Artificial Intelligence Technologies with Implications for Assurance Services

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AI technologies are being widely explored and adopted by entities to enhance their customer services, internal processes or production processes. CPAs may encounter these technologies in their workplaces or when providing advisory services or assurance services. This article describes some of the results of research we conducted to identify assurance-related technologies and tools such as those related to AI.[2] The research consisted of two main phases: 1) an information search aimed at identifying assurance-related information technologies and tools (T&Ts) and 2) a survey of practitioners to determine their familiarity with those tools and the impact of those T&Ts on service-related activities.

The information search consisted of three main elements. The first element was a search of accounting firm websites. This was followed by a search for information on other websites, identified through Google searches using a variety of assurance-related search terms. These searches were supplemented by a search of recent literature on Google Scholar, Social Science Research Network (SSRN) and the American Accounting Association's (AAA) digital library.

The search identified 37 organizational technologies for enhancing and analyzing business processes that could be subjects of assurance service or tools that could affect how assurance services are conducted. This article focuses on the AI-related T&Ts that could be subjects of such assurance services and tools. It summarizes some of the information reported in more detail in Boritz et al. (2023).[3]

The AI-related technologies identified by the searches include AI algorithms and machine learning (AI/ML), computer vision/image processing/facial recognition, natural language processing (NLP)/speech-text software, interactive conversation systems/chatbots,

[1] This article is based on research conducted by the team listed in the next footnote.

[2] Boritz, J.E., T. Bauer, K. Fiolleau, B. Pomeroy, A. Vitalis and P. Wang, *Cataloguing Assurance Related Technologies and Tools* (University of Waterloo, Working Paper) April 2023.

[3] *Ibid.*

virtual/augmented reality, automated self-assessment checklists, network platforms and social networks.[4]

The second part of the research involved a survey of CPAs to determine their familiarity with these T&T's and their assessment of the impact of these T&Ts on: a) identifying, collecting, and/or preparing data, b) analyzing data, c) assessing risks, d) obtaining an understanding of an organization's systems, processes and controls and evaluating their effectiveness (e.g., compliance with specifications and requirements) or e) obtaining and understanding of and evaluating transactions, amounts, activities, assertions, KPIs, etc. Respondents were also asked for their views about the general impact of technology on the accounting profession and which T&Ts they would be interested in learning more about.

In the balance of this article, I describe the AI-related T&Ts identified and some of the survey findings.

AI Technologies That Affect Organizational Performance and Risk

Network platforms such as Google, Uber and Airbnb, and social networks such as Facebook, Twitter, Reddit and others, gather enormous amounts of structured and unstructured data and have access to virtually unlimited computing power.[5] They not only require the use of AI technologies such a machine learning to manage the flows of information through their networks but also provide an ideal context for the development of powerful AI tools based on applications of machine learning techniques.

Because of the impact of network platforms on society across the globe,[6] there is interest in auditing the AI algorithms that the networks use.[7] For example, the Web Transparency & Accountability Project at Princeton University[8] creates online software robots that masquerade as various types of people with mental health issues in order to study the treatment received by these software robots, ranging from search results delivered by search engines to job placement responses. Similar initiatives are reportedly being undertaken at universities like Carnegie Mellon and MIT (O'Neill 2016).[9]

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[4] Robotic process automation (RPA) is included among the 37 T&Ts identified, but is excluded in this article because it is not an AI, but rather, is an algorithm-guided mechanism designed to connect and automate various processes. Like many other of the technologies identified (e.g., drones, internet of things, etc.), RPA can be enhanced through the use of AI, but doesn't require it. In contrast, network platforms such as Google and social networks such as Facebook are included in this article because, at their present scale, they require the use of AI/ML to make them operational.

[5] I make a distinction between network platforms and social networks. Network platforms connect buyers and sellers of products, services or information (e.g., Google connects users who are basically sellers of access to them based on their search requests with advertisers who are buyers of access to categories of search requesters, Uber and Airbnb connect buyers of transportation or accommodation services with suppliers of such services). In contrast, social networks connect users interested in communicating, sharing information and interacting.

[6] Kissinger, H.A., E. Schmidt and D. Huttenlocher. 2021. *The Age of AI And Our Human Future*. 2021). New York: Little, Brown and Company.

[7] Governments Should Independently Audit AI Tools For Fairness: Analytics Expert (iapa.org.au).

[8] https://webtap.princeton.edu/.

[9] O'Neil, C. 2016.Weapons of MATH Destruction. New York: Crown.

AI algorithms based on machine learning may require the use of AI tools, such as those commonly used in software quality assurance (Ramchand et al., 2021).[10] In fact, it may be impossible to test such algorithms without using AI tools (see Algorithm Assurance | Deloitte Malta). For example, Certified Artificial will independently verify that products and services offered by an entity are using AI technologies and issue an embedded digital certificate to that effect (see Certified Artificial).

The World Economic Forum (WEF), AI Global and the Schwartz Reisman Institute for Technology and Society (SRI) at the University of Toronto have announced the launch of a working group to lead the development of a globally recognized certification program for the responsible and trusted use of algorithmic decisioning and AI systems (see U of T's Schwartz Reisman Institute and AI Global to develop global certification mark for trustworthy AI (utoronto.ca)). Although certification is not the same as assurance as defined by the accounting profession, it has many similar elements, the most important being the provision of confidence about the trustworthiness of a subject matter by an independent party. The ability to explain the workings of an AI algorithm is crucial to justifying its trustworthiness. Zhang, Cho and Vasarhelyi (2022) provide a case study of the application of explainability to AI algorithms (XAI).[11]

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Computer vision/image processing/facial recognition is a subset of AI. Its purpose is to enable image processing devices to recognize objects, people and activities. It can be used for quality control in production, to recognize and record visual data and convert it into other data formats. For example, it can count objects and record the counts in a spreadsheet or database. Image processing can also be used for monitoring physical access security and continual surveillance of diverse types of locations by recognizing movement of equipment and people. Facial recognition can also be combined with chatbots to improve communications and to assess social interactions through the analysis of facial expressions. Facial recognition can be combined with eye tracking to understand human information processing behaviour, including what information is attended to during conversations or analytical processing. A major risk with image processing is, however, the creation of mis-information through the generation of erroneously or intentionally false images ("deepfakes").[12]

Natural language processing (NLP) is part of the AI domain that deals with communication between humans and computers. NLP includes text processing, voice processing and machine

[10] Ramchand S., Shaikh S., Alam I. (2022) Role of Artificial Intelligence in Software Quality Assurance. In: Arai K. (eds) Intelligent Systems and Applications. IntelliSys 2021. Lecture Notes in Networks and Systems, vol 295. Springer, Cham. https://doi.org/10.1007/978-3-030-82196-8_10.

[11] Zhang, A.C., S. Cho and M. Vasarhelyi, "Explainable Artificial Intelligence (XAI) in Auditing" (*International Journal of Accounting Information Systems*, August 1,2022). Available at SSRN: https://ssrn.com/abstract=3981918 or http://dx.doi.org/10.2139/ssrn.3981918.

[12] Researchers can now use AI and a photo to make fake videos of anyone | CNN Business.

learning and is applied in speech to text, text to speech, interactive conversation systems/chatbots, language translation, etc. NLP is suited to the analysis of unstructured textual information, which is said to make up 80% of data. NLP can be used to extract knowledge from unstructured texts, emails, records and files for evidential purposes, or to codify knowledge contained in historical records or to identify potential improvements in the understandability and informativeness of reports, filings and disclosures. NLP applications such as Kira Systems and Blue J Legal can be used for parsing contracts and other textual presentations of company information, saving time and improving accuracy of textual analyses (Agrawal et al. 2019).[13]

Interactive conversation systems (i.e., chatbots) have been in the spotlight with the introduction of ChatGPT in late 2022 by OpenAI, called a "landmark event" by the Canadian Broadcasting Service.[14] Chatbots have, however, been used by business entities in customer facing applications to provide services and support for some time. Effective chatbots increase operational efficiency, improve quality of service and enhance associated analytics.

Chatbots combined with facial recognition can also be used to control access to assets. For example, chatbots can be used to screen employees or other individuals seeking access to restricted physical facilities by combining biometric characteristics of the individual using facial recognition with information possessed by the individual by asking them questions that verify their identity. Chatbots combined with cognitive processing can be used to make judgments and arrive at conclusions based on their conversations with humans. For example, chatbots can be used to anonymously interview whistle blowers to encourage reporting of misdeeds while screening out frivolous or malicious reports. They can also be used for training purposes and there is ongoing research into the requirements and issues related to such uses. One of the worrying risks associated with chatbots is the creation of false information such as blogs, news reports and essays that are purported to be original works created by people.

Virtual reality (VR), augmented reality (AR) and mixed reality (MR) devices in the form of headsets, glasses, and even phones create visual environments that users can immerse themselves in to experience and interact with. Virtual reality refers to immersive visual environments. Augmented reality refers to physical environments that are augmented by virtual additions.

For example, Microsoft's HoloLens is an augmented reality headset that projects computer-generated images and tools onto a visor in front of the user's eyes. To the user, these images appear as holograms existing as part of the surrounding world. The holograms adapt to the environment while interacting and functioning with the user's eye and hand movements. Mixed reality is the integration of physical and virtual realities. For example, a camera at a remote site transmits images to the headset of the individual wearing it who then can interact with the remote environment in real time (see 1388-Texto do artigo-2520-1-10-20170315 (3).pdf). These

[13]Agrawal, A., J.S. Gans and A.Goldfarb. 2019. Artificial Intelligence: The Ambiguous Labor Market Impact of Automating Prediction. *Journal of Economic Perspectives* 33 (2): 31-50.

[14] ChatGPT a 'landmark event' for AI, but what does it mean for the future of human labour and disinformation? | CBC Radio.

interactions can be used to assess operations and controls at remote environments and for training purposes.

Automated checklists can automate repetitious completion of checklists to provide real time reports on the status of various risks and controls. When combined with AI-based tools and techniques, smart checklists can fill themselves out to expand the power and reduce the cost of monitoring and compliance checking of procedures and controls.

Our research identified companies offering smart checklists and self-assessment tools in several areas, including ones for use in connection with reporting on service organization controls (SOC) as well as reporting on ESG related processes and controls. For example, the Vanta platform offers tools for gathering data for a readiness assessment for SOC 2 engagements.[15] Sustainability Advantage offers a "Comprehensive, generic, sustainability self-assessment tool [that] can be used by any-size organization, in any sector, in any country."[16]

When applied to data networks, these tools can lead to more efficient and effective control testing.

AI Technologies that Affect How Assurance Services Are Conducted

The T&Ts discussed in the previous section not only affect organizational processes, but may also affect how assurance services are conducted. AI algorithms based on machine learning and neural networks can be used to monitor, analyze and evaluate systems/and processes. AI Algorithms can also be used to understand and evaluate the AI algorithms used by organizations to generate data. Through the addition of intelligence to continuous control monitoring (CCM), continuous auditing and process mining, AI algorithms can enhance continuous learning about system behaviour from the data processed by the system. When applied to data networks, such tools can lead to more efficient and effective control testing. AI algorithms based on machine learning can be used to understand and evaluate transactions and balances by relating them to other data recorded in internal data bases and external networks.

Audit firms are reportedly using image processing to scan documents such as invoices to extract key data from them as part of their audit procedures.[17]

As mentioned previously, NLP can be used for parsing various textual presentations of company information such as contracts, policies, disclosures, reports and regulatory filings. By combining with RPA, NLP can perform repetitive tasks to analyze documents to draw conclusions about risks, controls, evidence, etc., to identify inaccurate or misleading information. Auditors are reportedly using NLP for textual analysis of contracts, leases, mortgages and other documents to identify exceptions for human review.[18]

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[15] Automate security and compliance, starting with SOC 2 (vanta.com).
[16] Assessment Tools | Sustainability Advantage.
[17] Almufadda, G. and N. A. Almezeini. 2022. Artificial Intelligence Applications in the Auditing Profession: A Literature Review. Journal of Emerging Technologies in Accounting 19 (2): 29-42.
[18] *Ibid*.

Interactive conversation systems/chatbots can be used to gather data for control and audit purposes. For example, they can be used to "interview" operational staff periodically to obtain answers to internal control questionnaires. They can also be used to gather recurring data for spreadsheets and databases.[19]

Chatbots can be combined with facial recognition to enhance the communication between audit team members and the chatbot as a way of co-ordinating, centralizing and recording audit related communications. Chatbots combined with cognitive processing can be used to make judgments and arrive at conclusions based on their data bases and conversations with humans. For example, chatbots can be used to guide an auditor's assessment of management's estimates and to interview assurance service personnel as part of the review process. As noted in the discussion of organizational technologies, chatbots can also be used for training purposes and there is ongoing research into the requirements and issues related to such uses.

VR can be used for remote auditing; for example, it can be used for inventory observation (Smart Glasses Wearable Headsets Enhance Audit Quality - KPMG United States (home.kpmg) and plant inspections when biohazards are an issue (https://www.thepigsite.com/articles/eyesucceed-wearable-technology-and-augmented-reality). Thus, virtual/augmented reality can be used to review and evaluate processes, related risks and controls.

As discussed previously, automated (smart) checklists can automate repetitious completion of checklists to provide procedural guidance to assurance providers and help in the evaluation of processes and controls. Such self-assessment tools can enable the completion of risk and control assessments by client personnel, reducing the time and cost of performing such assessments by internal and external assurance providers who can verify and test those checklist applications as part of their risk assessment process when providing assurance on an entity's internal control.

Discussion and Conclusion

It is generally recognized that the economic and social impact of technology (especially AI) is significant, changing the way business is or will be done.[20] Our survey suggests, however, that CPAs are not familiar with most of the AI technologies discussed above.[21] Survey respondents attributed the greatest overall impact to virtual/augmented reality and the second greatest impact to AI/ML. The lowest overall impact was attributed to computer vision/image processing/face recognition, while the second lowest impact was attributed to interactive conversation/chatbots. Ironically, interactive conversation, in its GPT incarnation, was recently

[19] The most advanced use of generative chatbots such as ChatGPT involves using chatbots to generate information from its training database, and in the future, the internet.

[20] Holmes, A.F. and A. Douglass. 2022. Artificial Intelligence: Reshaping the Accounting Profession and the Disruption to Accounting Education. *Journal of Emerging Technologies in Accounting* 19 (1): 53-68

[21] *Op.cit*, *Assurance Related Technologies and Tools*.

identified as a technology that is likely to significantly affect the jobs of accountants and auditors, among others.[22]

Our discussions with practitioners suggest that most of the T&Ts used in business processes are often not within the scope of financial statement preparation or audits. Thus, preparers and auditors of the financial statements appear to be shielded from the sophisticated systems of the very companies/clients they serve, as the financial processes of these organizations are legacy systems involving little innovation. On the one hand, this enables financial statement preparation and verification to be relatively unaffected by the technology-based upheavals in organizations' business models themselves. On the other hand, this shield may prevent assurance professionals from seeing the potential for value adding advisory and assurance service opportunities arising from the organizational technologies underlying current and emerging business models and new automated tools and techniques.

Users may be familiar with technology but not the language that goes with it, which could cause difficulty in explaining problems discovered

If accounting firms wish to expand into new assurance areas, then additional knowledge and skills will need to be developed or obtained through other means to allow them to leverage their assurance knowledge in these new areas. Assurance on system and organization controls may require detailed knowledge of IT-related processing features, tools and controls. Some services may also require or benefit from knowledge of and ability to use advanced automated tools in the provision of assurance services. Although some of the technologies discussed above may not be applicable to small CPA firms or sole practitioners, a recent workshop on the impact of AI on the accounting profession included a presentation by a partner in a small firm (less than 20 employees) on the AI-enhanced tools she used to leverage her CPA competencies and enhance her efficiency and effectiveness in a variety of service areas.[23]

In their comments, survey respondents identified challenges with T&T adoption, digital transformation and change management. Some expressed concerns about the slow progression of digital transformation in corporate accounting and finance departments in Canada, resistance from accounting leadership or the adoption of semi-digital processes. Others noted that it is difficult to keep up with the pace of change and risks associated with adoption of new technologies (e.g., increased complexity, over reliance, data corruption, cyber risk). Also, digitalization can make tasks that were done effectively and efficiently in the past less effective and less efficient and reduce understanding of the cycle of business activity. It appears that there is a need for best practices and guidance related to automation and other technologies and the potential impacts of various technologies including both their potential utility and risk.

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[22] Eloundou, T., S. Manning, P. Mishkin and D. Rock. 2023. GPTs are GPTs: An Early Look at the Labor Market Impact Potential of Large Language Models. *(*Working Paper, University of Pennsylvania, Open AI, Open Research) available at 2303.10130.pdf (arxiv.org).

[23] Boritz, J.E., and T.C. Stratopoulos. 2022. JIS Workshop on AI and the Accounting Profession: Views from Industry and Academia (December 6, 2022). Available at SSRN: https://ssrn.com/abstract=4295282 or http://dx.doi.org/10.2139/ssrn.4295282.

In connection with education and training, practitioners expressed a need for a common language and terminology that is easily understood by those outside the computer science field. Users may be familiar with technology but not the language that goes with it, which could cause difficulty in explaining problems discovered. Some practitioners are concerned that students who rely solely on software may not have a grounding in manual processes, while others emphasize the importance of updating training programs to ensure CPAs have a robust understanding and working knowledge of new technology. Some point to the need for more specialized skills as technologies become more prevalent and some question whether CPAs trained as accountants are expected to become IT experts.

Beyond Traditional Technology Competencies

In summary, organizations' adoption of new technologies can create performance concerns, data privacy and security concerns, as well as demands for compliance with various regulatory requirements. These concerns create a market for assurance engagements to facilitate adoption of new technologies, as well as ensure compliance with regulations. Assurance services, such as the SOC branded services aimed at testing and evaluating controls at service organizations, create models for assurance provision (i.e., creating a description of a system, process or data set; auditing the description to ensure its completeness and accuracy; auditing the described system process or data set to determine its consistency with the description and achievement of suitable evaluation criteria; and providing information on the results of tests).

Many of the technologies and tools surveyed have already been adopted by some private and public sector organizations, and some have advanced to a second or third generation capable of enhancing organizations' products and services and automating their processes. The actual current experience in the accounting profession with many of these technologies and tools is, however, still limited.[24]

The competencies required by many of the technologies and tools discussed in this article may be beyond the professional accountant's traditional technology competencies related to financial measurement, disclosure and related controls. Specialists may be required to work with the technologies and tools discussed in this paper as suggested by Boland et al. (2022).[25] Although accounting firms are involved in disseminating information about many of these technologies and tools, and offering advisory services aimed at deploying them in organizations across the globe, they are still experimenting with them when it comes to incorporating them within their assurance processes. Part of the rationale for the slow uptake of some of the tools may be due to concerns about the uncertain economic benefits of investing in them, risks of misapplying them, costs of training personnel in their use and maintenance, and scarcity of human resources with the required competencies.

[24] Boland, C.M., N.B. Galunic and M.G. Sherwood. 2022. Technology-Based Audit Tools: Exploring the Current State and Future Direction (Working Paper, University of Wisconsin, PCAOB, University of Massachusetts) Available at SSRN: https://ssrn.com/abstract=4258373 or http://dx.doi.org/10.2139/ssrn.4258373.

[25] Ibid.