The Data-Driven Audit: How Automation and AI are Changing the Audit and the Role of the Auditor

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Forward

COVID-19 and the resulting environment has changed how we work for the foreseeable future. It has heightened our increasing reliance on technology and tools and we believe it is now more important than ever to embrace automation and begin to think about AI and how we perform audits today and in the future.

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Introduction

From accurately predicting traffic patterns to determine the fastest route to a destination, to employing face recognition to unlock smartphones, to using natural language processing (NLP) to allow humans to talk to virtual assistants in plain English … artificial intelligence (AI)-enabled programs are transforming our daily personal and professional lives.

For Chartered Professional Accountants and Certified Public Accountants performing audit and assurance services (collectively, CPAs, referred to as "auditors" in this publication) looking to keep pace with the rapid adoption and advancement of technologies in our increasingly **data-driven world**, the changes are already being keenly felt. Auditors and the entities they audit are using next-generation technologies more than ever.

For many auditors, **using automation and analytics is a first step in their digital journey towards an AI-enabled audit**. Much like the digital advancements that preceded it, AI will perform repetitive tasks, provide greater insights and improve efficiencies and quality, allowing auditors to better use their skills, knowledge and professional judgment.

As digital progress continues, the questions increase. What role will an auditor play in a world dominated by AI? How will the audit of the future change? What are the limitations of AI?

In order to provide auditors with a fundamental understanding of AI, Chartered Professional Accountants of Canada (CPA Canada) and the American Institute of Certified Public Accountants (AICPA) created A CPA's Introduction to AI: From Algorithms to Deep Learning, What You Need to Know, the first AI publication of an ongoing series being developed. A glossary of common AI terms is also available at the end of this publication.

In addition to exploring the benefits of an AI-enabled audit and how AI will evolve the audit and the role of the auditor, this publication also considers the change in mindset required to meet the challenges and take advantage of the opportunities this evolution presents. Further, it provides a peek into the next step on the digital journey beyond the current state of AI, as well as the assurance-related opportunities that will directly result from these continued advancements.

The topics are covered in sufficient detail to enable auditors to begin thinking of ways to use and derive the greatest benefits from–and even embrace–AI. In the process, this publication makes the case for why now is the time for auditors to do just that.

First, a few key terms:

	What is it?	Example
Automation	When a process or procedure is performed by a technology solution with minimal human assistance	Use automation to extract simple contract terms and data (e.g., contract value, start date, end date, incurred cost, estimated cost to complete, etc.) from standardized documents and input into workpapers.
Analytics	The use of (big) data and techniques (such as descriptive, diagnostic, predictive and prescriptive analytics) to gain insight and make decisions	Use analytics to dynamically visualize contract data and metrics (e.g., margin, related contract asset position) to inform risk assessment over the portfolio or analyze positions of contract types or specific contracts.
Artificial intelligence (AI)	The science of teaching programs and machines to complete tasks that normally require human intelligence	Use AI to analyze contract agreements and documents for unusual terms or clauses that require additional consideration.

Auditing in the digital world: Benefits

Building on the changes that computers brought to the assurance profession (e.g., moving ticking and calculating from hard copy ledger paper to electronic working papers), technology and the increased use of automation, analytics and AI are driving the evolution of the audit. With the combination of today's computing power (and ease of access to it), machine learning and AI-enabled audit tools, enormous volumes of data can be analyzed to find anomalies and identify insights, patterns and relationships that are not readily apparent to a human. However, it takes human insight and experience to understand the output, to determine if the information represents a true anomaly and, more importantly, to determine what the anomalies, insights or patterns imply in the overall context.

That said, not all auditors and firms currently have access to specialists, computer science engineers and data scientists who can program custom, in-house AI-enabled tools. Fortunately, custom-built solutions are not required and many off-the-shelf software solutions are available. Auditors and firms may determine the best option based on requirements, resources and schedule. Additionally, as AI technology continues to evolve along with automation, access will also increase, enabling many more auditors and firms to offer increased value to existing and future clients. AI also has the potential to enable an increased level of standardization across similar engagements and the ability to monitor quality throughout numerous engagements.

Consider this example of the use of automation and AI as part of risk assessment:

1. Extract data from financial statements (or interim financial statements) to calculate proposed materiality based on a range of benchmarks. Ratios and trends may also be calculated.

2. Use automated newsfeeds to pull information about the entity (market data, regulatory filings, financial and non-financial news articles).

3. Use AI-based programs that leverage NLP to analyze information for relevant data using dimensions such as tone and sentiment, and to classify key pieces of data into relevant factors such as potential business risks, leadership changes, material market moves, etc.

What does all of this mean for the role of the auditor? The auditor spends less time gathering, correlating, formatting and summarizing information. Instead, they spend their time analyzing and evaluating the results or implications of the information and data. This could provide more insight about the entity to help inform the audit approach earlier in the audit process.

You can find further examples for various phases of the audit in **Appendix A**.

It is important to see automation, analytics and AI for what they are: enablers, the same as computers. They will not replace the auditor; rather, they will transform the audit and the auditor's role.

Auditing in the digital world: Considerations

Along with the benefits, there are direct and indirect challenges to consider related to AI. Direct challenges include data privacy and confidentiality, data integrity, explainability and the operational management of an audit. Indirect challenges are related to the auditor having the appropriate competence and capabilities to perform the audit engagement.

Data privacy and confidentiality

The foundation of our profession is trust. Without it, we have no means of acting as an objective, independent intermediary between information producers and information consumers.

The effective use of AI often requires access to large amounts of data, including confidential client data, in order to learn relevant patterns and apply them to predict or suggest an output. Not surprisingly, clients may be resistant to providing access to this high-value data and information. Several high-profile cases of data breaches in the public domain have led to increased and stricter regulations around data, security and privacy. Auditors need to consider the risks associated with data and privacy, and design security protections commensurate with the sensitivity of the data.

To determine how best to augment existing data policies to securely enable data-hungry technologies such as AI, auditors are advised to ask themselves the following questions:

- How do I make sure that data is governed and secured properly?

- How do I protect privacy?

- How do I protect against damaging and costly data breaches?

- How will my data retention policies need to change?

Data integrity

Advanced analytics, automation and AI are only as effective as the underlying data. Procedures that focus on quality of data to be used in these tools become increasingly critical. The accuracy of the information presented or produced by these technologies depends on it. The old adage "garbage in, garbage out" applies exponentially. For example, if a process automation program is designed to copy a particular data field within a form from one

tool to another, any changes to the nature of that data field (e.g., changing its location on a screen, changing its definition, allowing for blank values, etc.) may cause the program to fail–not just once, but thousands of times, with the effects typically cascading to other processes.

Some key questions to consider as an auditor include:

- How do I assess the reliability of the data captured (e.g., accuracy, completeness) and method(s) of data acquisition from different systems, particularly client systems?

- What happens when clients' systems, controls, policies or procedures change, or if a mid-year acquisition occurs that impacts overall scope?

- Do only appropriate personnel have access to modify client systems?

The relevance of these questions has not changed for our profession when conducting audits and assessing extracted data, but they do become proportionally important to the extent of data-ingesting technology that auditors use in an audit.

Explainability: AI and the 'black box'

A lack of trust in AI is perhaps the biggest challenge to the widespread adoption of AI tools in the audit process. This is often referred to as the "black box problem."

A little background: Basic AI tools can look at a set of relatively simple data (e.g., a number of records), and formulate rules and classification trees that a human can then validate (i.e., understand the rationale of why an AI tool would identify a certain transaction as fraudulent or high risk). This then becomes its basis for predicting an outcome in the future.

This is all fine, until the data points become too complex for the algorithms and AI tools to clearly link driving factors and outcomes and determine the cause-effect pattern. When this occurs, advanced AI techniques, called neural networks, can be employed to learn these patterns. Neural networks work by using a series of algorithms to recognize relationships between large volumes of data, which may be difficult to understand or document. This lack of transparency or explainability of sophisticated AI tools is what is otherwise known as the "black box problem."

For example, Deep Patient, an AI tool used at Mount Sinai Hospital in New York to review the medical records for approximately 700,000 patients, was able to predict a wide range of diseases in the patients without any instructions provided by experts.[1] This included

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1   Riccardo Miotto, Li Li, Brian A. Kidd and Joel T. Dudley, *Deep Patient an Unsupervised Representation to Predict the Future of Patients from the Electronic Health Records* (**www.nature.com/articles/srep26094**, 2016)

anticipating the onset of psychiatric ailments such as schizophrenia in some patients. However, Deep Patient has no way of providing the reasoning behind why those patients were identified.

Another reason it's hard to trust AI: AI tools can give biased or bad predictions if they are trained using biased or bad data (such as a disproportionate sample). For example, if an AI tool was trained to automatically classify documents as either financial data, human resources data or operations guides, but 90 per cent of the training documents were financial data, the tool would wrongly learn that predicting every document is financial data will result in being right more than 90 per cent of the time.

Management needs to have a clear understanding and be able to explain and justify AI's results. To meet its responsibilities, they are required to implement and apply the appropriate level of IT controls around applications, including AI applications. Unlike traditional IT controls–where a process or logic is established and controlled through change management–the use of AI may require management to develop additional controls to monitor and assess the data fed into AI and the output of results, in order to check for accuracy and potential bias. This will also affect how the auditor obtains an understanding of the entity given International Standard on Auditing / Canadian Auditing Standards 315 or AU-C section 315 requirements.[2]

Like management, auditors also need to consider controls and processes around their AI audit tool. In preparing appropriate documentation when AI has been applied in performing the audit, it is important for auditors to be able to explain why the AI tool has selected "unusual" or "anomalous" transactions. This can be complex, as the AI tool may have taken into account both traditional sample selection methods (e.g., statistical sampling, highest value, close to period-end close, unusual amounts) and combination factors (i.e., more than one factor), which previously were not practical to assess in a population.

Further considerations on the use of AI by management and auditors include the following:

- If management is not able to explain or evaluate the results from an AI tool, are they able to assert that the subject matter is complete and accurate, and that internal control is effective to mitigate the risks of material misstatement?

- Similarly, if the auditor cannot explain or evaluate the results from an AI audit tool, can they conclude that they have obtained sufficient, appropriate audit evidence from the AI audit tool to form an opinion?

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2   ISA 315, *Identifying and Assessing the Risks of Material Misstatement through Understanding the Entity and Its Environment*
     CAS 315, *Identifying and Assessing the Risks of Material Misstatement through Understanding the Entity and Its Environment*
     AU-C section 315, *Understanding the Entity and Its Environment and Assessing the Risks of Material Misstatement*

- What are the basic requirements for understanding the original programming, controls and processes around the maintenance of management's AI tool or the auditor's own AI tool?

Myths and challenges

There are many misperceptions about AI. Contrary to popular belief, current AI tools are not all-knowing and inherently smart (**refer to the glossary** for a refresh on general AI versus narrow AI). It takes lots of data and a significant amount of time to carefully build successful AI tools that at best deliver value within a limited, narrow scope, such as identifying patterns in reasonably clean data that can be used to make useful predictions. That said, once ready, an AI engine can process millions of records very quickly, although the nature of such "processing" is still relatively limited in scope.

For example, an AI tool designed for anomaly detection may not necessarily be able to identify and differentiate the transaction as an anomaly related to money laundering. Other challenges include getting access and permission to use sufficient data sets from clients (especially data that may contain proprietary or personal information) or obtaining the data in a format that is usable (data may need formatting or cleansing), in order to train and fully benefit from the power of AI.

Some current limitations of AI include the following:

- AI cannot work on its own. While it may transform the profession through efficiencies gained and use of new technologies and new skills, an auditor will still be required to set parameters, consider the results in relation to other evidence and make judgments that a computer cannot make.

- AI cannot see the big picture. For example, a machine's world is restricted only to the (correct or incorrect) data to which it has access, what it has been taught and what it has been programmed to do. It does not know the nuances of the real world and can't replace an auditor's professional judgment. Fraud or bias can happen even when transactions processed by the AI seem perfectly legitimate. Auditors need to be alert to these qualitative aspects.

- AI needs to have controls. Data integrity could be compromised if appropriate controls are not implemented and operating effectively.

- AI cannot evaluate moral or ethical concerns. For example, while AI may be able to identify fact patterns of independence infractions, it cannot effectively contextualize intent or perceptions of conflict (i.e., independence must exist in both fact and appearance). For instance, AI cannot recognize if the financial market perceives a lack of independence when the facts suggest independence does exist.

On the horizon: Explainability and ethical AI

There are numerous organizations that are exploring explainability and ethical AI. For example, Explainable AI (XAI) is a growing Defense Advanced Research Projects Agency-funded program that aims to create a suite of machine-learning techniques that:

- Produce more explainable models while maintaining a high level of learning performance (prediction accuracy).

- Enable human users to understand, appropriately trust and effectively manage the emerging generation of artificially intelligent partners.[3]

In Canada, an international study group on inclusive and ethical AI has been established in partnership with France called the International Panel on Artificial Intelligence. The group brings together policy experts with researchers in AI, humanities and the social sciences and will issue reports aimed at guiding the development of policies that could keep AI technology grounded in human rights.[4]

3   Dr. Matt Turek, *Explainable Artificial Intelligence XAI* (**www.darpa.mil/program/explainable-artificial-intelligence**, 2018)

4   Government of Canada, *Declaration of the International Panel on Artificial Intelligence* (**www.canada.ca/en/innovation -science-economic-development/news/2019/05/declaration-of-the-international-panel-on-artificial-intelligence.html**, 2019)

Financial statement auditing in the future

> The auditor's use of real time AI does not relieve management of their responsibility over financial reporting.
>
> Excessive use by management of the results of auditor's AI could introduce an independence threat.

The audit of the future is likely to have much less human-to-human interaction related to highly repetitive and rules-based tasks. Interface tools could be used to automatically share information in real time with the external auditor's AI tool(s), which in turn could analyze, test and flag anomalies or issues that require the auditor's attention. This would focus the human interaction on high-risk transactions as opposed to routine inquiries.

Under this scenario, AI tools could identify unusual transactions while also providing insights on relevant considerations the auditor might take into account, including the applicable standards (accounting, disclosure, auditing or regulatory standards), similar historical situations, or outcomes from publicly available sources (including similar situations from industry peer groups). The AI tool could also analyze board meeting minutes or key communications in order to assist the auditor in identifying additional risks and requesting relevant supporting information, as well as scheduling meetings with the appropriate individuals to discuss audit matters. This is all in addition to being able to process large amounts of data (such as reading bank statements and legal contracts) and reconcile accounts many times faster than a human auditor and with fewer errors.

Changing skill sets

Advanced technologies provide a wealth of information to an auditor that enables them to make a judgment. But the auditor will still be the one making that judgment. Technology is an enabler and is unmatched when it comes to identifying correlations among datasets or variables. However, it takes human insight and experience to ultimately understand the context underlying the output as well as the causation of the output relative to the inputs provided. AI results are, at best, probabilistic predictions based on inferences in the correlation of data and should not be taken as truths (i.e., predictions are not necessarily the

"correct" answer[5]). The auditor needs to use professional judgment to assess the AI results in combination with other evidence. AI tools can give another level of insight, but they are not the only answer.

An auditor confirms the information and determines whether it is an anomaly and, more importantly, determines what it implies or how to conclude on how appropriate the treatment of the information is. As a result, it will be even more important for CPAs to have skills beyond expertise in accounting and auditing statutes to the fundamental underpinnings of accounting and auditing, and of business processes. For example, they might ask:

- Why is this transaction occurring?

- Why should it be reported as an asset?

- How do I know that the population of transactions is complete?

Armed with this knowledge, auditors can assess the transaction.

Auditors may also see changes in their multidisciplinary teams to include a range of CPAs, non-CPAs or specialists with additional technical expertise. Audit and assurance professionals will need an increased knowledge of data science, data management and machine learning techniques (how they function, as well as their limitations). An enhanced understanding of IT, data analysis, data capture and enterprise resource planning will be needed along with skills such as critical thinking, analysis and creativity.

To get new CPAs ready, many firms and schools are updating their training and curricula in response to updates in the competency map and framework. The **CPA Canada Competency Map** is adding data analytics and information systems to its curriculum (as part of its ongoing and continuous revisions) and the AICPA also includes technology and tools as part of its **Pre-certification Core Competency Framework**.

Expectation gap

These technologies have the potential to widen the **expectation gap** of our profession and raise the bar for the definition of "reasonable assurance." With the ability to analyze a larger percentage (or even 100%) of transactions and data, will there be increased expectation as to what the audit achieves?

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5   In many cases, such as estimates, the "correct" answer could be a series or range of acceptable answers.

Sampling

The use of AI tools may also raise questions around the use of sampling. For example, with respect to substantive audit procedures, it may be more efficient to use audit sampling if the auditor cannot design a procedure with precise enough parameters for a set of data to avoid the need to manage the resulting number of outliers, since the number of notable items or outliers can increase (sometimes into the thousands) when scanning 100% of the population.

Timing

Currently, audit reports are typically released after the close of the audit period (usually 25 to 120 days after the period end); however, users are increasingly demanding more timely information. Many parts of the audit can already be automated or run in parallel and thus result in faster completion of individual audit steps (notwithstanding AI limitations identified above). Continuous (e.g., monthly, quarterly or other relevant timeline) or real-time auditing and reporting (e.g., as transactions occur) may become common.

The speed at which the auditor can provide their opinion subsequent to a period end is inherently limited by a client's speed of reporting. The use of AI tools by the auditor may result in the auditor's AI tool continuously identifying material transactions as they are posted (assuming controls are designed and operating effectively) and automatically per-forming procedures to validate those transactions (e.g., tying to bank transaction detail, assessing against contract terms), so the auditor only needs to assess if any additional procedures are required on assertions that could not be tested in real time. This type of real-time and continuous reporting may also be relevant to clients who want to implement it as part of their own control or internal audit function.

New opportunities for auditors

Future publications from CPA Canada and AICPA may discuss these topics further

As AI continues to advance and clients implement AI-enabled tools into their processes, new offerings for assurance engagements could arise:

- **Assurance reporting on the client's AI tool**
(e.g., the output, algorithm or parameters, if the algorithm is acting as designed, or if there is a bias in the underlying data or the algorithm).

- **Assurance reporting on the client's AI tool controls and process** (e.g., system and organization controls (SOC) reports or other assurance / attestation-based engagements). Although reporting on controls is not a completely new offering, which controls are tested and how auditors test those controls may change.

- **Assurance reporting on the client's appropriate use of AI** (e.g., governance over the use of AI, compliance with regulatory or ethical requirements).

- **Assurance reporting on AI-enabled robotic process automation (RPA) applications**. These may already be tested in much the same manner as any IT dependent control (e.g., understand what the tool or application is doing, test a sample to validate that understanding, test set-up, assess user acceptance, assess change management). This reporting may become more prominent and frequent over time as processes and applications become more and more sophisticated.

Call to action: What can auditors do to get in the game?

We all work with computers daily and yet most of us do not know how a microchip works or what's on the motherboard. Likewise, auditors do not need to become experts in algorithms and mathematical theory underlying AI to learn about AI use and tools. As an auditor, you are encouraged to:

1. **Get informed and educated.** Read about AI opportunities and tools that are in the marketplace. Be curious about how other organizations are leveraging AI and if there are similar ideas that can be considered for your organization.

   - Learn more about AI (see A CPA's Introduction to AI: From Algorithms to Deep Learning, What You Need to Know and other resources identified within this publication).

   - Actively monitor assurance developments and strategies that use AI.

   - Increase your understanding of the opportunities and risks associated with using AI in audit engagements (see Appendix A).

   - Ask how clients are implementing AI. Auditors are required to understand their clients' systems, including those situations where the clients have implemented AI into financial reporting processes.

   - Deepen your knowledge by attending professional development seminars and webinars as a starting point to further your knowledge about AI and related topics such as data, analytics or automation.

2. **Identify AI leaders within your organization.** If there aren't any, ask "Why not?" Understanding who in your organization to approach will place you in a better position to support tangible change and implementation of any AI opportunities that you identify.

3. **Identify opportunities for automation**. Once you understand the tools and applications available and who in the organization to talk to, you'll have the knowledge and contacts to affect change based on opportunities identified. Be strategic.

   - An ideal place to start is with high-benefit, low-effort opportunities. Processes that lend themselves to automation are consistent and repetitive in nature (e.g., reviewing spreadsheets, filtering and sorting information, reviewing documents and manually entering information into systems of record, or following decision-making processes based on facts and circumstances).

   - Consider digitizing audit processes. Obtain schedules and evidence from clients in electronic format in order to keep fully-electronic audit files.

   - See Appendix A for ideas on how to use automation and analytics in your audit.
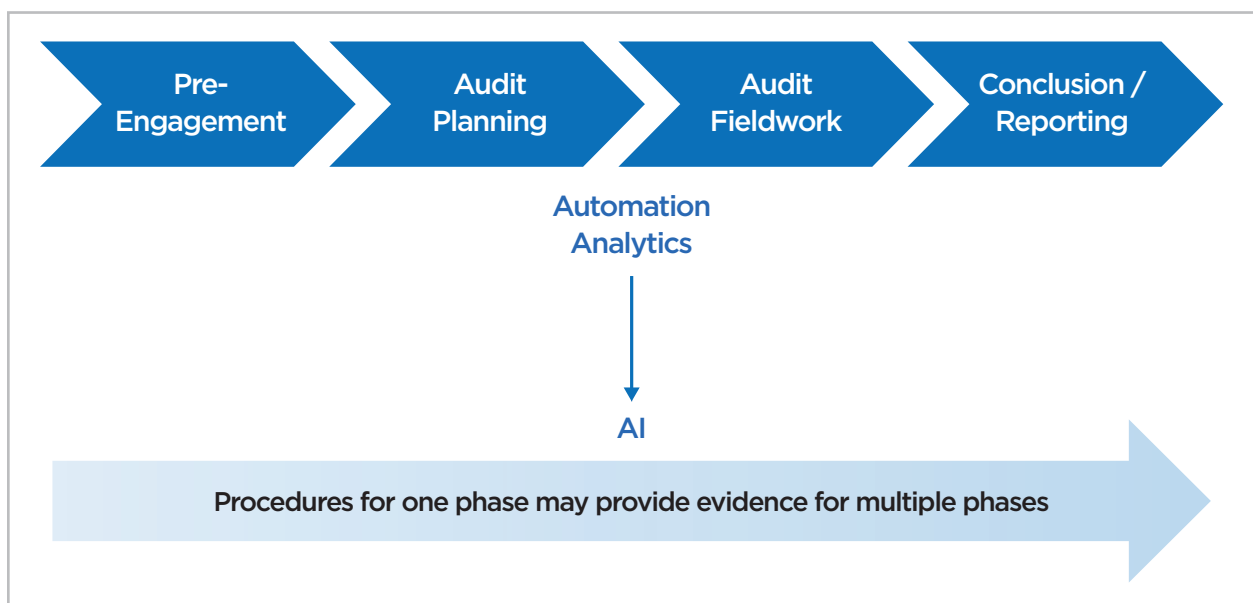
4. **Identify opportunities for AI.** Recognize tasks that require you to look for patterns in data or opportunities for checking for patterns in high volumes of data that would be challenging or time consuming for a human to do (e.g., higher than a certain number, beyond a date, percentage, reciprocal reviews, geographical clustering or combinations of any of the aforementioned).

    •   Think about data acquisition and standardizing processes to acquire data from different clients in a consistent format. If data is obtained in a consistent, structured format, client after client, year after year, AI tools may be easier to implement.

    •   Begin implementing AI processes on a small scale first and assess the results using professional judgment, as well as any potential efficiency savings (see **Appendix A** for examples).

5. **Reach out to CPA Canada and the AICPA**. We welcome your suggestions for possible future publications related to AI, including additional considerations or proposed responses to future considerations identified throughout the publication.

The above is not meant to be a comprehensive list, rather it can help you to start thinking about AI and the opportunities available to you and your firm.

Appendix A: Auditing with automation, analytics and AI

This appendix explores the opportunities for enhanced quality or efficiencies as well as challenges or considerations of implementing automation, analytics and AI across each phase of the audit. It also recognizes that, through the use of automation, analytics and AI, the outcome of performing procedures in one phase can increasingly provide evidence for multiple phases (see diagram below). It also demonstrates the evolution of opportunities and challenges from using automation and analytics to using AI. In many cases, examples are not purely automation, analytics or AI, as there may be overlapping characteristics. However, for purposes of this appendix, the examples have been grouped into the most relevant scenario applicable (automation, analytics or AI). Not all opportunities or challenges of each example have been discussed.

This appendix is non-authoritative and should not be considered a comprehensive list. Instead it is meant to provide examples of possibilities for using automation, analytics or AI, that could help you to identify other opportunities in the future.

Pre-Engagement → Audit Planning → Audit Fieldwork → Conclusion / Reporting

Automation
Analytics

↓

AI

Procedures for one phase may provide evidence for multiple phases

Pre-Engagement and audit planning (client acceptance and continuance, audit scope, risk assessment, understanding the entity, materiality assessment)

Automation and analytics: Planning opportunities

Materiality and scoping

Robotic process automation (RPA) and analytics can be used to extract data from prior periods or interim financial statements to determine proposed materiality based on a range of benchmarks. The same techniques can be utilized to determine materiality in a continuous or real-time audit.

RPA and analytics can be applied to identify anomalous transactions or areas that have not followed the understood course of business to determine scope and focus testing on accounts or transactions that appear to present a greater risk of misstatement.

Risk Assessment

RPA can be used to source information from subscription databases and publicly available information sources as part of the typical planning cycle. For example:

- Extraction of information from prior period financial statements; key financial metrics used in risk assessment; and extraction of bodies of text for NLP (see AI section below). Effective categorization and recording of geographic and industrial data for comparisons (e.g., generating ratio analysis appropriate for the given industry or geography as applicable).

- Completion of non-judgmental independence checks; review of entity structures and associated and related entities with internal audit department records and investments held (to assist in making relevant independence considerations); background checks of entity directors or owners. These will inform the auditor's assessment of independence (in fact and appearance).

- Acquisition of entity listing status across the globe. Geographical registrations of entity names and numbers are automatically obtained and populated in the risk profile of an entity.

- Acquisition of market data on clients. For example, the auditor can gather information on the percentage of an entity's stock that is held in a short position, which can be a leading indicator of potential going concern issues.

Automation and analytics: Challenges and considerations for the auditor

There is an expectation gap between what users think an audit does and what is required by the standards. The advent of automation, analytics and AI presents an opportunity to close this gap, but also to widen it. For example, the ability to evaluate 100% of the transactions within certain financial statement lines may raise user expectations, such as assuming that all erroneous or missing transactions will be detected.

How does the auditor create a flag or trigger that informs and enables the tool to identify information as relevant? Unless using standardized inputs, each time the auditor creates or uses RPA, they will have to build the logic for the information the tool needs to identify.

The auditor will need to consider how to deal with missing or incomplete data inputs, and how the tool will need to deal with these (e.g., either delegating back to the auditor or applying assumptions in place of the missing data). In order for the auditor to perform data-driven testing, significantly more data is necessary than a traditional sampling method requires. Completeness

Pre-Engagement and audit planning (client acceptance and continuance, audit scope, risk assessment, understanding the entity, materiality assessment)

Automation and analytics: Challenges and considerations for the auditor *(continued)*

of data is always a core challenge to the auditor, but this risk is felt more acutely when large volumes of data are required. As a simple example, if there is a sample of 25 items, the auditor can "eyeball" information received and see if there are unpopulated fields relatively quickly. If the data volume is millions of records, data processing tools are required to evaluate the data to identify missing information.

Assessment of the output is also required. It is important for the auditor to satisfy themselves (either through controls or substantive validation) that the data used by the tool is relevant and reliable. The auditor will also need to be comfortable that the tool has come up with appropriate analysis, considering the output of the tool in the context of their knowledge and understanding of the client.

Artificial intelligence: Planning opportunities

Understanding the business and risk assessment
NLP techniques enable an AI tool to review information obtained through RPA techniques on both public and non-public information. NLP techniques could enable the auditor to scan an entity's annual report, regulatory filings, phone transcripts with investors, websites, articles of association and meeting minutes, and encapsulate these materials into a coherent summary of the business, its purpose and risk profile.

- Building on knowledge of similar clients and clients' industries, the AI could suggest relevant risk criteria, for example, common misstatements identified for specific financial statement line items, analysts' focus areas or accounting developments.

- AI reviews of board minutes, internal audit reports, significant and unusual transactions, legal matters, market / customer / employee sentiment from emails, customer complaints, news stories, social media and online chats can all be summarized for the auditor.

Analytics
There is an opportunity for the AI to perform anomaly detection on income statement and balance sheet positions over a defined number of periods, taking into account industry trends, business cyclicality and other relevant factors.

Transaction mapping
AI can go further to map out routine transaction flows for given business units and financial statement line items. Gathering this information enables the auditor to visualize transaction flows and determine typical process flows (including transaction volumes and amounts). Transaction mapping can also identify outlier transactions that do not follow the normal course of business, or new products and services that have not previously been audited. Visualization of transaction mapping can also help support the auditor's understanding of the business processes and testing coverage. This can be supplemented with other data such as statutory (or internal) audit findings, branch and geographic location information, and the history of errors and adjustments, which can all be used to help assist the auditor in making the appropriate risk and scoping decisions.

> **Pre-Engagement and audit planning** (client acceptance and continuance, audit scope, risk assessment, understanding the entity, materiality assessment)
>
> **Artificial intelligence: Challenges and considerations for the auditor**

Understanding the business and risk assessment

AI cannot be plugged into the Internet and left to run. Rather, specified reliable sources of data, sites, folders or other input mechanisms need to be defined. Initially, the tool needs to be trained or taught to identify relevant information. For example, this could be through direction of the tool to credible news sources, information repositories, the client's own website or other relevant information. Additionally, the auditor will need to establish how much is enough for the AI to analyze, in terms of the reliability of sources of information and the data itself. Once gathered, the auditor also considers the information presented in light of knowledge and understanding of the business.

When gathering information on the industry, the tool also needs initial guidance on who the entity's "peer group" is (e.g., domestic versus global, industry, where in the supply chain the entity and competitors work).

Clients may be reluctant to share certain sensitive information electronically (e.g., board minutes). This may limit the auditor's ability to utilize these tools to their full potential. The auditor will need to consider how to demonstrate appropriate data protection (e.g., cyber security and lifecycle of the information).

Other challenges and considerations

The AI needs data over a period of time (day/week/month/year) to establish the "normal" course of business. The length of time required depends on the frequency of transactions (greater frequency transactions will require historical data over a shorter period). Changes in the process will also need to be considered as this could create a new "normal" after implementation.

The auditor will need to develop an approach to assessing notable items or outliers to determine whether they contain a risk of material misstatement. This can become increasingly challenging when the number of notable items or outliers increases (sometimes into the thousands). With additional training or experience over time, the AI tool may reduce the occurrence of false positives and the number of identified outliers.

In their scoping exercise, although not a risk to the auditor's use of AI, the auditor also considers any application of AI by the client in production of financial statements. For example:

• Does the auditor have the understanding and ability to test the client's AI tools, or are specialists required?

• Is there any potential training bias in the client's AI tools (either intentional or due to error)?

• Are the client's AI tools continually learning or locked down and periodically updated?

• Does the client's use of AI limit the ability of the auditor to reperform or recalculate?

• Do the client's AI tools affect the auditor's risk assessment?

• Does the auditor need to rely on AI? Are there alternative approaches that can be taken to test balances substantively? Or alternative controls as opposed to automated AI IT dependencies?

Audit fieldwork (test of controls if applicable, substantive audit procedures, including test of details or substantive analytical procedures, evidence gathering, review of deficiencies and determining whether the auditor needs additional audit evidence)

Automation and analytics: Fieldwork opportunities

Automating procedures

Digitize aspects of the audit and gain efficiencies in automating audit procedures so that "audit bots" can perform repetitive tasks through RPA. For instance, these "audit bots" can:

- Copy data across different audit files without risk of human fatigue or input errors.

- Run calculations (typically those that require business rules to be considered, such as simple tax calculations) to assist in determining financial statement mathematical accuracy, internal consistency as well as tie-outs of prior-year amounts.

- Rebuild financial statements from underlying data to form independent expectations of the financial statements for tie-out purposes.

Expenses

Analytics can be used to explore expenses and identify anomalies. Some of this information could also be used to inform going concern analysis, such as identification of key suppliers or an uptick in legal fees.

Contract review

The time taken to review significant contracts can be greatly reduced by using automation and AI.

Automation–Optical character recognition (OCR) can be used to extract terms from standard contracts to perform comparisons and ensure no changes have been made (or to evaluate the changes). Due to evolving accounting standards, leases are a good example of an area that can benefit from large-volume data analysis and extraction of key contract term information. Contract information can be used to substantively test the population as a whole or simply identify riskier areas for targeted review and testing.

AI–AI tools exist that read text and provide summaries of the key messages. These tools could be applied to identify standard and non-standard terms in a contract, as well as to summarize these terms for review. This would allow the auditor to focus on the reasonability of the key terms and understand how the contract fits within the larger business picture.

Automation and analytics: Challenges and considerations for the auditor

Automating procedures

The auditor will need to consider the complexity of the client, sophistication of their IT infrastructure and the time investment required to set up RPA rules. RPA does not work well in a changing environment, meaning that changes in disclosures, business processes or accounting standards will not be captured in the RPA rules, and as such an additional response from the auditor is required. However, in periods of limited or no disclosure or accounting changes, the preparation and comparison of prior-year information is much more efficient with the application of RPA.

Audit fieldwork (test of controls if applicable, substantive audit procedures, including test of details or substantive analytical procedures, evidence gathering, review of deficiencies and determining whether the auditor needs additional audit evidence)

Automation and analytics: Challenges and considerations for the auditor *(continued)*

Expenses

As with all anomaly testing, an adequately large data set is required to establish what is "normal" in order to allow the tool to determine what is an outlier. Some of the elements referenced may cross multiple systems, therefore an inability to obtain enough relevant data may hinder the usefulness of insights.

Auditors need to consider their approach in investigating anomalies, as discussed above.

Contract review

The application of OCR can be an RPA technique or AI technique depending on the documents under review. If the contracts are in a standardized format, then a rule-based RPA may likely be sufficient. However, if the inputs come in a range of formats and contain varying information, then an AI application is required to enable the tool to accurately and effectively identify the correct information. For example, a contract may have multiple dates on the document (date of the contract, date of signing, date of witness and dates of maturity, interest payments, etc.). The AI will need to apply judgment to interpret the different dates and identify the relevant date(s) to be used in the audit.

The auditor will need to have a mechanism for reviewing the determinations made by the tool to address the "black box problem."

A tool that continually learns cannot apply the same logic as traditional automated controls as, by definition, the process is constantly evolving. Some substantiation of the tool is likely required on an ongoing basis. Conversely, if the tool "version" is locked, then a control process may be appropriate.

Artificial intelligence: Fieldwork opportunities

Inventory counts

With computer vision, an AI-based app can look at millions of pictures taken from cameras (whether statically mounted in a warehouse or mounted on moving drones) and identify articles. Articles that have indexing information (such as bar codes) are even easier to identify and if the "eye sees them all," then it can count them all, giving the auditor the ability to obtain more coverage.

Control testing

System-logged reviews retain a wealth of information that can be analyzed and applied in the audit. Notable items or outliers are quickly identified and can be followed up by the auditor.

Application of metadata can further enhance the testing of controls by highlighting potentially higher-risk reviews. For example, system-recorded review evidence typically contains reviewer (user ID), date and time stamps. AI tools can analyze how many reviews an individual typically performs and their usual frequency and duration, as well as the amount of time since their previous review. As an example, if a reviewer marks five processes as reviewed in five minutes, depending on the complexity of the task and the comparability with others performing the same task, the AI could highlight this as a notable item to be considered for testing.

Audit fieldwork (test of controls if applicable, substantive audit procedures, including test of details or substantive analytical procedures, evidence gathering, review of deficiencies and determining whether the auditor needs additional audit evidence)

Artificial intelligence: Fieldwork opportunities *(continued)*

HR and entity policy data can also be layered into approval reviews, for example, an inappropriate ordering of preparers and reviewers (e.g., a manager reviewing a vice president's work), or reviews that have taken place that do not meet the designated level of authority for review.

Extracting information from external and internal support
Building on the OCR tools, there are opportunities to both automate and use AI in substantive testing (e.g., vouching of invoices). Through combinations of OCR, NLP and natural language generation to apply AI-enabled RPA, the AI tool can read and cross validate sub-ledger records with external confirmations (e.g., bank or debtor confirmations) or other relevant appropriate audit evidence. The process is simpler where external confirmation formats are more standardized and becomes more complex where an array of layouts is used.

Scanning documents and extracting information through some of the techniques listed above are the simple first steps in this process.

Machine learning techniques can enable the tool to learn how to identify the right information. Over time, a tool can be trained on how to identify the relevant information from the source document. Gradually, the tool will begin to require fewer and fewer training instances and will begin to identify the relevant information in documents with formats outside of the training examples.

Estimates
The assessment of management's estimates is a key and complex area of any audit–one that requires significant auditor judgment. However, in some cases, management may come up with an estimate for which AI can be used as part of the audit process.

Traditional audit techniques used to audit estimates will typically fall into one of three categories (or a combination of the three): reperformance of management's process; retrospective testing; or development of an independent estimate. An array of automation and AI techniques can be used to perform variations of these techniques.

For example, in estimating the likelihood of non-repayment for a debtor or bad debt provision, management has set a rate at which they believe the likelihood of default is expected. Using machine learning, the audit team could build an independent model to predict this likelihood based on historical bad debt write-offs. Once the model is built, it could be retrained every year based on actual loss data. This independent estimate could be made for each individual loan (or by portfolio or type of loan), and then compared to the result of management's estimate. The AI tool could also be trained to incorporate other relevant observable factors, such as: interest rate movements, customer credit ratings, share price, contractual terms, housing starts and unemployment rates. Inclusion of these factors could also enable determination of an independent expected loss estimate for comparison with the client's estimate.

While the audit team would still need to understand the underlying data as well as management's methodology, a machine-learning model would provide a more comprehensive estimate of the likelihood of default. Information gathered across industries and geographical locations could also provide the auditor with industry information to come up with expected loss provision by customer.

Audit fieldwork (test of controls if applicable, substantive audit procedures, including test of details or substantive analytical procedures, evidence gathering, review of deficiencies and determining whether the auditor needs additional audit evidence)

Artificial intelligence: Challenges and considerations for the auditor[6]

Inventory counts

The reliability of images is a challenge (e.g., are the images being viewed authentic or is there a risk that the image could be manipulated?). Over time, as the technology and image capture improve and training data increases, the AI will improve.

The ability to look at individual items may be hindered by storage locations. Use of computer vision may be limited by the location of the client, restrictions on accessibility of areas where inventory is held and use of the imaging data.

Control testing

Given the potential ability to scan 100% of the control population and then look for notable items or outliers, the auditor will need to consider their response to notable items or outliers in controls testing.

The ability to test 100% of key controls also has some challenges to overcome. Control testing has traditionally been performed on a sampling basis, where a given number of exceptions in their sample would typically lead the auditor to conclude that the control did not operate effectively. However, if the auditor can test 100% of the control occurrences for a key control, then the use of a tolerable exception rate may still be appropriate.

As mentioned above, in using AI techniques the auditor considers their approach in assessing notable items or outliers to determine whether they are in fact exceptions. This can become increasingly challenging when the number of notable items or outliers increases (sometimes into the thousands).

Does the ability to apply AI and analyze or test 100% of transactions in a financial statement audit reduce the need to test business process controls as extensively? The auditor can, based on their judgment, elect to test balances completely substantively as opposed to relying on a combination of business process controls and substantive work. Excluding audit work performed specifically for the purpose of controls opinions (e.g., integrated audits or SOC 1 reports), this could reduce the need to rely on business process controls in financial statement audits, with the tradeoff being an increased importance of management's IT controls around the accuracy and completeness of the transaction data analyzed, which may also include transaction logs and metadata feeds.

Another question to ask is how does the auditor effectively evidence that they are satisfied they understand the following:

- Why their AI tool identified specific items to be tested if all outliers are effectively identified?

- Has the analysis been performed accurately?

- Why have certain items been identified as outliers, and were these outliers identified appropriately? For example, if the date when a control is executed is the reason the control instance is being flagged as an outlier, how does the AI tool let the auditor know? Does it categorize it in a certain way, or highlight the issue?

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6   During their May 2020 meeting, the Auditing Standards Board voted to issue AU-C Section 500, *Audit Evidence* final. The standard addresses many of the considerations made by the auditor in evaluating information to be used as audit evidence, including the use of automated tools and techniques. The effective date for this standard will be for audits of financial statements for periods ending on or after December 15, 2022. Documentation of audit evidence is addressed by AU-C Section 230, *Audit Documentation*.

Audit fieldwork (test of controls if applicable, substantive audit procedures, including test of details or substantive analytical procedures, evidence gathering, review of deficiencies and determining whether the auditor needs additional audit evidence)

Artificial intelligence: Challenges and considerations for the auditor *(continued)*

The auditor will need to design a mechanism for interpreting the AI tool results. This would be applicable to all uses of AI within an audit.

Extracting information from external and internal support

The level of idiosyncrasy of supporting sources will determine the amount of training data required (low idiosyncrasy = lower levels of training data). For example, it is easier to design an AI tool for bank confirmations than for revenue and debtor invoices. Development and training will take significant volumes of data and considerable time. However, the even more difficult part of the AI is the process of training tools to identify pertinent information, for example, training a tool to extract a confirmation date from a letter as opposed to the date of the letter itself, or any other dates included in a given confirmation. The information may also need to be extracted from a variety of different templates and formats. The tool needs to be able to distinguish between formats so that it knows where to look for information. Further complications exist for non-standard formatting of documents (e.g., hand-written balances on a confirmation, especially where the handwriting is poor).

What is the knock-on effect of analyzing 100% of a population? For example, in the case of confirmations as a source, although it is possible to automate and apply AI to the analysis of external confirmations, is it reasonable to distribute confirmations for 100% of the population? The auditor needs to evidence appropriate review of the work performed by the AI in its extraction of information related to the external confirmations. Therefore, the auditor may need to establish a mechanism to revalidate the tasks the AI performed without having to reperform them. Tools that are continuously learning will likely need to have some form of substantive validation for each instance in which they are used.

Estimates

Developing independent estimates for estimation processes may not always have been an option available to the auditor, given the breadth of resources and depth of specific knowledge required to develop such an estimate. The application of AI in this space is plausible, but it can be difficult. For example, any model developed by the auditor to estimate a bad debt provision will require significant amounts of historical loss data, as well as other metadata pieces of information (e.g., customer credit ratings, geographical information, industrial information and other relevant information used for the calculation of the provision). Further, the information may still require specialist knowledge to evaluate.

Forming an opinion and reporting (review of financial statements and disclosures, review of material misstatements, conclude on the audit and prepare audit report)

Automation, analytics and artificial intelligence: Reporting opportunities

Refresh of planning
Certain planning exercises need to be refreshed in the completion phase of an audit (e.g., reaffirming scoping, materiality, independence). The automation and assessment performed by the RPA and AI tools enables the auditor to review and focus their time on issue resolution and closing down issues identified. This can help to shorten the reporting cycle, making the opinion timelier relative to the date of the financial statements.

Reporting
Required client communications can be automated, enabling AI to extract information from the file and draft engagement documents (e.g., auditor's report, management representation letter) based on the contents of the audit file. Specific representations and communications are required for clients depending on their characteristics (e.g., SEC registered, small private companies).

Standardized templates are already developed and available to the audit teams, but human effort is required to tailor them to specific clients. AI would be beneficial in ensuring a standard format and ensuring the conclusions in the file reflect the communications made.

The AI can compile and analyze the summary of adjusted and unadjusted misstatements and of aggregated control deficiencies. For example, an AI tool can identify and join adjustments posted and control deficiencies to determine if there are common denominators or specific audit areas that require additional assessment. This assessment could be presented to the auditor for consideration.

Automation, analytics and artificial intelligence: Challenges and considerations for the auditor

Refresh of planning
The risks discussed above in relation to planning are relevant here. The auditor would need to determine a cut-off date of information pulling from external sources.

Reporting
The auditor will need to consider the application of local regulatory or legal requirements for reporting on specific engagements and how a tool would incorporate these requirements (e.g., Is there a feed into the AI that informs it of the regulatory and legal rules to apply?). Further, the auditor considers client-specific nuances and qualitative characteristics that would be difficult for an AI tool to include.

In analyzing adjustments and control deficiencies, the nature of issues tends to be idiosyncratic, which makes training a tool difficult. The greater the variability in outcomes, the greater the volume of training data that is required. This is something that would be very difficult to accomplish.

Appendix B: Glossary of terms

For a better understanding of the terms below, see CPA Canada and AICPA's **A CPA's Introduction to AI: From Algorithms to Deep Learning, What You Need to Know**, which explains these concepts.

Term	Definition
Artificial intelligence (AI)	The science of teaching programs and machines to complete tasks that normally require human intelligence.
Algorithms	A detailed series of computer instructions such as if/then/else or probabilities/weights for carrying out an operation or solving a problem.
Analytics techniques	There are four main categories of analytics techniques: • Descriptive analytics provide insights into events of the past. Techniques can be used to evaluate performance and gather insights. • Diagnostic analytics examines data to answer why an outcome happened. It is characterized by techniques such as drill-down, data discovery and correlations. • Predictive analytics look into the future to anticipate outcomes such as demand forecasting for a supply chain operation. In this case, existing data is used to train machine-learning models to forecast what will probably happen. • Prescriptive analytics provide possible outcome solutions that guide predictions into actions, such as generating ways to optimize production or inventory.
Automation	A process or procedure performed by a technology solution with minimal human assistance.
Big data	Large and complex data sets that cannot be managed with traditional data-processing software.
Computer vision	The ability of a computer system or device to see (e.g., identify and process images).
Deep learning / hierarchical learning	A type of machine learning using algorithms that roughly approximates the structures and functions of the human brain (e.g., algorithms that can simulate an array of neurons in an artificial neural network that learns from vast sources of data).

Term	Definition
General AI / strong AI	Human-level intelligence allowing knowledge to be transferred between domains.
Internet of Things	Interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.
Logic and rules-based approach	The use of algorithms to carry out a task or solve a problem.
Machine learning	The ability of algorithms to learn from experience rather than being pro-vided with instructions. Algorithms create computational models that process large data sets to predict outputs and make inferences; more data leads to more examples, which helps the algorithm to finely tune its output and insight over time. The insights are fed back to further refine the algorithmic models, making them more accurate over time.
Narrow AI / weak AI	Narrowly-intelligent systems that can exceed humans in specific tasks, such as playing chess, but that cannot transfer capabilities.
Natural language generation (NLG)	The ability of a computer system or device to transform visualized data such as charts or graphs into a narrative in an understandable language.
Natural language processing (NLP)	The ability of a computer system or device to understand spoken or written natural language.
Quantum computing	Computer processing using qubits to store an enormous amount of information while using less energy than a classical computer.
Reinforcement learning	An AI system that learns under its own supervision by making predictions, validating them against reality and continually adjusting itself for a better output the next time.
Robotic process automation (RPA)	Software automation that can handle high-volume repeatable tasks such as answering questions, making calculations, maintaining records and recording transactions.
Supervised learning	A method to teach AI systems by providing them with the desired outcomes for the training data (where input and output training data are labelled) so they can connect those outputs to the data.
Unsupervised learning	The ability of algorithms to draw inferences from data sets by identifying patterns and looking for similarities by which that data can be grouped.

About the Authors

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