

The Impact of New Technology on Ethics in Accounting: Opportunities, Threats, and Ethical Concerns

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This study explores the advantages of using technology, specifically artificial intelligence, big data analytics and blockchain, in the accounting. AI helps to process massive amounts of data by accelerating automation, thus operating time can be shortened and the quality and relevance of accounting information can be improved at the same time. It is also expected to facilitate full transaction (as opposed to only sample transaction) audit and continuous audit (audit on demand). By using blockchain technology, a better internal control system can be built, data manipulation becomes improbable, and consequently, accounting transparency will be improved. In addition, unethical human behavior such as moral hazard, slack, and pseudo-participation could be minimized, if not eliminated. However, there are also threats that may arise from the adoption of new technology such as technological unemployment and loss of data privacy. Other issues may also arise concerning technology-driven judgements that vary depending on situations, specifically in determining who is responsible for the consequences. To overcome these ethical issues, I recommend that a code of ethics be clearly defined, advanced software devices be developed considering such code, and a review process be conducted by human beings. I also suggest more involvement by human beings in three key areas to uphold ethical accounting standards: decision-making, accountability, and education. This study will help search for ways to benefit from technology while simultaneously addressing related ethical issues in the accounting.

Keywords: Accounting Ethics, Accounting Technology, Artificial Intelligence, Big Data Analytics, Blockchain

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1. Introduction

Artificial Intelligence (AI) is often defined as 'intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals.' This brings us to ask: what are the attributes of humans that are different from machines? Immanuel

Kant, a German idealist and philosopher, said that a human being is a rational being. There are many ethical principles to be considered in deciding what is the right or wrong thing to do in a given situation, and society is sustained based on these considerations. Ethics is about discipline in dealing with what is good and bad in a way that considers moral duties and obligations (Spafford 1992). Human

beings are capable of making decisions that apply ethical norms and are able to take responsibility for the consequences; these cannot be expected from machines. The responsibility for any judgement made by a machine still lies with human beings.

Moreover, it is hard to expect ethical awareness or trustworthiness in the business world. It is believed that all economic entities seek to maximize their own benefits (Child et al. 2000; Doz 2001). Since the 1970s, organizational economists have argued that economic entities will not only be self-interest oriented but will also act opportunistically to hide or manipulate information in pursuit of their own interests (Milgrom and Roberts 1992; Williamson 2007). This also applies in the field of accounting. Determining how auditors and information users (who are both regarded as self-interest oriented and opportunistic entities) differ in their perception of ethics and how this ethical (or non-ethical) relationship affects the usefulness and transparency of accounting information is an important research topic.

The impact of technology on ethics in the field of accounting is a critical issue to address. The use of artificial intelligence and other technologies rapidly spread throughout society, and it is obvious that such technologies cannot help but be used in all areas. In the field of accounting, new technologies are getting more widely used to improve effi-

ciency and effectiveness in the audit process. As such, it is necessary to discuss the threats, opportunities, and ethical issues of using technology in the accounting profession as we have seen problems arise from the absence of ethics in accounting over the last few decades.

First, this paper presents the new technologies currently adopted in the accounting field: AI, Big Data and analytics, and blockchain. Second, it provides the pros and cons of the use of technology in the accounting profession and the resulting ethical issues. It also examines what needs to be considered to overcome these ethical issues. Finally, it presents the three aspects that should be considered when discussing the impact of technology on ethics in the field of accounting—decision-making, accountability, and ethics education.

II. Technology in Accounting

The evolution of accounting information systems, the increasing use of analytical technologies, and the emergence of big data, all have dramatically changed the accounting profession. There are many reports and articles discussing accounting technology. The Institute of Chartered Accountants in England and Wales (ICAEW) identifies the followings as the technologies transforming the accounting

industry: Artificial Intelligence, Big Data, Blockchain, and Cybersecurity (IFAC 2019). The Association of Chartered Certified Accountants (ACCA) and the Institute of Management Accountants (IMA) states in their reports that Mobile, Artificial Intelligence, Big data, and Cybersecurity are the top four technologies which change accountancy profession (ACCA/IMA 2013, P.10). *Forbes* (2018) also reports that harnessing the power of the cloud, accelerating automation, and breakthroughs via blockchain are the accounting trends in future. As such, while accounting technology can be defined in various ways, they address AI, Big Data, and Blockchain as top-priority technologies in common. In this section, I present these new technologies especially focusing on audit technologies, because one of the most significant changes with technologies is the automation of the audit process and these technologies are expected to contribute audit process.

2.1 Artificial Intelligence

AI, by its definition, will learn on its own (machine learnings or deep learnings) and dramatically expand its abilities such that it will be able to handle human jobs more effectively and efficiently. AI and robotics are automating complex and repetitive tasks and processes, with extreme accuracy, reducing operating costs and increasing efficiency.

These are some of the emerging technologies supporting the transitional role of today's accountant into a more critical thinking role.

Accountants apply their technical knowledge about accounting and finance to help businesses and stakeholders make better decisions. To support their decision-making and advices, accountants need high quality financial and non-financial information and analysis, and AI is expected to provide higher quality information by machine learnings. For example, AI technology can help accountants by providing better and big data to support decision-making and by generating new insights from the analysis of data. This technology will enable accountants to focus on more valuable tasks such as decision-making, problem solving, advising, strategy development, relationship building and leadership (FSB 2017). Furthermore, AI networking, which means a single AI connects to other AI techniques, will accelerate the expansion of its abilities.

In real-world accounting, we can utilize the AI and machine learning to code accounting entries, improve on the accuracy, and enable greater automation of processes. Accountants will enable to improve fraud detection mechanism through more sophisticated machine learning models of normal activities and better predict fraudulent activities. They will be able to forecast revenues using machine learning-based predictive models, and improve

access to, and analysis of, unstructured data, such as contracts and email, through deep learning models. In addition, data volumes and quality are crucial to the success of AI systems, because without enough good data, models will not be able to do machine learning.

2.2 Big Data Analytics

Big data and analytics present many important implications for accounting and opportunities for accountants to improve better decision-making. Warren et al. (2015) state that video and image data, audio data, and textual data are different types of big data as a supplement to existing accounting records, and this information made available through big data can provide for improved managerial accounting, financial accounting, and financial reporting practices. In managerial accounting, big data can play a role in developing effective management control systems by discovering behaviors correlated with specific goal outcomes, which would prompt the creation of corresponding performance measures.

For example, the Balanced Scorecards (BSC) collects data in four areas: financial, customer, internal business process, and learning and growth. Within each area, Big Data can identify new behaviors that influence respective goal outcomes. For instance, web use while at work may be tied to learning and growth goals, internal emails may correlate with the effective-

ness of internal business processes as well as customer service quality, and customer service quality may be related to vocalic cues mined from customer service calls. (Warren et al. 2015, p.400)

In financial accounting, big data will improve the quality and relevance of accounting information. For example, there is a criticism that traditional financial statements cannot properly present intangible assets such as customer base, human resources, product quality, company reputation, and so on. However, big data can help in enhancing relevance of intangible information. For instance, key indicators associated with these intangible assets could be accumulated, processed, and analyzed through data-mining algorithms, and this information might be disclosed on the supplement or notes to financial statements.

In addition, big data and analytics have a significant contribution to audit process. The general audit process currently performed by Certified Public Accountants (CPAs) is a procedure in which the auditors randomly sample certain transactions in the company and check for violations of the accounting standards. Meanwhile, analytical techniques that utilize big data enable the auditors to check all transactions, not just random sample transactions of the firms. Big data analytics is the process of inspecting, cleaning, transforming, and modeling big data to discover and communicate useful information and patterns

(Cao et al. 2015). At the end of the process it suggests conclusions and supports decision-making. The use of this technology is expected to shorten the audit time and ensure the accuracy of the audit.

Many companies are now adopting Enterprise Resource Planning (ERP) systems. They store and access data and program over the Internet through cloud computing so that large amounts of accounting data are available on the system. Big data analytics can efficiently utilize these data in an accumulated manner. Even if a transaction is added to the system at the same time that it occurs, it will be possible to continue to implement the audit process with this addition. It is expected that the use of a continuous data auditing systems through big data analytics will provide various benefits to the financial audit process besides shortening audit time and ensuring audit quality.

Continuous audit can also be accomplished by introducing big data analytical techniques (Teeter and Vasarhelyi 2015). Because audit procedures for firms' financial statements are traditionally performed only once a year for an "annual report," audit data may be gathered long after economic events are recorded; it

takes at least two to three months to conduct an audit, limiting the ability to ensure accuracy of the audit. Considerable research has provided a broad perspective on how technology is changing the auditing practice. Alles et al. (2002) found that there is an economic demand for continuously providing assurance and suggested a service called "audit on demand." "Audit on demand" can be realized by applying big data analytics. However, although continuous audit is not new, ideal and useful technique, widespread adoption in accounting is still in early stages.¹⁾

2.3 Blockchain

Another area in which technology will have a direct impact on the accounting profession is Blockchain. Blockchain is a data decentralization-based technique. Various data are saved on a list of records called blocks, and these blocks are linked like chains using cryptography. Blockchain is "resistant to modification of the data" (Anewalt 2018), since each block contains 'a cryptographic algorithm known as a "hash" of the previous block, a timestamp, and transaction data'

1) For continuous audit, a large-scale technical investment and company-wide training programs are required by both audited companies and auditors in order to build the audit system. Establishing legal system and regulation to force large investments for financial reporting is another obstacle. Currently, audit fee is set based on audit time, and it is expected to be significantly increased if continuous audit is actually employed. Total audit time may vary by increasing the preparation, operation, and time for auditor's professional judgment, even though audit time for technical audit process would be shorten (Cho et al., 2018, p.316). There could be a discrepancy in interests between audited companies and auditors.

(Bacani 2017). It is ‘an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way’ (Iansiti and Lakhani 2017). ‘Once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks, which requires consensus of the network majority’ (Raval 2016).

The blockchain techniques are operated as autonomous software agents; these can perform transaction verification and control or prevent fraud. Many accounting transactions can be programmed with various business rules or agreements and automatically processed by these blockchain-based smart contracts. The application of blockchain technology in accounting assumes ‘the utilization of decentralized consensus mechanisms based on the exertion of scarce resources,’ which is called Proof-of-Work (PoW) (Jakobsson and Juels 1999), and this leads to the validation of transactions without the need for any third-party verification. Together with the blockchain (a shared database), PoW is expected to lead to nearly immutable and therefore, fraud-resistant, real-time financial registers (Rückeshäuser 2017). Consequently, the blockchain technology and PoW will greatly contribute to enhance information transparency in the accounting profession.

The case of Comroad, which is a German telematics service provider, can be the example

of detecting accounting fraud by identifying the requirements on blockchains. Comroad case is one of the major accounting scandals of publicly traded firms in Germany. It is often observed that top management such as CEOs and/or CFO is involved in fraudulent activities. Top-managers are either directly involved in conducting accounting fraud or indirectly involved by convincing or enforcing the provision of fraud by other parties. To increase sales revenue, they recorded sales with numerous fictitious transactions and invented commercial relationships with non-existing trading partners (Rückeshäuser 2017). However, Comroad had a strong internal control system (required by German Law) based on blockchains, which adopted a proof-of-work(PoW) and decentralized consensus mechanisms to safeguard assets of a company as well as to check the accuracy of bookkeeping. Without the blockchain-based internal mechanism, the board of directors in Comroad might not be able to detect the management’s accounting fraud.

In the accounting and auditing industry, an interest in blockchain is increasing. Blockchain is considered as the next generation of business-processing software where transactions are shared among customers, competitors, and suppliers (PriceWaterhouseCooper 2016). In particular, blockchain with functions that enable data integrity, rapid processing and sharing, and programmatic and automatic

control processing will significantly contribute to developing new accounting systems. Bacani (2017) argued that a blockchain can change the business pattern. For example, there would be no need to issue invoices because the transfer of goods and services and the corresponding payment can be accomplished in real time on a distributed ledger; this can effectively improve invoice issuance, payment, and claim procedures. Moreover, Flynn (2016) noted that blockchain systems that record transactions in real-time would enable automatic tax filing, and that tax reporting authorities could quickly confirm reported taxes and payments; thus, simplifying the tax filing process. As a result, the use of blockchain could deter tax evasion and avoidance decisions, and the role of tax professional will be transformed from simple tax reporting into tax-related blockchain expert (Deloitte 2016).

Blockchain technology, when combined with appropriate data analytics, could help with the transactional level assertions involved in an audit, and the auditor would be better focus on considering higher-level questions. For example, auditing is not just checking the detail of whom a transaction was between the monetary amount, but also how it is recorded and classified. These judgmental elements often require context that is not available to general public, but instead require knowledge of the business, and with blockchain in place, the auditor will have more time to

spend on these questions (ICAEW 2018).

III. Ethical Impact of Technologies in Accounting

Three technologies adopted in the accounting field were presented: AI, big data analytics, and blockchain. The ethical impact of these technologies on the accounting profession is discussed as follows.

3.1 Opportunities provided by these technologies

The advantages of adopting these new technologies can be summarized as follows.

For AI technology, the advantages are that:

- Accuracy and efficiency can be increased and operating costs and time can be reduced in performing accounting tasks and process.
- It can provide higher quality information by machine learnings or deep learnings.
- It can contribute to generate more transparent accounting information.
- Greater automation of processes can be accelerated.

For big data analytics, the advantages include the following:

- It can play a key role in developing effective management control systems.
- Financial reporting quality and relevance of accounting information can be improved.
- Full transaction (not just random sample transaction) auditing is made possible.
- Continuous audit, or audit on demand can be implemented.
- Massive amounts of data can be processed quickly.
- Audit time can be shortened and audit quality can be improved.

For blockchain, the advantages are the following:

- Subsequent transactions cannot be retroactively altered.
- Modification, alternation, and manipulation of data become improbable (if not impossible).
- Data integrity, rapid processing, and sharing can be achieved.
- Accounting transparency can be enhanced.
- Automatic control over invoice-related procedures can be effectively improved.
- Tax filing and payment processes can be simplified, and tax evasion and avoidance can be controlled to some extent.
- Transaction verification can be performed, and fraud can be controlled or prevented.

Next section will address how to use these opportunities for accounting ethics.

3.2 Application of these opportunities considering accounting ethics

The use of software technology or robots will influence professional judgment in the accounting profession in the areas of gathering, summarizing and providing data with improved bases for making better decisions. Software robots or technology can provide alternatives or suggestions for more efficient decision-making. Companies with big-data-based decisions make 5% to 6% more profit than other businesses that do not employ such technology (Tene and Polonetsky 2013).

Accounting standards are often called generally accepted accounting principles (GAAP). If big data consist of accounting principles, norms, moral value, previous cases or precedents that are generally and widely accepted in society, and if algorithms suggesting for accounting practices are developed based on these big data, it would be possible to achieve rational decision-making. Given that there already exist massive amounts of accounting data and technology to handle these data, not only an accountant or human being, but also an accounting system, machine, or AI might be able to reach more rational decision-making.

Warren et al. (2015) also state that Big Data complement traditional financial information and can provide improved transparency and usefulness for decision-making. They discuss several forms of Big Data such as video, im-

age, audio, and text. In their paper, they discuss that, for example, relative to fixed assets, ERP systems can augment records with video clips and other types of multimedia. In this way, the user obtains a more comprehensive view of each asset's condition features, and characteristics. Using Big Data technologies will improve accounting transparency, assist in meeting stakeholder needs, and provide benefits to auditors.

As mentioned above, another application of new technology is in a tax system that automatically confirms tax filing and payment, the use of which could deter decisions on tax evasion and avoidance. All transactions and accounting procedures become more transparent with automated systems.

Moreover, it is possible that unethical behaviors will be reduced with the use of technology. Many researchers have focused on whether investors are deceived by misleading corporate earnings information. Healy and Wahlen (1999) address the complex process by stating that earnings management occurs when managers use their judgment in financial reporting and in structuring transactions to alter financial reports either to mislead some stakeholders about the underlying economic performance of a company or to influence contractual outcomes that depend on reported accounting numbers. CEOs of firms

aim to show more attractive results (through income smoothing, big bath, conservatism, and window-dressing, among others) to stockholders and other stakeholders of the company and thus are tempted to report improved profits by employing the practices mentioned above. Most accounting scandals and earnings manipulations stem from this intention to report improved profits as well as the social interactions between the manager who takes care of the accounting reporting, the auditor who audits the accounting information, and the financial institution that can financially support a firm. An example is the case of Enron where accounting fraud was committed using mark-to-market accounting and special purpose entities. If technology based on machine learning had been used, such accounting method would not have been chosen for the transactions that should not be used mark-to-market accounting method. The human intention of showing more improved profits to stakeholders could have been ruled out. Another example is the financial crisis that precipitated due to subprime mortgages in the US caused by a moral hazard of financial institutions. By contrast, machines are not human beings and, therefore, may not act against ethical values, may not need to consider social interactions, and may not pose a risk of causing moral hazard issues.²⁾ With

2) On the contrary, however, some argue that accepting the results of data analytics as audit evidence has not been officially announced. Moreover, the International Auditing and Assurance Standards Board (IAASB) addresses the use

audit automation, or any other kind of automated accounting system, there is no need to interact with the personality traits of accounting-information providers and users. The mechanisms by which technology is applied are not subject to ethical dilemmas that may result in economic harm due to the reporting of misleading accounting earnings. Rather, the use of technology can overcome this ethical limitation of human beings.

These ethical benefits are not just limited to financial accounting or auditing area but can also be applied in managerial accounting areas. One of the key processes of management accounting is planning, and managerial accountants are often involved in budgeting as a planning process. Today's budgeting process is not approached in a 'top-down' manner, which means top managers establish a budget and impose it on subordinate managers. Rather, it is more likely a 'bottom-up' process, which is known as 'participative budgeting.' Since participative budgeting largely allows subordinate managers to contribute to how the budgets are established, overall objectives are communicated to managers and all the managers and employees can cooperate to

accomplish the organizational goals. However, since the subordinate managers create the budget, participative budgeting is susceptible to dysfunctional behaviors such as budgetary slack³⁾ and pseudo-participation⁴⁾ (Mowen et al. 2011). The adoption of an automated budgeting system will eliminate the dysfunctional behaviors of human beings, process the inputs (big data) of all managers, (both top and lower levels), and search for ways to maximize the overall benefit of the organizational. Accordingly, the benefits of participation will be realized. In addition to this, variance analysis based on an automated budgeting system will improve efficiency of the performance evaluation process and provide better suggestions on where the variance should be controlled and adjusted.

AI systems can be utilized to develop various kinds of tools that can detect fraudulent audit. With the introduction of technology, auditors will be able to play the role of protecting public rights and interests against internal corruption. Automatic accounting systems can be designed such that these systems automatically provide pop-up warnings in real time and require further action if

of new technology may not solve all ethical problems or not achieve reasonable judgement, therefore it recommends that the use of new technology should always be accompanied with auditor's professional judgment (IAASB 2016, p.7).

- 3) Budgetary slack, often referred to as padding, exists when a manager deliberately underestimates revenues or overestimates costs in an effort to increase the likelihood that he/she achieves the goal, which consequently reduces the risk that he/she faces (Mowen et al. 2015, p.404.)
- 4) Pseudo-participation occurs when top management assumes total control of the budgeting process, seeking only superficial participation from lower-level managers. Top management is simply obtaining formal acceptance of the budget from subordinate managers, not seeking real input (Mowen et al. 2011, p.405.)

any type of fraudulent activities is found. New technology will automatically “blow the whistle,” so that accountants and auditors can perform surveillance of their clients on behalf of the public’s interest without any personal disadvantages. Therefore, the manner by which ethical considerations are built into the use of technology in fraud detection and forensic work must be discussed and the codes of ethics (including confidentiality) should be addressed in advance. Also, auditors should report any unethical uses of technology or data during their work and ensure that the ethical benefits that technology can bring to the audit profession are not exploited. Advanced technology is expected to provide various opportunities and advantages. It is necessary to continuously discuss the ethical issues arising from the emergence and use of new technology and to introduce relevant laws and regulations accordingly.

3.3 What are the threats?

Next, I discuss the threats of new technology on the accounting profession. Even though the use of technology provides many advantages mentioned above, there are threats. Technology can be used to replace or augment human judgment, but its focus on a rational approach to problem-solving and decision-making ignores the consideration of ethics. This section presents the ethical threats that

may result from the adoption of new technology.

One of the biggest concerns is ‘technological unemployment.’ Technological unemployment is defined as the loss of jobs caused by technological change. This change is likely to be most keenly felt in areas where auditors use technology to replace those parts of the process previously done manually. Ernst & Young (EY) estimates the number of new college graduates to be hired in 2015 could fall by half in 2020 (Agnew 2016). In addition, according to a survey by the McKinsey Global Institute (Manyika et al. 2011), 44% of firms reduced their headcount since the financial crisis of 2008 through automation. At a symposium on the impact of computing on economic activity held by the Harvard Institute for Applied Computational Science in 2017, Chavez, Chief Financial Officer (CFO) of Goldman Sachs, said that Goldman Sachs’s New York headquarters employed 600 traders back in 2000 but there are just two equity traders left today, and explained that automated trading programs have taken over the stock trading work. Why would this be considered an ethical issue?

Harari (2014) cited Adam Smith’s book, ‘The Wealth of Nations’ published in 1776, and explained why modern economy was able to grow faster than in the past. He wrote:

Smith’s claim that the selfish human urge to increase private profits is the basis for collec-

tive wealth is one of the most revolutionary ideas in human history - revolutionary not just from an economic perspective, but even more so from a moral and political perspective... Smith denied that traditional contradiction between wealth and morality... Being rich meant being moral. In Smith's story, people become rich not by despoiling their neighbors, but by increasing the overall size of the pie... All this depends, however, on the rich using their profits to open new factories and hire new employees, rather than wasting them on non-productive activities. (Harari 2014, p.439)

If the rich do not use their profits to hire new employees or create jobs, the whole society will be harmed, not just economically but also morally and politically, which consequently affects social and ethical norms and values; therefore, in this way, the loss of jobs due to automation becomes an ethical issue.

Frey and Osborne (2017) reveals that accounting and tax preparation are highly ranked as occupations with high probability of computerization.⁵⁾ Although there may be some misunderstanding of what the accounting profession involves (that it merely focuses on simple bookkeeping and clerical audit work), big data analytics nevertheless is expected to provide useful information for decision-making in the fourth industrial revolution. The process of collecting, providing information, and sug-

gesting alternatives will probably be replaced by machines; thus, this is a likely threat to the accounting profession. Unemployment resulting from the use of machines will cause economic slowdown, or more severely, a recession. It will shake the foundation of capitalism and affect the accounting profession, with accounting being a product of capitalism.

The second ethical threat is that business-related judgments are likely to be changed depending on the owner of the new technology. For the sake of discussion, I consider the autonomous vehicle example, where an autonomous-driving vehicle that is driven according to an AI algorithm needs to make a decision when another vehicle comes in and threatens a collision (Han 2018). The owner of the vehicle can be hurt or killed by a collision, or can hurt or kill another driver in order to survive. In this situation, what is considered the ethical choice? Should the choice be made for the owner of the vehicle or for the other party? A related question is: who is the owner of the vehicle, the car manufacturer or the driver? Assuming there are two possible outcomes: the collision will cause almost no damage to the car but the driver will be killed, or the driver will survive but the car will be a total loss. How would the algorithm work in this case? What decision should be made?

5) This study also claims 'for workers to win the race, they will have to acquire creative and social skills' (Frey and Osborne 2017, p.269.) However, in this paper, it is already discussed that social skills often cause ethical problems in the accounting profession.

A similar situation can occur in the accounting field. One of the most important practices in the accounting profession is ensuring the transparency of accounting information. How is this transparency rule applied? Who should the financial statements be transparent for? Will the algorithm in an accounting system be designed to protect the interests of the company? Or should it be designed to protect the interests of stockholders, creditors, or the general public? This can be an ethical dilemma. On the one hand, this is a general ethical issue that can arise in financial reporting, in capital and audit markets using accounting information, not an ethical dilemma raised specifically from the use of new technologies. On the other hand, however, a situation that poses an ethical dilemma arises from choosing how to manage the reporting of earnings. Should a firm reduce the reported taxable income to benefit from tax-savings or boost up earnings to report better management performance as compared to the previous year? Which accounting choice should be made to manage earnings? Or should a firm report 'unmanaged' earnings? What is considered transparent accounting information as far as the general public is concerned? These are not easy ethical questions to be answered by machines. Therefore, as in the case of autonomous vehicle example, guidelines or AI algorithms to deal with every single collision situation

should be programmed, human beings should give straightforward guidelines regarding how to apply transparency rule in financial reporting. This is because the machine does not have the ability to make a judgement by itself with an ethical mind.

Third, privacy matters. How can we ensure privacy in the era of big data? Does data privacy exist when used in data analytics by auditors and accountants? This issue appears to be different from other privacy concerns (such as those on users' personal information disclosed by social media or online companies) because accounting information (of listed companies) is available to the general public. However, who will access, when to access, and determining what intentions are valid to access the data can be problematic. There can be an ethical issue if accountants and auditors access internally secured data for personal profit earlier than fairly disclosed, or link the data across organizational units that are supposed to be separate (Hoffman et al. 1996). However, this is not a technology-related issue; rather, it is a problem similar to internal transactions and therefore it is a matter to be addressed in the design of a better internal control system. Related to data privacy, if internet service providers and social media companies disclose or report their users' suspected malfeasance to the authorities, this is also subject to ethical limitations.

The fourth ethical threat is that account-

ants and practitioners maybe abandon their critical thinking and reasoning ability as they begin to heavily rely on technology. They may simply accept the suggestions made by machines. Early attempts to introduce technology in the accounting profession will most likely be in the form of software support for decision makers. However, Friedman and Kahn (1992) are concerned about the decision support tools. They said that these tools could induce willingness to give up human being's decision-making responsibility because the software tools could make decisions that are considered good enough. The more people trust the decision support tools' suggestions, the more difficult it becomes to question them, and the decision support tools will eventually dominate the decision-making process.⁶⁾

Accordingly, the fifth ethical threat of technology in accounting is what has become known as a 'responsibility gap.' Accountants and auditors have increased the use of technology in decision-making. Through this, they are able to shorten the audit time, realize audit cost savings, enable continuous audit, and achieve overall efficiency in the decision-making process. Technology offers these benefits, but these come with consequences. Technology results in the abdication of ethical responsibility for the consequences of

decisions made by human accountants. This is called 'responsibility gap' (Johnson 2015). This brings us to ask, who will be responsible for the 'behavior' of machines? Are humans responsible for the consequence resulting from the use of technology? This should be reconsidered.

Finally, another threat is that human beings will not be able to control machines as they do not understand the algorithms that are dramatically advanced by machine (or deep) learning.

3.4 The best way to deal with these ethical threats

To reduce 'technological unemployment,' it is necessary to change the employment model. More accounting system developers and IT personnel can be hired. It would be possible to increase employment by hiring new people, who can train technology-related knowledge and provide support to existing employees. The qualification required for new employee will also change. They should be qualified with the skills of new technologies such as ability of developing information systems and sharing IT techniques, as well as basic knowledge in accounting, taxation, auditing and consulting. We need to keep in mind that

6) Delegating decision-making to computerized systems will be very risky. This paper discusses the decision-making issue in the next section.

the tasks can be handled by technologies are labor-intensive ones. To deal with the ethical threats mentioned above, we can use technologies to find specific patterns and to select areas where humans should investigate in-depth, and let auditors focus on more important issues, which required their ethical and professional judgment. New technologies including machine learning, artificial intelligence, and big data do not provide indicators of cheating and misconducting. Securities and Exchange Commission (SEC) claims that it still needs human experts to identify the following unethical behaviors: manipulation and deception through misrepresentation and omission, materiality, possible misconduct involving the sales of securities, scienter - intention and knowledge of misconduct (Cho et al., 2018).

In previous section, it is mentioned who is responsible for the judgment made by machine. Under the Certified Public Accountant Act, each certified public accountant should perform the audit services (Article 2) and carry out his or her functions in impartial and sincere ways.⁷⁾ Therefore, the auditors cannot avoid responsibility even if the audit opinions are made by an automated audit program, because the establishment of an automated audit system is also under the responsibility

of the human auditor. This act indicating the responsibility of audit opinions presented using technologies belongs to human auditor should be explicitly added to Certified Public Accountant Act. International Auditing and Assurance Standards Board (IAASB) recommends that the use of new technology should always go along with auditor's professional judgment.⁸⁾ Therefore, human auditors should keep in mind that they can use the new technology and take advantage from it, but they also have the responsibility of the audit opinions provided too. Human auditors cannot blame for the behavior of machines and always need to maintain professional skepticism.

In summary, in order to overcome the threats mentioned above, it is important to develop mechanisms that would obtain advanced consensus, taking into account these ethical dilemmas, and these mechanisms should be added to the technology-based accounting information system. As previously discussed, blockchain-based accounting systems provide numerous advantages. Many accounting transactions are programmed and automatically processed in smart contracts such that smart contracts can be operated as fraud control and prevention systems. In summary, blockchain is a base system that provides a safeguard against distortion or manipulation of

7) http://elaw.klri.re.kr/kor_service/lawView.do?lang=ENG&hseq=47928

8) <https://www.ifac.org/system/files/publications/files/IAASB-Data-Analytics-WG-Publication-Aug-25-2016-for-comms-9.1.16.pdf>

accounting records, while smart contract is an operating system with software embedded in business regulations and accounting standards. Although a blockchain-based accounting system can protect data and prevent fraud, it is exposed to the risk caused by managers' fraudulent behaviors. Therefore, concrete applications or internal corporate solutions that can control for managers' accounting fraud should be thoroughly designed.

Designing a device or application that can prevent managers' accounting fraud and adding it to the accounting information system can be very helpful in solving the ethical problems mentioned above. To do so, the code of ethics including integrity, objectivity, and confidentiality must be clearly defined. Guidelines and formal codes are needed to determine who to make decisions for, the purpose of using the technology, as well as the purpose of business-related judgements. It is important to explicitly specify guidelines, formal codes of ethics, and moral standards because it is impossible to design a properly functioning device without them. Furthermore, continuous training and education programs should be provided to technicians, accountants, and auditors who need to understand the rationale of the technologies and algorithms. Moreover, ethical considerations must be integrated into user-training programs and into the design and operation of the accounting information system.

Finally, when designing analytics to process accounting data, decision rules used in software should be created, which can be the very last step to enable checking of whether the final suggestions that are provided meet the ultimate ethical requirements. Additionally, the decision on this last step should be made by humans and the decision of the last step should be designed to have priority over any other protocol. Nevertheless, these procedures will not overcome all the drawbacks. If a human being with questionable intentions participates in the decision-making process on the last step, the ethical issues discussed above will arise. However, designing this last step can at least prevent problems that may arise due to the technology's failure to consider ethical principles. Once a fully automated software system with these decision rules is designed (if it can be implemented as a prototype in actual accounting and audit settings), it will help in examining what kind of ethical issues can be brought by an automated accounting system, and in finding ways to deal with such ethical problems. This can be meaningful for the future.

However, these ethical threats can be overcome more effectively with cooperation from human beings. Next, I discuss three areas wherein the use of technology alone is not sufficient.

IV. Technology Requires Human Intervention

The society still needs people for better judgement concerning ethical accounting issues, specifically in the following three areas: decision-making, accountability, and education.

4.1 Decision-making

I have discussed that the emergence and use of technology broadly influences not just technical processes but also ethical and professional decision-making in the field of accounting. Machine-learned analytics based on big data can rapidly process a massive amount of accounting records and share the data through an automated system. Blockchain techniques can make data alteration and manipulation improbable, if not impossible. However, there also exist ethical problems including data privacy, data security, and abuse of investigative power. Therefore, we suggest developing formal guidelines and codes of ethics and incorporating a final step in the decision rules that can check whether the suggestions made by a machine meet ethical standards.

I also presented the problem of “technological unemployment.” The use of machines, AI, and robotics can diminish the role of humans

to produce and create value-added. The processing of accounting information can be replaced by automated machines. Occupations that require subtle judgment can be automated using computerized systems. In this case, the unbiased decision-making that is based on algorithms can provide a comparative advantage over human beings’ decision-making. However, in the most challenging or critical applications, algorithmic suggestions are best used as inputs or recommendations to human accounting practitioners. Not all decision-making processes can be replaced by machines. Bacani (2017) claimed that “technology will enable full automation, but it cannot substitute for human judgement.” Big data analytics are useful tools that can clean, transform, and model data, as well as discover and communicate useful accounting information; however, they best serve as provider of alternatives and as support for decision-making. AI can be used to review the quality of the work done and to make decisions based on machine learning, but it is not capable of moral considerations or ethical reasoning required by the accounting processes; this makes decisions made by AI ethically deficient and risky. As previously discussed, considering ethical norms and values in the decision-making process is important; however, technology cannot effectively execute decision-making tasks because ‘technology is ethically neutral’ (Brusoni and Vaccaro 2017). Automatic

processing systems can help develop new accounting information systems, but it alone cannot be operated as a decision-making system. As Friedman and Kahn (1992) stated, accounting technology should be viewed as 'decision support tools.'

4.2 Accountability

Making an appropriate decision and being responsible for the decision made are closely related, so these cannot be separated as two different things. If a decision-making process needs human judgement, it is also humans that should take the responsibility for the decision made.

Accountability is related to the 'responsibility gap' previously discussed. Johnson (2015) argued that because certain artificial agents learn as they operate, those who designed or deployed these agents may not be able to control or even predict what their agents will do. Hellström et al. (2013) claimed that humans tend to assign responsibility to computers and robots rather than justify the attribution of responsibility. In other words, 'robots will not be responsible for their own behavior but humans will be inclined to treat robots as if the robots were responsible for their own behavior' (Hellström et al. 2013). Ultimately, human beings are responsible for the behavior of machines. Technology, in the form of an automated accounting system,

cannot take responsibility as it does not suffer any consequences. For instance, in a fraud audit, there is no way to punish an automated accounting system: destroying the machine results in no consequence to the machine, this act is meaningless.

The way for a purely technical machine to incorporate ethical and professional considerations is by including clearly addressed codes of ethical conduct into the system at the point when humans design the system. Humans need to be aware of how technology implements the codes of ethics in decision-making processes and how the machine learns as it implements them, and modify the system as necessary. Human beings bear the responsibility for how the system behaves. This mindset makes it possible to seriously and carefully design the system and address the ethical concerns in the accounting profession.

4.3 Education

Another area where technology requires assistance from humans is education. The importance of ethics education in the accounting profession cannot be overemphasized.

While it is good to be able to make meaningful decisions efficiently using technology, it is difficult for humans to understand and predict the outcomes because new technologies can learn as they operate and take actions on their own. As previously discussed it is a

threat for human beings if we are not able to understand and control algorithms that are significantly advanced by deep learning. Therefore, through educational programs, humans will have opportunities to learn the logic behind the 'behavior' of technological applications. Technicians who design, develop, and modify technology also need to be involved in these educational programs because without domain knowledge about accounting, they will be limited in developing technologies that are useful in the accounting profession. The issue on responsibility due to human being's excessive reliance on technology was previously examined. We need to understand how the system works so that we do not depend entirely on the machines. We need to be prepared for problems that may be caused by system instability such as a shut-down. Even if a system is fully automated, it is still human beings' role to design and maintain an automated system. As such, human beings need education.

The development of automated training programs can present opportunities to learn many real-world examples and practices, and automation of professional training can save time and money required for program development. An automated training program can contribute to the development of sound professional judgement of auditors and accountants. Through programmed instruction materials, trainees can improve awareness about ethical consid-

erations in technical tasks.

AI or technology alone cannot play a role in these three areas and humans should be involved in them. Conversely, it can be said that humans need assistance from technology and technology can support human beings.

V. Five Levels of Accounting Process Automation

I propose five accounting process automation levels as follows.

Level 0 is a stage of "no automation" of the accounting system.

Level 1 is a stage of using computerized systems to merely record accounting information.

Level 2 is a continuous control monitoring stage. At this level, computerized systems are connected within an organization. All the company resources are planned and managed with computerized accounting information system, for example, enterprise resource planning (ERP), and all economic events of a firm are monitored and controlled by an autonomous accounting system.

Level 3 is the stage of continuous data assurance. Assurance service is an independent professional service with the goal of improving information or the context of information so that decision makers can make more informed, and presumably better, decisions. This service

will be provided by an automated accounting system. Continuous audit is possible at this level. However, human beings will still make the decisions.

Level 4 is a stage where an automated system will provide and narrow down suggestions for final decision-making. Most of the accounting information procedures can be done by machine, but the final decision will still be made by human beings.

Level 5 is a stage of full automation of the accounting processes. All accounting information procedures will be fully automated. Technology can even make final decisions requiring no human involvement.

The higher the automation level, the stronger is the intervention of technology and the less is the human being's participation in the decision-making process. At levels 0, 1, and 2, we may not need to seriously consider ethical issues arising from the use of machines because humans have all the controls and means of monitoring. However, as the automation level goes up, considering the ethical impact of technology in accounting gets more critical because a machine learns by itself and technology makes a machine smarter than human beings. At the higher stages, using technology can make better decision than human beings, and will be more strongly involved in decision-making compared to the previous

levels. It is therefore necessary to incorporate ethical standards into utilizing technology at these levels and to collaborate with linkages to the International Ethics Standards Board for Accountants (IESBA). For example, in order to effectively use data analytics in the audit, auditors may be required to have access to and, physically store large amounts of client-sensitive data. Since the IESBA's Code of Ethics for Professional Accountants addresses confidentiality and independence, it may need to interact with IESBA in these areas and to prepare standards that can be met by these ethical codes.

Level 5 is a stage of fully automated accounting information system with no human intervention; however, it is doubtful whether this can actually become a reality. As described above, technology should be used only to provide suggestions for making judgements. It is dangerous for machines to make judgements by themselves for ethical reasons. Final decisions should be made by humans and humans should take responsibility for such decisions. To do this, simultaneous education about ethics and technology is necessary.

Five levels of accounting process automation mentioned in this section are addressed in general terms, not in specific areas of accounting such as auditing,⁹⁾ financial accounting, managerial accounting, and taxation.

9) For example, Dai and Vasarhelyi (2016) distinguish four generations of the audit according to the development of artificial intelligence technology. Traditional manual audits (Audit 1.0) have existed for centuries fulfilling many needs

Further studies on how to apply the automation levels to the detailed areas of accounting will be needed in the future.

VI. Recommendations for Best Practice

This section discusses the cases of other countries (or international) accelerating efforts to implement legal or ethical codes raised with the introduction of new technologies and suggests directions for establishing future codes of ethics and best practice.

IESBA by International Federation of Accountants (IFAC) defines section 140 confidentiality and section 290 independence regarding data analytics. IESBA addresses, even though professional accountants are able to access to the massive amount of client-sensitive data, without adequate and specific approval, legal/professional rights or obligations, confidential information obtained from performing their professional duties should not be disclosed to the third party and should not be used for their own interests.

The assurance framework by IAASB clearly describes the objectives and elements of audit and the audit areas subject to International Standards on Auditing (ISA), International Standards on Review Engagements (ISRE), and International Standards on Assurance Engagements (ISAE). Thus, appropriate ethical standards for audit procedures using new technologies should be established based on these.

Financial Stability Board (FSB, 2017) also presents the issues around data privacy and data protection related to the ability to access the data processed by AI and machine learning. These applications usually depend on access to, and use of, large amounts of data that includes data collection, data compilation and consolidation, data mining, and analytics. The applicability of regulations will be generally fact-driven and jurisdiction-specific. However, certain issues are being commonly evaluated in the context of the use of technology with big data, such as the applicability of data ownership rights and data privacy protections: therefore, ethical standards fit into for data privacy and protection when using technologies

with manual audit tools such as pencils and calculators. Although the IT audit (Audit 2.0) emerged in the 1970s and most all business used computer based software such as Excel and CAAT, only about 15 percent of auditors are IT enabled. Audit 3.0 includes Big Data in audit analytics, and emerges much faster than the previous generations. Korea is considered to be the third generation that utilizing big data as a tool for audit analytics (Cho et al. 2018, p.294). Audit 4.0 is semi- and progressive automation of audit stage. In this stage, sensors, location identifiers (e.g., GPS), individual identification devices (e.g. RFID tags), Cyber Physical System(CPS), and Internet of Things(IoT) will be frequently used as audit tools. "Audit 4.0 will significantly change the auditing profession by automating current procedures, enlarging their scope, shortening time, and eventually improve the overall assurance quality" (Dai and Vasarhelyi 2016, p.2)

should be prepared.

The European Union (EU) recently enacts a General Data Protection Regulation (GDPR). Article 11, which is relevant with respect to the use of AI and machine learning, provides a right to an explanation of the decision reached after algorithmic assessment, and allied articles provide for similar disclosures. Article 9 prohibits the processing of special (or sensitive) categories of personal data. Another key article relating to new technologies is Article 22, which provides for a data subject's qualified right not to be subject to a decision with legal or significant consequences based solely on automated processing. Article 24 provides that decisions shall not be based on special categories of personal data.

There are a number of initiatives to further research on machine ethics and the ethical use of technology. For example, a group of large tech firms including Amazon, Google, and Microsoft, founded the 'Partnership on Artificial Intelligence', which aims to develop and share best practices on AI (FSB 2017, p.39.) Big audit firms such as Deloitte (Deloitte, 2016) and PriceWaterhousCooper (PWC, 2016) also publish ethical issues considered using technologies. IESBA, IAASB, and IFAC have been developing and promoting the code of ethics for professional accountants. Human auditors with this code of ethics should supervise the behavior of machine, intervene, and make a final decision. The best practice recom-

mended is using a human-centered approach.

Not all of these codes of ethics may be addressed specifically and in detail in Korea yet. Korea is currently in the stage of utilizing big data to audit analytics and accounting professions in Korea generally and implicitly follow the basic codes of ethics required by IESBA including confidentiality and independence.

While there are so many areas of ethical concerns regarding new technologies, the specific ethical code of conducts - how to apply ethical principles and what level of behaviors should be applied to - still remain arbitrary. Moreover, infrastructure and the level of technology advancement are different across countries and there exist differences between big firms and small local firms. In addition, if auditors or regulatory institutions lack domain knowledge in IT technologies - big data analytics, artificial intelligence, blockchains and so on -, it may ends up with decrease in audit quality and audit failure. Therefore, these issues should be considered when establishing the ethical code of conduct, and defining and providing the detailed and specific code of ethics in accounting areas remains for future research.

VII. Conclusion

I discussed the benefits of the adoption of

new technologies in the accounting field. Due to the use of new technologies, massive amounts of data can be processed at a high speed, almost instantly, and accounting transparency can be achieved. Unethical behaviors related to moral hazard can be reduced as well. I also addressed the threats caused by the use of new technologies. These include the loss of jobs, infringement on data privacy, and responsibility issues. To minimize these threats, I suggested that human intervention is necessary. The role of human beings in the use of technology should be emphasized. For example, humans should develop advanced mechanisms that can deal with potential ethical dilemmas and incorporate these into the technology-based accounting information system. The more important question is probably how we use 'human beings' than how we use 'technology' in the future, which is expected to be a technology-based society.

Why is it necessary to examine ethics in relation to machines? Perhaps it is not necessary to think about the ethics of technology because technology provides numerous benefits and yet does not need to be ethical itself in order to provide these benefits. It is not the machines but us, human beings that need to be ethical because it is human beings who need to design, implement, and operate the technology. Only human beings can make judgement and take responsibility. Marshall

(1999) proposed the definition of ethics as follows: 'ethics are guidelines to influence human social behavior in a manner intended to protect and fulfill the rights of individuals in a society.' Machine is 'ethically neutral,' so it does not understand 'human social behavior.' It can only suggest ethical behavior but cannot make ethical judgement. Although machines' intelligence is expected to be dramatically and rapidly improved, machines cannot replace human beings. Human beings alone can make moral decisions, and only human beings can be held responsible for their actions.

How would life and society change with the worldwide use of technology? Not only AI experts but also lawyers and philosophers are examining the anticipated changes and resulting risks and ethical issues brought about by new technology. In order for the use of technology to be beneficial to the future of mankind, it is necessary to hear opinions from various stakeholders. The introduction of technologies can be of great help in the accounting field. Therefore, it is essential to discuss what the advantages and disadvantages are, how to benefit from the opportunities, and what to do to minimize the related risks and threats. It is recommended that studies in these areas continue in the future.

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새로운 테크놀로지가 회계 윤리에 미치는 영향: 기회와 위협, 윤리적 이슈를 중심으로

윤소라*

요 약

본 연구에서는 회계분야에서, 새로운 테크놀로지의 출현으로 인해 얻을 수 있는 장점들을 - 특히, 인공지능, 빅 데이터 분석과 블록체인을 중심으로 서술한다. 인공지능 기술은 자동화를 가속화하여 방대한 양의 데이터를 처리하는데 도움을 줄 수 있으므로 회계 프로세스를 운영하는 시간을 단축시키고 회계정보의 품질과 목적적합성을 향상시킬 수 있을 것이라고 기대된다. 기존의 감사시장에서는 일련에 일어나는 모든 비즈니스 거래 중 극히 일부의 샘플을 취하여 감사하는 환경이었다면 새로운 기술의 출현으로 인해 이제는 모든 거래의 전수 조사가 가능하게 되었고 또한 상시감사체계의 구현으로 새로운 거래가 추가되면 해당 거래를 포함하여 감사 결과를 즉시 재무제표에 반영하는 것이 가능하게 되었다. 또한, 블록체인 기술을 활용하면 보다 강력한 내부통제시스템을 구축할 수 있으며, 분식회계나 재무제표의 조작(manipulation)이 점차적으로 불가능해지므로, 그 결과 회계의 투명성은 더욱 높아질 것이다. 또한, 이러한 기술을 활용하여 회계분야에서 대두될 수 있는 인간의 비윤리적인 문제들 - 도덕적 해이, 대리인 문제, 예산 슬랙(slack), 가 참여(pseudo-participation) 등등 - 도 최소화 할 수 있으리라 예상된다.

그러나, 이러한 신기술의 출현은 회계분야에 위협적인 요소들도 가져 올 것으로 예상되는데, 테크놀로지로 대체될 수 있는 일자리 상실 이라든가, 고용 문제, 그리고 데이터 프라이버시에 대한 문제점들이 존재할 수 있다. 더욱 위협적일 수 있는 문제는 회계정보를 처리하는 AI 알고리즘의 소유주가 누구냐에 따라 적합한 의사결정이 달라질 수 있는 점이다. 회계정보시스템에 사용되는 새로운 기술은 기업의 소유인가, 회계감사인 소유인가, 그렇다면 기업의 이익을 최우선으로 할 것인가, 아니면 외부감사인, 이해관계자, 혹은 그 밖의 불특정 다수의 일반인들에게 가장 유익한 의사결정을 해야 할 것인가, 누구에게 최적화된 의사결정을 내려야 하는가 등은 이러한 새로운 기술을 개발하는 단계에서부터 반드시 선행되어 고려해야 하는 문제들일 것이다. 뿐만 아니라, 이러한 신기술을 활용하여 내려진 의사결정에 대한 책임의 문제도 반드시 명확하게 규명되어야 한다. 그러므로, 이러한 윤리적인 문제들을 극복하기 위해서는 신기술의 개발 및 활용의 전 단계에 걸쳐 윤

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리강령을 명확히 하고, 개발, 활용 및 리뷰프로세스에서 인간의 개입이 반드시 적극적으로 이루어져야 하며, 특히 의사결정(decision-making), 책임(accountability), 교육(education)의 세가지 분야에서는 기술(technology)보다는 인간(human beings)이 핵심적인 역할을 수행하며 인간을 중심으로 이루어져야 하는 분야라고 할 것이다.

본 연구는 회계분야에서 이러한 새로운 기술을 활용하여 얻을 수 있는 여러가지 이점들을 이해하는데 도움이 되는 동시에, 반드시 고려되어야 하는 윤리적인 문제들을 기술함으로써 이미 도래한 4차산업혁명 시대에 신기술을 십분 활용하고 윤리적 문제점들을 극복할 수 있는 방안을 모색하는 계기를 제공하는데 의의가 있다고 하겠다.

주제어: 회계 윤리, 회계 기술, 인공지능, 빅 데이터 분석, 블록체인

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- 저자 윤소라는 현재 아주대학교 경영학과 회계 전공 부교수로 재직 중이다. 미국 오�클라호마 주립대학(OSU)에서 경영학 박사를 취득한 후 아주대학교로 부임하여 재무회계와 관리회계를 주로 가르치고 있다. 2015년에는 캘리포니아 주립대학의 연구교수로 재직한 바 있으며, 주요연구분야는 accounting education, technology and transformation of accounting, R&D accounting 등이다.