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How would the emerging technology affect the future of auditing?

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1. Abstract

In the 21st century, new technologies, such as Big Data, Robotic Process Automation, Artificial Intelligence, and Blockchain, has transformed the way we live and work. The ideas of several emerging technologies such as Artificial Intelligence, Big Data, and Blockchain were conceptualized, introduced, or popularized in 1900 (McCorduck, P., 2004), 1990 (Lohr, 2013), and 2008 (Narayanan, A., Bonneau, J., Felten, E. W., Miller, A., Goldfeder, S., & Clark, J., 2016) respectively.

Although there is also the elements that remain unchanged when time goes by (Bednarek, 2018), the emerging technology is virtually disrupting every existing industry, which overturns and changes the business models. Accounting and auditing industry will definitely face plenty of changes under the emergence of new technologies.

In this study, several new technologies affecting audit industry will be introduced, followed by the impact of such emerging technologies on audit procedure, and necessary constructive actions that can be taken by both industry and accounting students.

2. Emerging technology applied in the accounting industry

2.1. Big Data

Big Data refers to immense volumes of data that cannot be effectively processed with traditional applications (Giovannini, C., 2018). In consequence of the widespread mobile device adoption and internet of things, the amount of data created on a daily basis is growing exponentially, approximately 2.5 quintillion ($10^{18}$) bytes of data are generated in miscellaneous forms every day (Chua, F., 2013).

Better decisions and competitive advantage can be achieved by analyzing big data as it contains various useful information. It can be used to improve the understanding of market conditions, increase business effectiveness and efficiency, and help small business to compete with larger organizations.

For instance, PwC uses their big data analysis tool, Halo, to evaluate an entire population of transactions. It can process the characteristics of millions of entries within seconds, then it can be used to visualize the data by supplier, transaction date or amount. This increases the probability of an auditor spotting suspicious items or trends and provides more assurance while taking less time and human effort.

2.2. Robotic Process Automation (RPA)

Robotic Process Automation (RPA) can be applied for the automation of rule-based tasks with clear-defined rules and parameters, such as journal posting, ratio calculation, voucher documentation and confirmation, so that routine activities can be performed 24/7 without the office-hour constraint and experiencing diminishing efficiency and human involvement. For example, EY has introduced using bots to perform these low-end tasks such sending bank confirmations and finding journal entries that do not balance.

2.3. Artificial Intelligence (AI)

AI enables machines to perform cognitive tasks like a human such as problem-solving and identification. There are a few functions such as natural language, voice, and gesture recognition and processing. Auditors can use to review financial information, analyse financial ratios and identify trend from the figures, with a low margin for error and increasing efficiency.

Similar with RPA, AI can be used to perform routine task but also with analytical function. For example, PwC is using AI to scan through 100 pages of contracts in seconds, on the basis of its knowledge of various legal terms and phrases, it can extract key information and produce a summary, which originally takes at least 4 hours for a human auditor.
2.4. Machine Learning (ML) and Deep Learning (DL)

It is a form of AI that can be trained to recognize patterns in mass volumes of data, especially unstructured data such as social media, emails and conference call recordings (EY, 2015). The problems will be “learned” by the machine and applied the learning to the next set of data. After the audit engagement team's decision about the anomaly, the result is then "taught" and fed back to the machine the way to respond to similar relationships in the future. And the more the “learning process” is carried out, the better the machine will be able to spot real anomalies (CPAJournal, 2017).

Deep learning is part of a broader family of machine learning methods. The differences compared with Machine Learning are that deep learning can process a larger amount of data at the same time, and the use of neural networks as a learning model which increases the relationship complicity and layers of data.

2.5. Blockchain / distributed ledger technologies

Blockchain provides an open and decentralized database of every transaction involving value, such as money, goods, property, work, and even votes (Morabito, 2017). Information is stored in batches (blocks), that are linked together in a chronological order to form a continuous line (chain). When the blockchain is being edited, a record will be left and verification is needed by the entire community.

As every transaction will be recorded on a public and distributed ledger, blockchain acts as a global decentralized source of trust. In other words, the level of security is high that it can be used to store financial information. In auditing practice, PwC and EY have introduced blockchain auditing to enhance the ability to perform an in-depth review of cryptocurrency business transactions as well as validating data in blockchain.

3. Impact of emerging technology on audit

3.1. Benefits in audit procedure

3.1.1. Client acceptance / continuance

**Understand client business and industry enviornment - Textual analysis**

Before accepting prospective clients or retaining continuing clients, it is necessary to go through their financial information. However, these processes are repetitive and time-consuming, automation in these areas can release workforce, thus increase the audit effectiveness (CPA Journal, 2017).

Textual analysis can be applied to documents such as transcripts of conference calls, press releases, management discussion and analysis (MD&A) and business contracts. These kinds of textual data can provide various information based on their nature once they are processed. For example, textual analysis can extract management’s perspective on the financial situation of the company from MD&A.

This automation is achieved through deep learning, it converts qualitative information to quantitative data through the algorithms that are capable of identifying concepts or sentiments such as positive or negative opinions and a wide range of emotions. Therefore, text analysis performs the tasks that traditionally requires human effort and also speeds up the process.
Making inquiry with related parties - Speech recognition

Auditors need to make inquiries from related parties including the management, internal auditors, employees, predecessor auditors, banks, lawyers and investors. Apart from letter inquiries, auditor might conduct verbal interview such as phone inquiry. However, human even with proper training such as deception detection cannot process the entire verbal information efficiently, as there are myriad verbal behaviors and it is not efficient for auditors to analyze all oral responses.

With speech recognition from AI technology, computers can sensitively recognise the keywords of messages and try to interpret the meaning of them. For example, there would be wordings such as “kind of,” “maybe,” or “sort of,” inside a sentence. Auditors might not be aware of this words and consider them as a normal expression in social occasion. However, these words which infiltrate uncertainty might be an indicator, a signal of concealment or falsification (Pickard, Burns and Moffitt, 2013). Through recognising the speech, computers will remind the auditors to have further considerations and investigations on clients if there is any suspicious activity intentionally concealed by them.

As a result, AI acts as a predictor of fraud and indicate unusual activities in clients’ company. Auditors may then carry out suitable engagement actions in order to ensure the financial information is reasonably free from mistakes. Their work might expand from historical analysis to provide advice to client on internal control system and safeguard on company’s asset. The “experience” can be accumulated for future clients and cases through Machine Learning.

In addition, AI is able to keep a record of messages as reference provided to auditor for future use. A comprehensive datafile of speech documentation could benefit auditors that such a large volume of data will not be messed up. (Pickard, M. D., Burns, M. B., & Moffitt, K. C., 2013). It will bring convenience to auditor so as to avoid conducting repetitive inquiries during the completion of auditing work.

3.1.2. Preliminary engagement activities

Emerging technology changed the audit engagement team requirements, which now includes background in information and technology.

With the advancement and increasing application of new technologies in auditing process, accounting firms need to look for people versed in data analytics or computer science. In 2016, EY hired more data scientists than Google, in order to accommodate new technologies that reshaped the environment of auditing (Murphy, H., 2017).

3.1.3. Plan the audit

There is an impact on the timing of audit. Thanks to the emerging technology, audit work is able to be conducted earlier, or even may have real-time audit in the future.

Historically, substantive procedures are carried out after the year-end. For example, to validate the account balance, auditors obtain the underlying details from the client and then select and analyze a sample; Now, auditors can begin gathering data for audit earlier in the audit process, and hence the audit scoping, risk assessment and planning are influenced by the data analysis. For instance, analyzing the details of a loan portfolio in advance by applying collective quantitative expertise specialized in finance, risk management and IT (EY, 2015), which can help auditors to better assess the risk profile of that portfolio. It enhances auditor’s effectiveness by enabling them to focus their resources on high-risk items and the areas where more judgment is required.

As a result, audit work may be no longer a prolonged "look back" requiring large teams of auditors and long working hours after the year-end.
3.1.4. Audit business processes and related accounts
One of the main issues with sampling is cost-effectiveness. AI has far outweighed the processing ability compared to human beings. For example, AI can read a 100-page document within seconds, while a fast-reader needs at least 4 hours (Lord, 2017). Without the assistance from technology, full audit of company’s financial information was more likely to be a non-achievable objective.

Reperformance of stock-taking
Technology will make reperformance of stocktaking become more efficient. According to Murphy (2017), auditor can identify the inventory (e.g., its quantity and condition) by flying a drone to client’s warehouse. With high quality images of comprehensive information of inventory, auditors can explore and access the physical state of inventory without real travelling between sites (Lord, 2017). Therefore, the time and human effort allocated to stock-taking process can be shortened efficiently.

Audit Sampling
There is an essential issue of sampling risk that the auditor fails to choose the misstated sample, which may make the auditor gives an inappropriate audit opinion of whether the client’s financial reports is fairly stated. By making use of AI, the sampling risk can be lowered due to the ability to discover default samples and outliers among the population of particular financial information. A full population analysis can be conducted by the AI (EY, 2018) to identify outliers or transactions that fall outside expectations of the entire population that the auditors can carry out further investigation, resulting in a lower sampling risk compared to the traditional sampling method.

In addition, human error can be minimized. Presently, sampling activities such as sending confirmations and vouching are done by human, which might lead to human error, especially for clients that have tons of documents for auditors to review. Yet, AI can possibly go through documents without making any mistake and scan through numerous documents expeditiously. In addition, it might also contain a function that can highlight all the suspicious misstatements. As a result, auditors in the future may be able to take samples that are very close to the population size and spend more time investigating the origins of the misstatements.

Audit Confirmation
Instead of manually preparing confirmation letters, putting into envelopes, sending out, waiting for a long time for reply and spending time to remind for the replies, RPA can be used by auditors to send out confirmations (Huang, F., & Vasarhelyi, M., n.d.).

Taking accounts receivables and payable as an example, not only time can be saved by letting the computers to send the confirmation letters but also the entire population of debtors and creditors can be assessed by sending confirmation letters to all of them.

In addition, RPA in some countries can also help verifying the authenticity of the responding party when sending confirmations, which minimizes the audit confirmation risk (AICPA, n.d.)

3.1.5. Completing the audit
The emerging technology can help with the contingency part during the final stage of audit, which involves a large amount of reviews and inspections of documents such as minutes of directors’ and board meetings, lease agreements and legal letters. With AI, it can scan through all documents during the subsequent-event period and hence notifies auditors about potential contingency right after the information is released and make proper modification in disclosure or audit opinion. The schedule of proposed adjusting entries can also be prepared by Robotic Process Automation (RPA).
After that, for final analytical procedures, auditors have to assess the structure and profitability, and how the client performed when comparing to its industry by calculating ratios again based on the audited financial statements. As such, auditors can use machine to find and generate a peer group of the client's company, then calculate the ratios from client’s F/S and its peer group F/S to see if there is still any major difference between the client and the industry after audit adjustment (PwC, 2017).

3.2. Challenges to audit industry in general

Data Governance and Return On Investment

Big Data is penetrating across all other kinds of emerging technologies we mentioned. However, the vast majority of Big Data is semi-structured and unstructured, which requires labeling, categorizing, and validating by human in the incubation stage of Artificial Intelligence and Machine Learning (CPA Journal, 2017). Therefore, it requires data mining and interpretation skills, with a prerequisite of having a clear objective when analyzing the data. Although companies may have the ability to acquire a huge volume data with high potential value, an ineffective governance and low quality give rise to a return-on-investment (ROI) issue.

Cyber Security

Technology brings countless positive impacts on audit procedure but simultaneously makes it vulnerable. With the use of emerging technologies, auditors need to put data into the analytic server (such as Halo and Aura from PwC) and access to the data from the centralized server from time to time. Due to the fact that auditors connect to the servers through the internet, and the data has substantial value (Akred, J., & Samani, A., 2018) that attracts cyber criminals to hack. According to Goodman (2015), there are over 200,000 types of new malware emerging every day. At the same time, only 5% of the total number of type of computer virus can be detected by normal household anti-virus software. Commercial software might perform greater degree of protection compared to the households, however, it is yet insufficient to react to emerging cyber attack. Goodman (2015) also suggested that there is an incubation period of 210 days in average which implies that the criminals can exploit this period to commit fraud before being detected by the security system of the company. Insufficient cyber security might give rise to the violation of the confidentiality principle as auditors should always respect the confidentiality of information acquired from all business relationship and not disclosing them without proper authorization. Therefore, auditors should evaluate their cyber security thoroughly before full deployment.

Further Dominance of the Big 4

New technology is also expensive to implement. With huge amount of income from multi-discipline every year, Big 4 is surely easier to implement the latest technology into their daily operations. To that end, Big 4 firms can enjoy the first-mover advantage of adopting technology which will result in a further dominating situation in the accounting industry. This may weaken the competitiveness of small and medium accounting firms, and in long run, auditors using AI will eventually replace those who do not (John Bednerek, 2018). In addition, the increase in capacities of each Big 4 firm will enable them to serve more clients as certain tasks will be replaced by automation. As a result, they might be auditing the whole supply chain of certain industries in the future. The worsened dominance may also create threat to independence.

Dilemma: Professional Judgement or Software?

Another question is to determine the degree of reliance on AI. For example, when doing substantive tests, in certain circumstances auditors need to decide whether to use their professional human judgement to select samples with intervals or rely on the sample suggested by AI. Yet, there is currently no regulation nor guideline for auditors to make such decision. Hence, this may deter auditors from adopting new technology as auditors might have to bear legal responsibilities if the result of AI goes wrong.
Managing Expectations: Widened Expectation Gap

Auditors have limited clearly-defined responsibilities of limited assurance. However, according to Chartered Accountants Ireland (2017), “public reaction to high profile corporate fraud shows that expectations of auditors extend beyond this”. When accounting firms such as the big 4 possess emerging technologies, clients may expect higher value-added services beyond the limited assurance, such as providing insights and advice. Therefore, auditors have to consider whether or not to work only according to the minimum standard stated in the HKAS or to do their best in order to meet the competence and due care principle and get client’s satisfaction, at the same time consider the possibility of self-review threat.

4. Adaptation: Audit industry and university students

4.1 Audit industry

Both market-leading and small accounting firms should focus on implementing new technology into their operations and nurturing the new generation of professional accountant.

For implementation of new technology, in the short run, firms might consider deploying robotic process automation (RPA) to simple, repetitive auditing process such as sending confirmations since it does not require a lot of planning. Therefore, top management of the accounting firms can use it as a test run to evaluate the effectiveness and feasibility of a full-scale implementation of new technology. In the long run, artificial intelligence, machine learning and big data analytics should be implemented to further reduce the workload of auditors. To that end, auditors can emphasize more on analyzing results and make better professional judgements.

Transformation of the audit by using technology cannot be accomplished without the right talent. For existing staff, accounting firms should expand existing training to audit analytics and the use of emerging technologies in audit. HKICPA should also take a leading role in promoting the use of new technology in auditing process by embedding them into the continuing professional education (CPE), in order to give accountants and the industry more insightful ideas about the utilization of new technology in the field.

On the other hand, for future talents, in order to equip accounting students with the skills needed to transform from the campus to the workplace and suits the recent development of the accounting industry, senior managers or partners can exchange ideas with university professors to develop an up-to-date and better teaching curriculum for accounting students, as well as establishing technology apprenticeship programme for universities students.

4.2 University students

The key to success for accounting students in the 21st century is to go beyond accounting and auditing knowledge, from technological and analytical aspects.

Technological aspect - three-stages: acquisition, participation and evaluation

During the acquisition stage, students should grasp every opportunity to learn about the most updated technology which is related to the accounting industry. Seminars organized by schools and HKICPA, mentoring programmes with practitioners, and even YouTube videos are some good ways for accounting students to start learning the relationship between new technology and their future career.

Once they have obtained fundamental understanding of the emerging technology, students can participate in various forums and competitions to apply those knowledges into real-life practice. By participating in different activities, students are able to share and exchange ideas with one another. Better still, students can receive advice from practitioners and experts.
Finally, for evaluation, as time goes on, students should keep tracking on the latest technology that has significant impacts on the accounting industry.

Analytical aspect - skills
On the other hand, advanced analytical skills are crucial for future accountant. Since technology will replace most of the repetitive work in the future, students should not only focus on memorizing the core accounting rules. On top of that, they should start developing professional skepticism such as critical thinking and analytical skills so as to work with emerging technologies in new ways. There are many simple ways to develop one’s critical thinking skill and as a student, they can always develop it by questioning basic assumptions that they learnt in school.

5. Conclusion
In the digital era, it is inevitable that the world is continually being reshaped by advanced technologies, and the emergence of technologies in the auditing industry discussed in this study is a worldwide trend.

Despite the positive impact they pose to the audit procedure as we discussed, at the same time, emerging technologies can also be a double-edged sword that accounting firms should take the potential challenges into account, so as to obtain the optimal benefit of reduction of overall audit risk and audit engagement as well as the increased level of assurance.

In this transformative age, in order to avoid being replaced by the technology, current accountants will need to re-skill by continuously obtain knowledge about the ever-changing technology to retain their role as the gatekeeper of corporate data.

As accounting students at the moment, we should start to immerse in the technological world to equip ourselves with the right mindset.
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