Artificial Intelligence has helped in making the process of data management, analysis and reporting easier and convenient to both the end users and customers. Through machine learning, data is collected processed and executed at a high speed and recommended actions provided to the users. This has helped many accounting businesses to gain competitive advantage in a sector that has multiple players. Also, Artificial Intelligence has changed the roles of accountants in organizations through them in automating transactions account payables, travel expense, fixed assets, general ledger, financial reporting and payroll. This has led to many speculations that the technology could render many professions within accounting useless hence threatening the jobs of these individuals. Therefore, this paper provides the analysis through provide an overview of the history and current status of Artificial Intelligence, importance to data management, analysis and reporting, impact on the role of accountants, how auditors can change to the advisory role through using AI and how auditors are still needed in the era of AI in accounting.

Introduction to artificial Intelligence

The roots of Artificial Intelligence date back to the era of classical philosophers of Greece. They were on a mission of modeling human thinking as a system of symbols. This led to the development of 'Connectism', a school of thought used to study the process of thinking (Etzioni, 2017). In 1950, Alan Turing published a paper that provided suggestions on how thinking is modeled. He argued that a machine could describe as thinking if it could carry on a conversation through a teleprinter and imitate a human without any noticeable differences (Vijay, 2013). Ideally, a teleprinter involves a machine that receives telegraph messages whereby it receives and sends typed messages either for printing or communication purposes. In 1952, the Hodgkin-Huxley model was developed and it had individual neurons firing in all-or-nothing pulses (Ertel, 2018). This sparked a conversation on the possibility of Artificial Intelligence. In 1956, Dartmouth College sponsored a conference which helped in driving forward the conversation on Artificial Intelligence. Plans were made to ensure that there was enough funding for research on Artificial Intelligence. This is also the time the term, "artificial intelligence" was coined by John McCarthy, a professor of Massachusetts Institute of Technology (Ertel, 2018).

The Dartmouth College conference developed Artificial Intelligence as a distinct field. Similarly, the goals of AI were defined. The first goal was to understand and model the thought processes of humans. The second goal was to design machines that could mimic the human behavior. Most research conducted between 1956 and 1966 were theoretical in nature (Ertel, 2018). However, in 1967, Joseph Weizenbaum, developed ELIZA. This program was capable of simulating the responses of a therapist to patients. This shifted focus in AI research. Computer Scientists focused on solving specific problems where the technology of Artificial Intelligence could be possibly applied.

During the 1970s, several reports emerged criticizing the rate of progress in Artificial Intelligence. Consequently, Artificial Intelligence funding was cut. Therefore, efforts in neural networks, imitating the human brain, were tested and some dropped. The research established that the only impressive and functional programs were being ridiculed as only being toys by those who were not impressed. Nevertheless, researchers in Artificial Intelligence remained adamant. They maintained their optimism in achieving their goals and undervalued the problems they were likely to face. They faced two basic limitations: lack of enough memory and processing speeds that would be impressive by today's standards. During the 1980s, Britain and U.S. government provided funding to respective Artificial Intelligence for their respective countries to compete with Japan. The latter had launched "fifth generation" computer project to enhance its efforts in becoming the leader of computer technology in the world. This led to technological supremacy battles among the countries. Hence, the period between 1974 and 1980 was named the First Artificial Intelligence Winter. The period ended with the introduction of "Expert Systems" (Ertel, 2018). These were quickly adopted by competitive corporations worldwide. This gave the research in Artificial Intelligence a sense of direction. The primary focus became accumulating knowledge from various experts.

An Expert System works through the knowledge of experts created as programs. It can answer questions and solve problems found in a clearly defined area of knowledge. It uses logic and rules. During the 1970s, Expert Systems became popular because of their simplistic designs which made it easy for the programs to be designed, created and modified. The Bank loan screening, programs, sales and medical applications, are among the Expert Systems used from the early 1980s (Etzioni, 2017). From using these programs, business and corporations started seeing the possible advantages of Artificial Intelligence because they helped to save business operations costs. One of these businesses was Digital Equipment

Corporation (DEC) which required its sales team to use an Expert System, XCON, in placing customer orders.

Before adopting Expert Systems, XCON, DEC used technical advisers to screen the orders, identify non-functional combinations, and issue instructions for assembling the system. This process caused a myriad of challenges in terms of communication and automation. Consequently, DEC decided to adopt XCON. In 1986, DEC realized the use of the Expert System was saving them \$40 million annually (Etzioni, 2017).

XCON was a large system. It had a total of 759 rules. Before DEC could use it, it had to be adjusted and tweaked. The company learned that the system could not be efficient as it had been originally designed and they lacked the expertise capacity to maintain it. The system needed a consistent collection and addition of knowledge by people trained in Expert Systems (Ertel, 2018). Further, although DEC had technical advisers, it lacked Artificial Intelligence Experts and no one was familiar with the language, OPS-4, used by XCON. A year later, with help from the original writers of the program, Carnegie Mellon, DEC managed to take care of programming and maintenance of XCON. Although the process of integrating XCON into the DEC culture was difficult, it was successful. Above all, it taught both the company and other organizations that managing an Expert System needed trained personnel. Therefore, DEC trained and hired people who could specifically work with the Expert System.

Meaning, XCON became the first computer system in the world to use Artificial Intelligence techniques to solve real-world problems within a specific industrial setting. This led to the emergence of a new career field in Expert System from 1985 (Etzioni, 2017). In this period, XCON had the capability of configuring sales orders for all VAX-11 computer systems manufactured in the US (Ertel, 2018). However, there was also the realization that

Expert Systems needed a full-time IT team and were to be continuously adjusted and updated.

Research in Artificial Intelligence went through another winter between 1987 and 1993. This slowdown happened the same time during which the XCON, an early Expert System, started to be viewed by businesses as clumsy and slow. On the other hand, desktop computers were gaining recognition popularity. They replaced the older models which were bulkier and less user-friendly. They gave an impression that XCON was too expensive to maintain, adjust and update compared to them. Consequently, Defence Advanced Research Projects Agency (DARPA) redirected its funds to projects they considered quickly in giving results (Copeland, 2015). They decided that research In Artificial Intelligence would not be the next frontier.

Beginning 1980s, there was a shift in Artificial Intelligence research. Unlike before, the research focused on intelligent agents. These could be used for news retrieval services, browsing the web and online shopping. Eventually, intelligent agents evolved into virtual assistants or digital assistants with the help of the Big Data programs.

The Big Data Technology enabled research in Artificial Intelligence to create an intelligent machine capable of imitating human conversation using a teletype and after the development of personal digital assistants, or virtual assistants, it allowed research in AI to begin efforts to create software programs capable of speaking in a natural language and act like virtual assistants (Hager et al, 2017). These efforts have marked the future of AI research and are likely to take the forms of robots used for physical help in making business decisions, customer service or answering the phone. Robots function through interacting in a variable and richly populated world, and it uses senses to collect data and compare the sensate inputs with expectations that are embedded in its model of the world. Today, AI is used to automate discovery, Design experiments, interpret data, probe complexity and make

decisions in commerce, online customer chatbots, Online Smart Recommendations, Smart Cars, Virtual Assistants, surveillance, detecting Credit Card Fraud and recruitment.

Artificial Intelligence is capable of machine learning, image recognition, language analysis, natural language classification and speech recognition. Being that it enables machine learning; the system ingests large amounts of data, contains rules derived from data, contains algorithms which are based on patterns of data and has networks which can learn from unlabeled or unstructured data (Vijay, 2013). Similarly, in visual recognition, AI helps in understanding the content of an image, detect particular the position of particular objects within the image and recognize the classification of the object. In language analysis, AI can conduct learning from a large group of textual data, understand the meaning of the text, utilize data for pattern identification and extract components of the data that will be used for analytics. In natural language classification, AI provides a language classification model which can understand the meaning of a text and classify data. The natural language classification also enables the programs to obtain supplemental audit evidence (Moorthy et al, 2012). Further, the speech recognition features of AI enables an analysis of grammar and the language structure of data, transfer audio signal to transcript and transfer speech into searchable and analyzable audio data.

Currently, there are four main types of AI. Type I is purely reactive. It directly perceives its environment and acts according to what it has perceived (Ertel, 2018). However, the purely reactive type lacks the concept of the wide world. Also, it cannot form its memories or make decisions based on past experiences. It can only work in one area of a specific field. IBM's Deep Blue and Google's Alpha Go are among the most used purely reactive AI. Type II is Limited Memory. It considers some level of past experiences and adds them to programmed representations of the world (Ertel, 2018). It has enough memory and past experiences which it uses to execute actions. Self-driving vehicles and chatbots

(personal digital assistants) are examples of the limited memory AI. The third type is Theory of Mind AI. It has the capability to understand and affect human behavior. It can understand motives, feelings, intentions, and expectations (Ertel, 2018). Developers are in the process of improving its capability to enable it to socially interact. C-3P0 and R2-D2 is an example of Theory of Mind AI.

The last type is Self-aware AI. It can form a representation of itself. This is why it is considered to be an extension of the theory of mind because it can relate to internal states, make abstractions and inferences and predict feelings. It is still in the process of being developed hence considered the future generations of machines which will be intelligent, conscious and sentient.

The accounting, taxation, and auditing firms that embraced Artificial Intelligence

Most of the public accounting, auditing, and taxation firms are embracing the significance and potential of the Artificial Intelligence. Ideally, the Big 4 accounting firms including Klynveld Peat Marwick Goerdeler (KPMG), PricewaterhouseCoopers (PWC), Ernst & Young (EY) and Deloitte are employing the massive use of Artificial Intelligence. The massive adoption of the Artificial Intelligence in these companies shows the potential benefits that aspect accrues (Mates, 2009). Furthermore, Al Jon Raphael, who is the chief innovation officer at Deloitte outlines that the successful implementation of the artificial intelligence technology creates an avenue for successful audit processes. The use of Artificial intelligence makes the processes more efficient, accurate and faster. Subsequently, in 2016, the KPMG also announce that it would embrace the cognitive computing by working in unison with the IBM Watson. It would enhance the efficiency of the delivery of the professional services to their clients including auditing services. Majorly, KPMG utilizes the Watson in analyzing the huge volumes of the financial statements from their client's in order to detect any anomalies that may exist. For instance, integration of the cognitive technologies

in analyzing a bank's mortgage portfolio, allows the auditor to acquire extensive information about the credit files and any potential audit exception on loan grading of the bank. In this case, it aids in providing a fair and credible judgment on the financial data therein. Similarly, Deloitte also works in unison with the Kira Systems Inc. to undertake the analysis of large volumes of financial data. It is enhanced by creating cognitive models that are capable of analyzing large and complex documents and further extract a structure that aids in a more clear analysis. It thus reduces the burden that auditors face while reviewing a large volume of the document manually. While the EY provides software that aims at modeling the human behavior, PWC integrates cognitive techniques such as DeNovo to enhance the operations. Ideally, DeNovo technique allows the firm to evaluate and analyze the future operation of a certain technology including the future risks and benefits. The Big Four firms have launched various Artificial Intelligence projects than create subsequent benefits. Nonetheless, it is also essential to factor the costs benefits of the inputs therein (Rikhardsson, & Yigitbasioglu, 2018).

Previously, most of the firms relied on human capital to undertake the tax preparation, auditing, and the strategy consulting services. Nevertheless, the introduction of the Artificial Intelligence tends to create a threat to these business models. The cognitive technologies such as Natural Language Processing (NLP) and Robotic Process Automation (RPA) are completing tasks within hours yet the auditors would take months to complete the same tasks. The efficiency of the Artificial Intelligence is thus the major reason the Big Four firms are finding the need to incorporate the cognitive technologies. The study by Sun, & Zhang, (2006), shows that the respective innovation managers in these companies outline the various benefits that the Artificial Intelligence is creating in the tax and auditing operations. While the three companies including Deloitte, EY, and PwC were the earlier adopters in the Artificial intelligence, KPMG began adopting the technologies in 2016. Nonetheless, all the

companies employ a different mechanism to develop the cognitive Artificial intelligence technologies.

Deloitte focuses much on innovation and thus devotes up to 80% of the time to developing artificial intelligence technologies. The innovation team engages in creating a framework that guides all the artificial intelligence investments across the firms and also for the external users. Usually, the firm strives to speed the innovation processes using the artificial intelligence aspects. Secondly, the EY employs the cognitive technologies from a smaller scale and further aims at improving as the Return on investments grows. Besides, Chris Mazzei, who is the emerging technology leader in EY, suggests that organizational efficiency begins from a smaller business perspective rather than beginning on the technological perspective. In this case, the firm begins by implementing the organizational business value and further implements the cognitive technology that fits the business value. Thirdly, PwC employs the four-week artificial intelligence 'Sprints' that entails reflects a quick software development technique. It aims at providing the client with a working model before embarking on a more accurate and actual service (Rikhardsson, & Yigitbasioglu, 2018). It provides the concept of how the work implementation will look like. Anand Rao, the global artificial intelligence leader at PwC, outlines that the company holds up to 80 sprints annually. It shows that the need and use of artificial intelligence are thus increasing day by day. Consequently, each of the sprints comprises a small group of people up to three members. Given the increase in the number of sprints annually, not only does artificial intelligence boost the performance of the organizations but also create more employment opportunities to the public. Following the early adoption of the artificial intelligence in the three firms above, the following cases show the success of the tax and accounting activities.

Natural Language Processing (NLP)

This artificial intelligence aspect is applicable in accounting to review large volumes of documents. Initially, Deloitte would engage dozens of employees to check and evaluate a huge volume of legal documents to check any error or a change in control provisions. Given the huge burden, it would take the employees close to half a year to complete the task. Nonetheless, the introduction of the NLP reduces the underlying burden. Currently, it requires a few employees to run the NLP system and complete the task in less than a month. The EY also integrates the NLP artificial intelligence system in reviewing the lease accounting standards (*Logic for Computer Science and Artificial Intelligence*,”2018).

Machine Learning (ML) for Anomaly Detection

Anomaly detection entails the analyzing and evaluating of any fraudulent or false information in the financial data. The EY employs the machine learning system to detect any fraudulent and faulty invoices. EY usually processes millions of invoices for their clients annually. In this case, using the machine learning enhances the accuracy and the efficiency of their activities rather than operating manually. Furthermore, manual operations are subject to errors such as failure to detect any fraudulent documents or violation of the anti-bribery regulations. Chris Mazzei further outlines that since the adoption of the artificial intelligence, the fraud detection system in EY has thus depicted up to 97% accuracy (*Logic for Computer Science and Artificial Intelligence*,”2018).

Natural Language Generation (NLG)

The NLG is applicable in developing new products. Deloitte employs the natural language generation in creating computer texts relevant in its tax business. The firm is a multinational company and thus deals with a wide range of customers that may portray complex financial situations. Ideally, the company processes up to fifty thousand tax returns per year. In this case, Deloitte adopts the NLG system to create reports for the individual

clients. Furthermore, the tax professionals in the company rely on these reports to provide financial advice to clients who seek consultation services (*Logic for Computer Science and Artificial Intelligence*,”2018).

The innovation leaders in the Big Four companies are acknowledging the significance of the artificial intelligence in the accounting sector. Ideally, artificial intelligence is propelling innovation in those companies creating better and more efficient accounting systems that enhance the performance and productivity of these firms. It also boosts the services enhancing the consumer confidence therein. Furthermore, the companies are continuing to depict a remarkable growth as global providers showing that the business strategy is effective.

How Artificial Intelligence helps in data management, analysis, reporting

The corporate world continues to face myriad of challenges and regulations that limit their performance in the complex business environment. For many years Data Management Personnel have solved problems using data. However, in future, highly capable machines using AI will solve accounting problems using data in an unheard scale (Brynjolfsson et al., 2017). Some of the features of AI used in data management are Smart Data Discovery, Virtual Personal Assistants, Cognitive Expert Advisors, Interactive User Interfaces and Smart Robots.

The data management problems encountered by accounting firms are a result of the individual companies being poorly-equipped hence affecting their capability to handle large amounts of unstructured data. Consequently, the companies decide to staff the data somewhere which is unsafe (Vijay, 2013). Additionally, people charged with the responsibility of making business decisions do not like discard data and the lack of data retention policies have added problems to the already poor status of data management without the intervention of AI.

AI can use its feature of machine learning to mine data easily. AI and analytics can improve the power of algorithms thus enabling them to sort through different categories of data like emails, videos and images. All these programs are stored in the servers. The remaining work is done by an expert who reviews the data classification and provides recommendations regarding the automated processes (Hager et al, 2017). This way, AI provides various recommendations which enable data to be purged from files.

Additionally, AI has data management features that enable it to identify data that is rarely used in an objective manner. For example, unlike the traditional techniques of data management, AI can identify which data has not been accessed within a particular period. This enables companies to identify and remove data that may be obsolete. This saves accounting companies the time-consuming processes of searching for obsolete data. Also, AI helps in efficient grouping of data. This is through the automatic development of boundaries between data repository of the application and the data sources. Normally, analytics developers assume the responsibility of deciding the data to collect for queries (Copeland, 2015). During this process, analytics developers create a repository for this type of application. Through drawing data from diverse sources, they create analytics data pool. Therefore, through AI in accounting data management, enable analytics developers to create integration strategies used to establish the various sources of data to be used in queries. Consequently, the integration and aggregation times are significantly reduced.

Similarly provides assistance with data storage organization hence enabling improved access. Many accounting companies have made steps in automating storage in data management. This has been enabled by advancement in storage technology enabled by AI (Vijay, 2013). Apart from enabling the business to identify which data is never used, it helps in understanding commonly used data through machine learning. Also, it helps in

automatically storing data in fast or slow storage according to the business rules provided in the machine's algorithms. This solves the problem of manual optimization of data storage. Apart from data management, AI helps in data analysis. This process helps to make sense out of consumer data. It provides psychographic and biographic data. The problem is that data sometimes the data being analyzed is huge hence making it hard for content marketers to analyze. Therefore, through the AI-driven analytics tools enabled by machine learning, organizations can transform the current data analysis labor market and speeding the rate of data analysis thus allowing higher-level thinking (Ertel, 2018). Also, AI makes data analysis easier even for non-experts through providing easier ways of analyzing data. This makes the data understandable and usable for both governmental institutions and companies. As a result, governance and control of organizations is improved.

Similarly, AI provides a way of extracting insights from data to help in improving the experience of end-users and customers hence optimizing customer loyalty. AI enables accounting business to collect various variables about their customers. Because this is done in real-time, it necessitates the quick processing of data through the three types of AI analytics: descriptive, predictive and prescriptive. Descriptive analytics tells the user what has happened. Predictive explains what will happen while prescriptive provides recommendations regarding the decisions needed to be taken to maximize opportunities and counter risks. The process of extracting data insights from data begins with adopting a Data Science Mindset (Vijay, 2013). This process is used to formulate a question or problem statement, generate hypotheses, gather data, analyze data and take action. This enables the user to identify and leverage the insights that assist in delivering the right experience to the client at an accurate time.

Importance of Artificial Intelligence in Financial Reporting

Artificial Intelligence is making a change in the accounting sector and more so in financial reporting. In the accounting perspective, financial reporting aims at providing financial information to both the external and internal users for the purpose of decision making. The financial report thus gives the financial position and the condition of the firm in the current economic situation (Sun, & Zhang, 2006). Usually, organizations can either execute the objectives manually or by automation. Although human resource capital is capable of executing the tasks, it is significant to evaluate the proportion of tasks that can be automated. Today, most organizations such as the Big Four are using the artificial intelligence in financial reporting to enhance the accuracy and efficiency of the operations. For instance, EY uses the Natural Language Processing in order to enhance the adherence to the International financial reporting standards (IFRS), and the generally accepted accounting principles (GAAP). In a case where the IRS issues a change in the lease accounting regulations, the large companies face a burden in reexamining thousands of the leases manually to comply with the new regulation. The use of NLP allows the company to extract the information easily and thus validate the results. As a result, NLP provides accurate and consistent results as compared to using a manual method. The artificial intelligence systems appear to be thrice consistent compared to the human workforce in preparing financial reports. In Deloitte, Nigel Duffy, the leader in artificial intelligence suggests that reached the break-even return on investment within a year. The company also records a significant number of benchmarks regarding this system. Therefore, not only does this artificial intelligence technique enhance the efficiency of the operations but also reinforce the human activities in relation to measuring costs (Mates, 2009).

Another aspect of financial reporting is the evaluation and reconciliation of the accounts payable and receivables data during mergers and acquisitions. It requires

accountants to evaluate each transaction and financial data in order to avoid any errors or missing any relevant financial information. Previously, the accountants in the accounting and auditing firms faced a burden in evaluating and reconciling these data as it required manual creation of spreadsheets and pivot tables. In most cases, it was consuming a lot of time and tiresome such that the accountants felt it was a burden and they feared to start the process before a deal was struck with a client. Nevertheless, the introduction of the artificial intelligence creates an efficient avenue to reconcile the financial data and generate reports in conformity with the GAAP and IFRS. The cognitive systems take less time compile the information in an artificial intelligence system. Moreover, it reduces the burden while enhancing the accuracy and efficiency. Currently, accountants in Deloitte take up to one week to complete a task that would take up to five months to complete before the introduction of artificial intelligence. Accountants can now begin the process even during the evaluation of a deal allowing an opportunity to create value for the clients. In the long-run, it creates more business opportunities (Rikhardsson, & Yigitbasioglu, 2018).

Today, accounting requires an extensive institution perspective. The regulation and standard board ought to acknowledge the significance of adopting artificial intelligence and the underlying risks associated with the aspect. It means that the institutional support is paramount in implementing any changes in auditing and financial reporting standards. Therefore, the process of implementing the artificial intelligence technology should incorporate the standard boards such as ISA and IFRS. For instance, when the auditors employ artificial intelligence in conducting an audit examination, the regulation board may want to know the techniques used to collect evidence and whether these techniques are credible and reliable. Although the artificial intelligence technology creates efficiency in financial reporting, human input is also critical. Some of the reporting standards require a human judgment that is not applicable to machines. For instance, the depreciation method,

materiality concept, and other accounting patterns require human input. More often, it is not clear how the complex learning systems derive outputs (Sun, & Zhang, 2006).

Effects of Artificial Intelligence on auditing and assurance services

Auditors face a challenge in reviewing and scrutinizing a wide range of documents. In many cases, auditors spend a lot of time while flipping the pages of each document to identify any errors during the auditing process. Nonetheless, artificial intelligence can aid in reducing the underlying complexity and burden. For instance, the machine learning context is applicable in analyzing the routine and semi-defined tasks since the machine is able to learn and spot the existing patterns. In this case, it creates efficiency in the auditing process (Vasarhelyi, Bonson, & Hoitash, 2005). Besides, the innovation leaders in the Big Four firms outline that the introduction of artificial intelligence technologies has enhanced the efficiency of operations. For instance, it takes a few hours for a machine to complete what took the accountants' months to complete. The cognitive systems are making the auditing and assurance services efficient since they can perform the structured and predefined tasks that were initially done manually. These systems can collect and combine data wide range of documents and present the information in a well-structured format such that inconsistency and anomalies are easily detected. Furthermore, artificial intelligence has made the data collection in auditing to evolve. Initially, due to the complexity of the process, auditors would select a sample from a population. Sometimes, the sample would not be a representative of the entire population and thus compromising the audit opinion therein. Nonetheless, with the cognitive systems, the auditors can analyze all elements in the population rather than just a sample.

More importantly, artificial intelligence is enhancing the auditor's detection tests. It entails the analysis of the auditor's risk model presented as follows:

$$\text{Audit Risk} = \text{Inherent Risk} \times \text{Control Risk} \times \text{Detection Risk}$$

The audit risk refers to the uncertainty that the auditor's opinion may be inconsistent with the financial statements. The model provides that the audit risks are a product of the other risks that may be encountered during the auditing process. Artificial intelligence plays a very significant role in reducing the risks associated with the other risk components in the model. Inherent risks relate to the material misstatement that exists in the financial statements as a result of errors or omission caused by other factors rather than the lapse of the internal control. The risks occur where the entity has very complex transactions that require human judgment or estimation. Human beings are prone to errors and thus the integration of cognitive technologies can help reduce these risks. Although the inherent risks are not associated with internal controls, some of the control procedures contribute to the material misstatement. In this case, therefore, integrating cognitive capabilities such as machine learning helps the auditing process to be more accurate by reducing the inherent risks (*"What counts as artificially intelligent? AI and deep learning, explained,"*2018).

Control risk refers to the risk of financial misstatement due to the lapse or absence of the relevant internal controls in the firms. Internal controls are paramount in detecting any fraud or error in the organizational transactions. In this case, the control risk tends to be high in organizations that fail to integrate the relevant internal control system that aid in detecting the fraud and errors in the truncations therein. Therefore, there is a high probability that the financial statements contain errors. Nonetheless, the artificial intelligence is enhancing the auditor's detection test by providing mechanisms that help in reducing the control risk. For instance, an organization can employ the cognitive procedures to develop and implement preventive and detective control systems. The preventive controls are designed to avoid any errors and fraud that may occur while the detective techniques are designed to identify the fraud and errors once they occur.

Detection risk is the risk that occurs when the auditor fails to identify any material misstatement in the financial statements. The auditor is highly vulnerable to this risk when they fail to employ the relevant audit procedures. Consequently, the auditor is also vulnerable to the inherent audit limitations as a result of using the tradition auditing techniques. For instance, the use of sampling method may compromise the auditor's opinion when the sample choice does not act as a representative of the entire population. Although this risk can be reduced by increasing the number of samples, it is very tiresome and complex to the auditors. Nonetheless, the introduction of the cognitive technologies is making it easy to reduce the detection risks. With the cognitive systems, the auditor can evaluate each element of the population rather than creating samples. It thus helps in avoiding any compromise associated with the sampling method. Therefore, artificial intelligence not only enhances the auditing process but also helps in reducing the underlying risks therein. As a result of enhances the efficiency of the auditing and assurance services (Vasarhelyi, Bonson, & Hoitash, 2005).

Artificial Intelligence in Risk Management

As time passes, the aspect of cognitive technology is becoming an integral part of the accounting industry. Alongside the human resources, businesses are employing artificial intelligence to solve organizational problems. Ideally, cognitive capabilities are becoming helpful in risk management among other benefits. Many are the cases that risk factors entail uncertainty and ambiguous event in the organization. Today, accounting firms, in particular, require using extensive data from the external and internal sources to develop risks preventive mechanisms (*"What counts as artificially intelligent? AI and deep learning, explained,"*2018). Nonetheless, the traditional methods are often becoming incapable to provide and process such huge volumes of data. In this case, the firms such as Deloitte are increasingly seeking the help of cognitive capabilities to provide such data. For instance, aspects such as data mining, machine learning, and the natural language processing are

replacing the traditional method in detecting the known and unknown risks in the business environment. The traditional mechanisms such as the use of data spreadsheets are becoming outdated as it cannot hold the massive amount of data that firms currently hold. With the aid of a computer, firms can store the necessary information that can aid in detecting the underlying risks. Moreover, the machine learning technique allows computers to process codes as they learn. Although machines initially performed technical and complex calculations more efficiently than humans, the aspect of cognitive analytics was missing. Therefore, the introduction of the cognitive analytics allows machines to handle and evaluate both the structured and unstructured data and thus enhancing risk management. For instance, the use of Natural Language Processing system and algorithms allows the machines to evaluate the command tests and thus develop insights from the unstructured data.

More importantly, artificial intelligence aids in developing credit risk models. In this case, accounting firms use the machine learning aspect in particular to create credit risk models that analyze the financial and further provide an insight into the foreseeable risks in future. For example, when a client applies for a loan, the lender has the obligation to evaluate the reliability of the client to repay the loan. It is the work of accountants to assess and measure the profitability and leverage position of the applicant. Given the two performance metrics, it creates a complex situation for accountants to determine the credit risk manually. Additionally, some accounting firms involve long risk assessment procedures by including the liquidity ratio analysis or the assessment of loan repayment behavior of the client. Accountants face a challenge to summarize all the dimensions in a single element but the use of machine learning makes the work easier. Accountants can employ the machine learning techniques such as artificial neural networks, random forests and boosting to develop simple algorithms that can aid in creating a credit risk model. The artificial neural networks (ANNs) are a mathematical algorithm that works on the basis of the biological neural network. It

entails the transmission of data from a three input point to a two output point (Vasarhelyi, Bonson, & Hoitash, 2005). Moreover, the transmission also links to some hidden layers. The network allows the ANNs to process the non-linear and unstructured data. The random forest employs the decision tree context. In analyzing the credit risk, the random forest technique combines the probability of the various decision trees and creates the final decision based on the average output of the independent decision tree therein. The technique is effective as it incorporates all the probabilities of the underlying risks. Boosting technique is similar to the random forest technique. However, in determining the final decision, boosting selects the output of the decision trees based on the weighted performance. The three machine learning methods aid in developing risk models that supplements the human efficiency by providing higher degree accuracy and less ambiguity.

Consequently, the Moody's analytics risk calculator model amplifies the use of artificial intelligence in developing risk models. The model utilizes the impact of various risk drivers and thus develops and the expected probability of the risk occurring. Usually, the model incorporates the generalized additive model (GAM) guideline. In this model, it analyzes the nonlinear transmission of individual risk drivers, assigns a weigh to the risk drivers and further transmits the weight into a single score. Thereafter, the model develops a link that maps the single score into a probability insight. Looking at the above benefits of artificial intelligence in risk management, it is clear that accountants accrue significant help from the cognitive capabilities. Other than solving the credit risk problem, CPAs also integrate risk models in developing risk assessment plan during an audit process. For instance, the use of data mining is applicable in acquiring the relevant evidence in an audit process. For this reason, ever since the case of the Sarbanes-Oxley, accountants have found the need to review the internal controls. Besides, a weak internal control system contributes to exposing the firm high risks and external threats. In this case, therefore, the uses of

artificial intelligence can aid in developing a strong internal control system that does not compromise the accounting role and thus enhancing the risk management process in the firm therein (“*What counts as artificially intelligent? AI and deep learning, explained,*”2018).

Artificial Intelligence in the Accounting Industry

While the concept of artificial intelligence is not new, and the pace at which is spreading is fast, it is still in its initial stages in the accounting industry. Nonetheless, many accounting firms are finding the need to integrate the artificial intelligence technologies. Given that the Big Four firms are depicting excellent performance after adopting the artificial intelligence techniques, other companies in the accounting and auditing business are beginning to acknowledge the potential benefits. In this case, therefore, the CPAs look at the potential accounting challenges that the artificial intelligence solves. More importantly, it is essential to understand the potential skills that the accountants ought to portray alongside adopting the cognitive technology systems (“*How AI is driving a new era of accounting,*” 2018).

Artificial Intelligence is relevant in solving accounting problems. Many are the cases that accountant applies their technical and professional knowledge in accounting and finance to enhance decision making by the key stakeholders. In order to provide reliable advice, the accountants require both high quality financial and non-financial information. Given the accounting role, accountants engage in preparation, practice, capture, analysis, and communication of information relevant to making a decision. The accountants can employ cognitive artificial intelligence technologies to solve challenges such as providing readily available data necessary for making decisions and creating more time to focus on more beneficial tasks in the firm such a decision making, research, problem-solving, leadership, and development of strategies. Machine learning techniques equip the accountants with substantial information and accounting capabilities that enhance the execution of accounting

roles. More importantly, the automation of activities enhances the efficiency and accuracy of the accounting roles. For instance, automation allows the machines to code the accounting entries enhancing the accuracy of the transactions that follow particular accounting rules. Secondly, automation enhances fraud detection process and thus providing a better prediction of the future fraudulent activities in the system. Machines also allow the accounting department to create predictive models that can easily forecast costs and revenues (*"How AI is driving a new era of accounting,"* 2018).

Artificial intelligence is gaining popularity in solving some of the practical challenges in the accounting industry. Currently, the artificial intelligence aspect such as machine learning is being incorporated in most of the accounting software. More often, the accountants thus engage in machine learning without even recognizing. Although many small organizations do not find the need to incorporate artificial intelligence, the dynamism in the technological aspects will force the firms to adopt the artificial intelligence technologies. Today, many accounting and auditing firms are adopting the artificial intelligence tools to solve the practical challenges such as minimizing costs, creating a competitive edge, privacy, and enhancing the customer service. In other cases, a firm such as Deloitte is using the Natural Language Generation system to develop better products in the tax business.

More importantly, the accounting industry is adopting the artificial intelligence concept as it is enhancing the roles and skills of the accountants. The machine learning is providing the accountants with new capabilities such as data analytics, and high levels of skills in numerical computing. The artificial intelligence particularly enhances the efficiency and accuracy of the accounting activities (*"How AI is driving a new era of accounting,"* 2018). For instance, the innovation leaders in the Big Four firms acknowledge that artificial intelligence is boosting the productivity of the firms. It is manifested in how the firm can perform their activities and deliver services more efficiently upon adopting the artificial

intelligence technologies. Nonetheless, the automation does not wholly take over the human input but rather reinforces the capabilities. Some of the machine learning activities requires technical and specialized human skills in order to operate successfully.

How the role of an accountant is changing due to artificial intelligence

Since the development of AI, many big accounting firms have embraced it and it has helped them in automating transactions such as account payables, travel expense, fixed assets, general ledger, financial reporting and payroll. For example, since, KPMG has been using McLaren Applied Technologies (MAT) in its audit processes (Ertel, 2018). The company has also been using IBM's cognitive computer known as Watson. Similarly, Deloitte uses Kira Systems to improve its work in assurance.

A research conducted by Censuswide on 300 CFOs with annual revenues of more than \$150 million (Hager et al, 2017). The results revealed that Artificial Intelligence plays an important role on the daily running of the organization. Finance directors and accountants of the companies in the survey. When asked the specific business areas affected by Artificial Intelligence, 56% of them said that AI helped in completing accounts payable and receivable function without necessarily requiring human intervention (Hager et al, 2017). The findings of this research indicate that AI has changed the role of accountants in organizations.

Traditionally, the roles of auditors revolve around long methods of professional standards of report preparation and long-established methodologies for information analysis and event-based tasks like tax filings, day-to-day business management and audits. Currently, there is complex software that automates accounting, audit-gathering and processing tasks, tax and provides results for experts to provide their human judgment. Artificial Intelligence has changed accounting technicians' roles to be automated. This is because it enables computer learning systems to perform routine and simple tasks at a higher speed and accurate levels.

The Future Projections of Artificial Intelligence in Accounting

In the coming decades, the artificial intelligence systems will take over some of the human tasks such as decision making. Nonetheless, the intelligent systems cannot fully replace the human input. Despite the growing need to incorporate the intelligent systems, accounting firms still need accountants to perform some of the accounting roles (*“Forbes Welcome,”* 2018). The accounting firms should acknowledge that the cognitive technologies are only appropriate to supplement and reinforce the human capabilities to enhance the efficiency. Moreover, there are some of the accounting tasks that particularly require human technical knowledge. For instance, the coding and entry of some transactions require human input. Additionally, some technical judgments such as the method of depreciation and the accounting standards require the human input. Nevertheless, some accounting software is capable to code and apply the accounting standards across the financial transactions.

Accountants have the obligation to help the organization by providing information necessary in making better decisions. Intelligent systems provide the accountants with the necessary and credible information appropriate in making a decision (Rikhardsson, & Yigitbasioglu, 2018). Accounting firms will require more intelligent systems in the future in order to enhance the decision-making process as the firms strive to solve the fundamental problems in the accounting aspect. For instance, investors need to have the confidence of the organization financial information, the firms and governments need to ensure that the actual amount of tax is paid, and the management ought to make a decision on the allocation and utilization of the resources available. The accountants thus strive to provide advice that accounts for the interest of all the stakeholders. Many are the cases that the management may not want to be held accountable for any wrong decision made in regard to allocation of resources. In this case, therefore, with the rising help of the artificial intelligence, accountants will need to

utilize these systems to enhance the accountability of decision making (*“Forbes Welcome,”* 2018).

The Artificial Intelligence cannot replace the Human Element

Since 1950s artificial intelligence has shown a remarkable improvement. The automation of services is forming an integral part of the online activities and more so in the accounting firms. Nonetheless, artificial intelligence cannot be as equal and thus cannot replace human intelligence. Artificial intelligence is a tool that in enhancing the accuracy and efficiency of the daily activities in the accounting sector. It provides a high level of accuracy that exceeds the human proficiency. However, artificial cannot replace the human input but it just provides the accountants with a chance to enhance the efficiency and create value for the business in the short run. In the long run, the intelligence systems provide an avenue for a more extensive radical change in the firm. It gradually enhances the human decision making by providing readily available and credible financial information. Usually, it is important to understand that the Artificial intelligence is a tool than reinforce the accounting role but cannot fully takes over the human input position (Sun, & Zhang, 2006). While organizations continue to embrace the potential benefits of the cognitive technologies, it is paramount to embrace that it requires human input to run successful machine learning and thus the two elements work together. Although, technology is enhancing the decision making process, the humans also employ two methods of decision that are paramount. The intuitive thinking allows humans to think unconsciously based on the past history of patterns. On the other hand, human input also use the conscious reasoning to make rational decisions especially where intuition thinking does not provide a sufficient solution. Accountants employ both methods of decision, especially where organizational problems relate to their field. While most scholars argue that artificial intelligence will replace the human intelligence, this is not the case. For instance, for many years, artificial intelligence has been focusing of encoding

the human reasoning capabilities in areas such as logic reasoning and decision trees.

Although the system appeared to capture the human knowledge, it barely produced effective results. Some of the experts outline that it was due to technical issues but with time, the systems were overcome by the practice activities of the real world that require intuitive thinking. Intelligence systems can thus not operate independently without the help on the human element (Vasarhelyi, Bonson, & Hoitash, 2005).

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