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Audit and technology

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ACCA supports its **219,000** members and **527,000** students (including affiliates) in **179** countries, helping them to develop successful careers in accounting and business, with the skills required by employers. ACCA works through a network of **110** offices and centres and **7,571** Approved Employers worldwide, and **328** approved learning providers who provide high standards of learning and development.

Through its public interest remit, ACCA promotes appropriate regulation of accounting and conducts relevant research to ensure accountancy continues to grow in reputation and influence.

ACCA has introduced major innovations to its flagship qualification to ensure its members and future members continue to be the most valued, up to date and sought-after accountancy professionals globally.

Founded in 1904, ACCA has consistently held unique core values: opportunity, diversity, innovation, integrity and accountability.

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ACCA and CA ANZ created a strategic alliance in June 2016, forming one of the largest accounting alliances in the world. It represents 800,000 current and next generation accounting professionals across 180 countries and provides a full range of accounting qualifications to students and business. Together, ACCA and CA ANZ represent the voice of members and students, sharing a commitment to uphold the highest ethical, professional and technical standards.

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Audit and technology

About this report

This report provides an overview of some of the various technologies that currently affect or are likely to affect the audit profession in the near future and what this means for auditors as people. The report is supported by existing research, panel discussions held in Greece, Czech Republic and Slovakia and by interviews of leading practitioners.

ACKNOWLEDGEMENTS

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Foreword

Maggie McGhee
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Technology is transforming the accountancy profession, and has the potential to revolutionise audit.

Robotic process automation, data analytics, artificial intelligence, machine learning, distributed ledger technology…to name but a few: a seemingly endless list of transformational technologies at varying stages of evolution is already having, and will continue to have, an indelible impact on the audit process. Technology of course is never the panacea to resolving all the current challenges in audits, or conversely seizing all of its future opportunities.

Like all transformational stories, technology in the audit story is the enabler; an enabler to renew processes that improve quality and increase efficiency. It is also a catalyst that will help shift the focus of the audit process from a retrospective view to one which is prospective, enabling much deeper insights to clients and an enriched narrative on corporate performance and its sustainability for the future. Yet it is the nexus of emerging technology with human endeavour, skill and judgement where real future value from auditing will be unlocked. In the face of exploding technologies, audit remains at its heart a very human activity. That said, digital developments could have profound implications for how auditors conduct their activities, as well as potentially raising new ethical and moral considerations.

This report assesses the technologies having most impact on the audit profession as we know it today. Drawing on existing research and exploring the views of leading practitioners, it provides an understanding of how the changing business environment is shaping technological change in auditing. It also provides a unique summary of how different technologies could be expected to impact its future. We hope it also provides insights for both businesses and auditors themselves on how they may adapt most effectively in the face of this significant change.

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Executive summary

The latest advances in technology promise significant benefits for the audit profession, with a number of key drivers signalling the need for technological change in audit. Such drivers include the rapid increase in volume of data, changes in business models, the shift towards automation and the demand for a proactive and forward-looking approach to audit. These developments require auditors to be technologically sound to enable them to continue servicing businesses and to execute high quality audits.

These conclusions are supported by panel discussions held in Greece, the Czech Republic, and Slovakia, with panellists representing audit practice, audit regulators and the business side, along with technology experts. The report is also supported by interviews with audit practitioners and technology experts in the audit profession.

In this report, ACCA and CA ANZ provide an overview of the various technologies that currently affect or are likely to affect the audit profession in the near future.

Such technologies include distributed ledger technology (DLT), data analytics, robotic process automation (RPA), drones technology, artificial intelligence (AI) and machine learning (ML), natural language processing (NLP), and deep learning (DL). Reference is also made to smart contracts and cloud technologies.

Our research found auditors needing to understand the various technologies used by businesses, and adapt to the changes in their business models.

Data analytics was found to be the most mature of the technologies currently used by most firms, while machine learning is still not at the stage where it is embedded in everyday practice. ACCA and CA ANZ also explored what this means for auditors as people, with the human relationship between business and auditor emphasised, because this remains central to auditing. In sum, the auditors of the future should be technologically sound with excellent project management skills and able to adapt to change.

1. What is driving technological change in audit?

INCREASE IN VOLUME OF DATA

The volume of transactions and data in businesses has increased dramatically since 2016 and is expected to keep increasing in the future. It has been estimated that over 90% of the world's data has been generated since 2016, and significant amounts of it are financial data (Marr 2018).

This rapid increase in the volume of data requires auditors to be equipped with the latest available technological tools to analyse a much higher volume of data in their audits than has previously been the case.

CHANGES IN BUSINESS MODELS

Businesses across almost every industry are in the front line, experiencing at first hand the disruptive changes that are also affecting their auditors. Disruptive change needs to be distinguished from innovation and technology per se: the key to disruption is that it creates innovation in business models, new ways of working in markets and new sources of value. Disruption can be enabled by technology but need not involve technological breakthroughs: it can involve simply putting existing technologies together in a new way. For example, a food delivery app such as JustEat or Deliveroo rests on some very basic underlying technology – kitchens, bicycles and a smartphone app – but puts them together in a way that radically changes the way users order food: aggregating restaurants at the user end and allowing new players to enter the market at the other, or service it in different ways ('dark kitchens').

> *'Auditors must be able to adapt to the changes in business models of their clients.'*
>
> Juraj Sekera, Finance Director, Vertiv Slovakia

Such technological changes in businesses and their business models require the attention of auditors of any size including small and medium-sized practices (SMPs). For example, start-up businesses now tend to have business models based on advanced technologies. Complex audit challenges could therefore come from smaller businesses too.

> *'Both our auditors and us are already using advance analytics and we expect to adopt blockchain technology as soon as the supply chain of the steel trade adopts it.'*
>
> Michalis Samonas, CFO, SIDMA S.A. Greece

> *'Understanding how technologies such as Blockchain [and] Machine Learning work is necessary to enable auditors to assess and respond to the current and prospective risks of the organisations that place their trust in us.'*
>
> Dimitris Sourbis, Assurance Partner, PwC

SHIFT TOWARDS AUTOMATION

The most immediate impact of technology on the profession is in the automation or even elimination of manual and routine tasks. This movement is accelerated because it has multiple drivers. The shift to cloud-based accounting systems and the attendant standardisation of processes has made data more easily and more widely available, easier to move between systems, easier to manipulate and analyse, and less prone to corruption and errors. For example, where data cannot move seamlessly between systems, the use of robotic process automation (RPA) can remove the need for manual intervention to cover the 'last mile'.

Despite this, there seems to be little appetite for 'human-free' audit – automation can reduce errors and spot patterns, but that merely provides

70%

of the general public across 11 countries believe that audit should evolve to prevent corporate failure

the opportunity for individuals to exercise thought and judgement, and to bring into play other skills such as communication, persuasion and empathy. Auditors may find they are asked to look into fewer anomalies – but these will be the ones that count. It seems that the role of the auditor as filter, narrator and independent challenging voice remains secure.

THE DEMAND FOR A PROACTIVE AND FORWARD-LOOKING APPROACH IN AUDIT

The use of advanced technologies such as AI and ML, blockchain and data analytics promises a transformation in the audit profession, changing audit from a reactive and backward-looking exercise to a proactive, constant source of forward-looking insights that can be used all the time, with the auditor as the custodian and interpreter of the underlying data foundation.

Even in its traditional context, technology now offers an opportunity to produce higher-quality audits that better serve for their existing purpose.

> *'In order to meet society's expectations of today and to remain relevant within the environment we operate, we have the responsibility of transforming the way we deliver on our obligation to the public. This transformation includes our response to the advances of technology-based solutions.'*
>
> Dimitris Sourbis, Assurance Partner, PwC

ACCA's report *Closing the Expectation Gap in Audit* found that 55% of the general public across 11 countries believe that, if auditors followed the requirements of existing auditing standards, they could prevent corporate failure (ACCA 2019a). Furthermore, 70% believe that audit should evolve to prevent corporate failure. Although some may reasonably argue that such demands are unrealistic, technology could well help to satisfy the public demand, at least partly, in the future.

An example would be the use of ML in risk assessment, 'supervised learning algorithms can be used to help identify specific types or characteristics that warrant greater scrutiny and improve targeting areas of focus for the audit.' (ACCA 2019b).

2. Which technologies are changing audit?

Businesses across almost every industry are experiencing at first hand the disruptive changes that are also affecting their auditors. This chapter explores which advanced technologies are impacting the audit profession, referring to both the tools available to auditors and the systems that need to be audited.

In April 2019, ACCA surveyed members and affiliates about their understanding of terms such as artificial intelligence (AI), machine learning (ML), natural language processing (NLP), data analytics and robotic process automation (RPA). On average for any given term, 62% of respondents had not heard of it, or had heard the term but did not know what it was, or had only a basic understanding. On average, only 13% of respondents claimed a 'high' or 'expert level' of understanding of these terms.

There's a need for greater awareness of what these technologies are and their implication for the audit profession.

ARTIFICIAL INTELLIGENCE (AI)

AI is often described as 'an evolving technology' that is equipping computer systems with something akin to human intelligence, but it is better seen as an umbrella term for a group of technologies that can be combined in different ways, whether for driving your car, controlling your central heating, or managing your investment portfolio. It is also the subject of a large amount of hype, with 'human-like intelligence' predicted to appear in 2029 (or whatever the current date is plus ten years) and either drastically reducing the workforce or destroying us all. According to Elon Musk: 'with artificial intelligence we're summoning the demon' (Finamore, E. and Dutta K 2014).

It could be argued that because of a lack of understanding of concepts such as 'intuition' and 'thought,' we do not even know what it is we are trying to emulate. Is intelligence what is measured by an 'Intelligence Quotient' (IQ)? Or, in developing AI, should we be trying to emulate other quotients, such as an 'Emotional Quotient' (EQ).

> *'It is clear that some tasks will no longer be done by the auditors. In the long term, it is likely that the profession will see a shift in its focus with more emotional intelligence expected from auditors rather focusing on data testing.'*
>
> Michal Stepan, Assurance Director, Deloitte Czech Republic

The 'intelligence' in AI often constitutes a combination of processing power and access to data: for instance, a computer will play a game such as chess by analysing all the possible outcomes of a move, using datasets from past games and selecting the winning option.

But that fact alone makes AI highly useful to people: it enables the analysis of entire populations of data to identify patterns or exceptions. Auditors are freed from mundane tasks and can focus their time on deploying their skills, training and judgement: although technology is making progress in areas such as speech processing and sentiment analysis, professional judgement is much harder to apply technology to.

ROBOTIC PROCESS AUTOMATION (RPA)

RPA is often mistakenly thought of as a form of AI but the 'robots' are software routines that are more like very sophisticated Excel spreadsheet macros than genuine AI.

As highlighted in ACCA's joint report with CA ANZ and KPMG *Embracing robotic automation during the evolution of finance*, 'RPA is software that can be easily programmed or instructed by end users to perform high-volume, repeatable, rules-based tasks in today's world where multiple loosely integrated systems are commonplace.' (ACCA et al. 2018).

The next step for auditors and finance is to apply AI and ML algorithms to improve the quality of analysis and forecasting, and increase the rate of fraud detection.

RPA is commonly used when the output of one financial process needs to be input into another, or where multiple sources of information need to be consulted. As a result, it is sometimes referred to as 'swivel chair automation', conjuring up the image of an employee swivelling their chair around as they consult multiple systems and re-key and check information.

Such work is repetitive, mundane, time consuming and, when done by individuals, prone to error. It is also difficult to scale to cope with variations in workload. A classic example would be processing timesheet information from seasonally employed temporary staff.

One solution is to deploy or lease a 'robot', a software routine that precisely mimics the actions of the chair-swivelling person shifting between systems. Looking back to the timesheet example, the robot would take the information gathered by optical character recognition (OCR) from the paper records and feed it into the payroll system. Because it mimics a process rather than analysing data, RPA itself is not AI, which could be used later to look for the anomalies that previously a human operator might have had to spot.

RPA offers many benefits: the robots work non-stop and are faster, more accurate and scalable. Nonetheless, there are also questions about accountability and ownership of the RPA process and security of the data that passes through it.

There is also the question of whether RPA simply perpetuates inadequate processes that should have been overhauled. We can distinguish between 'good RPA', which closes gaps and contributes to straight-through data processing and 'bad RPA', which simply disguises the flaws in obsolescent or badly implemented systems. In short, fix the process first before applying RPA.

DATA ANALYTICS

Analytical tools have long been applied to the data derived from accounting and operational systems.

Some firms are already using data analytics as part of their transactions testing, gradually moving away from traditional sampling techniques. Data analytics allow auditors to use 100% of a population's transactions when performing their tests.

'Using D&A we make the analysis of the past more insightful. Rather than sampling transactions data to test a snapshot of activities, we can now analyze all transactions processed, allowing us to identify anomalies and drill down on the items that show the greatest potential of being high risk. Our systems automate this process, increasing its ability to produce high quality audit evidence.' (KPMG 2015).

> *'I expect that my auditors will no longer test a sample of transactions, for example 100 items, and consider this to be sufficient evidence to form a conclusion for the entire population, when in fact we have tens of thousands of transactions coming in and out on a daily basis.'*
> Juraj Striezenec, CFO, Kiwi.com

However, the UK Financial Reporting Council (FRC) has found that 'the use of data analytics in the audit is not as prevalent as the market might expect' (FRC 2017) and it is not yet used consistently across the entire ledger.

Even where it is used – such as in journal entry testing, auditors will still need to consider the issue of completeness, as well as the increasing amount of corporate reporting that does not derive from transactions in the ledger.

'Being able to test 100% of a population does not imply that the auditor is able to provide something more than reasonable

> 'We are investing in various technologies to support "digital audit", with data analytics being at the moment the most prominent.'
>
> **Leonidas Hatzikonstantis, Partner EY Advisory Services, Greece**

assurance opinion or that the meaning of "reasonable assurance" changes.' (IAASB 2016)

The next step for auditors and finance is to apply AI and ML algorithms to improve the quality of analysis and forecasting, and increase the rate of fraud detection.

The business 'data warehouse' is increasingly being supplemented by information drawn from a variety of public and/or proprietary sources, often using cloud-based applications combined with desktop analytical tools. Augmenting these tools with DL and NLP increases the range of data that can be handled, from written text speech or even images.

The ability to analyse data across and outside corporate data silos promises to enhance the ability of organisations to spot opportunities, head off threats, make better decisions and enable this process to be 'democratised' throughout the organisation.

Auditors can use 'data mining software' to drill down and identify anomalies – possibly aided by AI – focusing resources on identifying risks in addition to monitoring 'business as usual' activities.

MACHINE LEARNING (ML)

A major challenge to the audit profession has been the extreme proliferation of data, accompanied by a less extreme but nonetheless rapidly expanding volume of regulation.

According to ACCA's report M*achine Learning: More Science than Fiction:*

'The rapid growth in the volume of financial transactions, if not properly managed, could pose a threat to the work of accountants. For auditors, this may relate to the sample they need and its ability to be representative of the population, enabling them to form conclusions that can be generalised beyond the sample' (ACCA 2019b).

'In fact, technology like machine learning could go beyond that with the possibility for reviewing entire populations to assist the auditor to test for items that are outside the norm' (ACCA 2019b).

ML uses statistical analyses to generate predictions or make decisions from the analysis of a large historical dataset. A classic example would be credit scoring decisions for loans. The accounting software company Xero has implemented ML to make coding decisions for invoices. ML can achieve surprising levels of accuracy quite quickly: in the case of Xero's software, the system achieves 80% accuracy after learning from just four invoices.

ML 'predictions' can be both backward and forward-looking. It has clear applications in risk management and the detection of fraud and inaccuracy by comparing historical data sets with current data, which can help with risk assessment. Or it can look forward, predicting, for example, the likely future value of an asset.

In practice, the usefulness of ML is crucially dependent on the data it 'learns' from. This means the possibility of bias is ever present. Examples have come to light where ML has introduced bias into areas such as credit-scoring and CV assessment. The machine correctly sees that a previously excluded group had not completed many successful loan transactions or risen very high in management and wrongly concluded that the defining characteristics of those groups, such as gender, were predictors of poor future performance.

An example using ML in audit can be found in PwC's report *Confidence in the future: Human and machine collaboration in the audit* report. As per this example 'company A was way out of line with the peer group benchmarks on a particular point. This data is then shared with the audit team, who can decide whether that variance is really an anomaly and if so, what caused it.

The team's decision about the anomaly and its cause is then fed back to the machine, which is 'taught' how to respond to similar relationships in future. And the more this exercise is carried out, the better the machine will get at spotting real anomalies — meaning we'll be better able to identify unusual patterns and anomalies in huge amounts of data in an instant.' (PwC 2017).

The self-instructing nature of ML means that decision-making can often be a 'black box', with no one able to say precisely how decisions have been arrived at.

There is also the danger that during the learning stage – when ML is shadowing human auditors – it will pick up any human errors and repeat them eternally.

In the era of Big Data, the structured information accessible to auditors is only a fragment or an abstraction of the much wider universe of data.

ML therefore needs to be validated in some way: it is a risk as well as a tool.

This raises the possibility that the challenging and testing of internal algorithms may become part of the external auditor's role, with a much wider remit than assessing accuracy: as the Harvard Business Review comments: 'the auditor's task should be the more routine one of ensuring that AI systems conform to the conventions deliberated and established at the societal and governmental level' (Guszcza et al. 2018).

NATURAL LANGUAGE PROCESSING (NLP)

NLP refers to the ability of the computer to recognise and understand human speech.

The most immediate impact is speed: NLP has been shown to achieve orders of magnitude improvements in due diligence exercises involving very large numbers of documents. In 2017 Forbes reported that Deloitte's use of NLP took contract review from a task keeping 'dozens' of employees occupied for half a year to one which six to eight members could complete in less than a month (Zhou 2017).

Deloitte's Audit of the Future Survey found that 70% of audit committee members and other stakeholders believed that auditors should not only use advanced data analytics but consider information beyond traditional financial statements (Deloitte 2016).

This data could be anything from recordings of phone calls to board minutes or postings on social media, which are unstructured and therefore require an understanding of natural language.

DEEP LEARNING (DL)

DL is a subset of ML; it more closely mimics human learning through the use of artificial neural networks to perform more complex tasks such as visual object recognition.

Its best known example is Google's AlphaGo, which mastered Go, a game which exceeds chess in intellectual complexity and where it was thought that computers could never match the best human players. Unlike previous programs, which learned winning strategies from databases of previous games, AlphaGo taught itself and not only defeated its human opponent but also used highly inventive winning moves, which – according to Demis Hassabis, CEO of the Google subsidiary DeepMind, which created AlphaGo 'were so surprising they overturned hundreds of years of received wisdom' (Hassabis 2017).

DL systems are commercially available and have already been deployed by the Big Four accountancy firms: KPMG uses IBM's Watson to analyse commercial mortgage loan portfolios, while Deloitte works with Canadian-based legal AI company, Kira Systems to 'read' thousands of complex documents, such as contracts, leases and invoices, extracting and structuring textual information such as key words or phrases.

In the era of Big Data, the structured information accessible to auditors is only a fragment or an abstraction of the much wider universe of data. But this 'dark matter' exists in unstructured formats: the ability of DL to analyse a range of internal and external sources means that Big Data can potentially supply complementary audit evidence and feed into the narrative requirements of audit.

'For instance, content analysis of social media postings and news articles could inform auditors of potential litigation risk, business risk, internal control risk, or risk of management fraud…auditors may identify troublesome products or services by analyzing customers' reviews… sentiment scores of the Q&A section of earnings conference calls can help the auditor predict internal control material weakness' (Sun and Vasarhelyi 2018).

Used in audit, DL potentially goes beyond merely extracting set words or phrases or even what has been explicitly said:

'auditors interview management, internal auditors, employees, predecessor auditors, bankers, legal counsel, underwriters, analysts, or other stake-holders. The language that subjects use and how they respond to questions over the course of the interview can be just as important as the answers themselves, because they may indicate deception. For example, the use of terms that suggest uncertainty, such as "kind of," "maybe," or "sort of," as well as response latency, could be signs of concealment or falsification' (Sun and Vasarhelyi 2017).

The Big Four accountancy firms have spotted the potential for the use of drones in inventory inspection, particularly where physical scale or distribution is an issue.

DRONE TECHNOLOGY, INTERNET OF THINGS AND SENSOR TECHNOLOGIES

Unmanned drones are used in a variety of commercial projects, such as power line inspection, and the Big Four accountancy firms have spotted the potential for their use in inventory inspection, particularly where physical scale or distribution is an issue. For example, PwC recently announced its first stock count audit – of an open cast mine – using drone technology (PwC 2019).

Drones are the aerial component of the Internet of Things, the constantly growing number of devices and sensors connected via IP (internet protocol). An example of a sector that is ripe for the adoption of such technologies in audit and assurance is agriculture.

DISTRIBUTED LEDGER TECHNOLOGY (DLT)

DLT, a family of technologies that includes blockchain, is of great interest to both auditors and businesses.

According to ACCA's report *Divided we Fall, Distributed we Stand*, DLT ensures that 'in a distributed ledger all participants are looking at a common view of the records.' (ACCA 2017a), which are validated without the need for a central authority for this purpose. 'So if the majority of participants agree that an update has been correctly validated, that becomes the basis for the updated entry to be added to the ledger.' (ACCA 2017a).

For businesses, the attraction of DLT is that it greatly enhances performance in areas where inefficiencies are introduced by the so-called 'efficiency visibility' and 'trust' deficits. Examples include the inefficiencies and delays involved in setting up trade finance, the need to establish trust via 'know your customer'/'customer due diligence' (KYC/CDD) requirements in finance and banking or the lack of visibility in the global garment supply chain are all key areas for distributed ledger applications.

For the auditor, distributed ledgers become a sort of universal bookkeeping service, removing the need to reconcile multiple databases of records and providing a perfect audit trail. A key principle of DLT is immutability: historical entries cannot be changed, only corrected with a balancing entry.

While this may help auditors to test audit assertions such as occurrence and cut-off, it does not remove the need for higher-level auditor judgements. Transactions may exist outside the ledger and, while those recorded are unlikely to be false, they still may not be legitimate.

The auditor therefore needs to combine the ledger information with judgements based on accounting principles and an understanding of the nuances applicable to ownership and valuation.

For auditors, DLT offers the possibility of generating exception reports that are based on all transactions rather than on using sampling techniques – a return to the roots of auditing. Today's audit cycles could potentially be replaced by more frequent or even continuous, real-time, audit.

This is likely to release resources and provide the material for a deeper and more contextual understanding of the business, as required for the production of extended audit reports. However, this is also likely to increase resources with specialised skills in DLT, at least in the short-term. While DLT may be supported by standardisation and automation of data collection – possibly via 'accounting-as-a-service' platforms – the removal of mundane tasks will bring the contribution of the auditor's judgement into stronger focus.

Although DLT has mainly come to prominence for its use in underpinning cryptocurrencies such as Bitcoin, it originated in relation to smart contracts.

The report concludes: 'The auditor role may pivot towards non transaction-management elements requiring human judgement, business context and knowledge of technical accounting policy and of the outputs created by the application of these elements to specific questions within the audit, for example the fair value of assets' (ACCA 2017a).

As noted in CA ANZ's and Deloitte report *The Future of Blockchain*, 'Distributed ledger technology and blockchain are important innovations in themselves. But there are many potential uses ahead, as augmenting these technologies with others can create novel applications' (CA ANZ and Deloitte 2017).

The implications for audit as an industry suggest a reversal of the current model, in which largely predictable, high-volume work is charged on an input basis, with the attendant risks of commoditisation and low margins. Instead, the audit model could move towards a value-based charging model based on outputs: higher margins, fewer people and more high-end skills.

It has even been claimed that blockchain will become the industry standard for accounting and reporting. According to Jon Raphael, audit chief innovation officer at Deloitte & Touche LLP:

'Blockchain has the potential to be very transformative. By itself, blockchain will likely change how records are maintained and how value is transferred between counterparties…

'Most compelling, however, is blockchain's potential for transformative analytic capabilities. One of the beneficial outcomes of blockchain is easy access to structured data which can then be used to generate advanced analytics and accelerate machine learning. This will enable tools to get smarter and drive us further and faster toward more continuous auditing and assurance' (Deloitte 2018).

SMART CONTRACTS

Although DLT has mainly come to prominence for its use in underpinning cryptocurrencies such as Bitcoin, it originated in relation to smart contracts.

A smart contract is self-executing: the terms are written into code which, like a Bitcoin, exists in a blockchain network and therefore shares the same characteristics. Smart contracts are literally anarchic in that they do not require external enforcement by any kind of central authority. Smart contracts therefore allow transactions to take place without any underlying basis of trust, or even anonymously. Suggested uses include land registers and trade finance.

From this perspective, a cryptocurrency such as Bitcoin is just a minimal instance of a smart contract to transfer value from one person to another. More generally, a smart contract is just an instance of more general ability to generate code that executes exactly as its originators intended.

For example, Ethereum, a smart contract platform that enables developers to build new decentralised applications ('dapps'), is a programmable blockchain that potentially has uses in many areas of finance, including audit.

Of course, just because an app executes as intended does not mean that the intentions of those using it are good or correctly expressed, or that there may not be unintended consequences as programs automatically execute, as has happened on trading platforms. The audit of smart contracts themselves is a requirement, and is already a nascent industry.

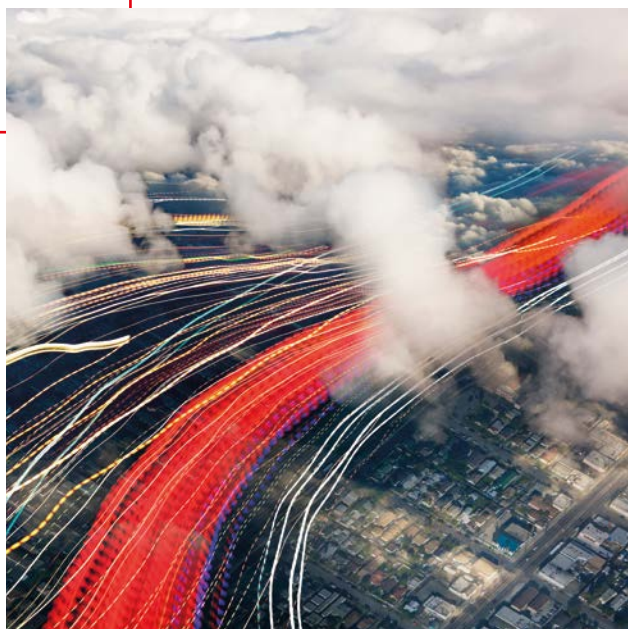
Blockchain is a system for dealing with information, and the effectiveness and resilience of platforms such as Ethereum is very much a factor of their size. The Big Four firms could conceivably set up blockchains for businesses or for entire industries; however, that would have potential implications for example, on auditor's rotation and independence.

'In regards to distributed ledger technology, we are not there yet in terms of real implementation in audit'
Lukas Caputa, Senior Manager Risk Assurance, PwC Czech Republic

For cloud to be useful it must contain critical data, and a key benefit for audit is that organisations will increasingly be referring to a single data source, which updates for everyone, everywhere with no time lags or inconsistencies.

CLOUD TECHNOLOGIES

The rise of cloud-based systems goes back a long way: arguably, a mainframe computer connected to dumb terminals in regional offices represented an early form of 'cloud'. Now, a cloud system will be hosted remotely and accessed remotely by generic devices such as tablets, PCs or smartphones.



The attractions of cloud systems are summed up in the ACCA report, *The Race for Relevance:*

'Compared with an organisation's own legacy physical infrastructure, cloud technologies provide high functionality at a low price point. The associated maintenance costs are also reduced… cloud technology costs may be classed as operating expenditure rather than capital expenditure.' (ACCA 2017b).

'As well as the cost benefits, cloud storage can provide seemingly infinite capacity, with the business only paying for the space that it uses.' (ACCA 2017b).

'One benefit of cloud is that it allows employees to work from anywhere in the world, which means that geographically dispersed teams can work on the same project in real time.' (ACCA 2017b).

However, cloud systems also force the organisation to adopt standardised processes: 'they need to adapt their business models and processes to suit these applications, rather than adapting the applications to suit their business models.' (ACCA 2017b). Arguably, this is a benefit, preventing finance functions from unnecessarily overcomplicating their work and reducing the complexity for auditors when dealing with entities comprising different or multinational companies: even companies that have standardised their functions around a common ERP system are generally running multiple variations and lack the skill or the resource to create appropriate APIs between them.

For cloud to be useful it must contain critical data, and a key benefit for audit is that organisations will increasingly be referring to a single data source, which updates for everyone, everywhere with no time lags or inconsistencies.

This also comes with risks arising from the need to protect critical data and comply with relevant regulation. 'Cyber risk is one of the most talked-about business risks. In our increasingly disrupted world it is at the forefront of our minds.' (ACCA et al. 2019) While implementation of appropriate risk-mitigation strategies rests with the cloud provider, the risk itself remains with the data owner. In practice, however, many smaller entities argue that cloud vendors offer better security than, say, an in-house server.

According to KPMG, auditors need to integrate more cyber security capability in the audits and rethink and re-evaluate their approach in providing assurance around cloud systems.

'This can be achieved by transforming audit approaches leveraging data analytics-driven procedures in order to address the less preventive controls in the system. In addition, the processing and storing of data in the cloud for cloud bases systems introduces new challenges around third party management and data security and confidentiality.' (KPMG 2018).

3. What does this mean for auditors as people?

The endlessly repeated mantra is that, while technology is automating away all the administrative and routine work, accountancy (and many other) professionals can focus on value-added activities.

Certainly, this is happening with Big four firms and mid-tier firms. However, as discussed in ACCA's report *The Passionate Practitioner*, there is also evidence that this is happening within SMPs too, which are using technology to free themselves from routine compliance work, and focus on deepening their relationships with clients and creating value for both their client base and their own businesses (ACCA 2019c).

As CA ANZ's report *The future of trust* highlights, it is not the shift towards increased use of technology that is damaging trust in the delivery of professional services, but the accompanying move away from face-face contact (CA ANZ 2019). Focusing therefore on deepening their relationships with clients will also ensure trust is maintained in a digital world.

> *'The human relationship between client and auditor remains important, not everything can be replaced by technology.'*
> Peter Mrnka, Director Assurance, PwC, Slovakia

The importance of human relationships between businesses and their auditors, was discussed in all panel discussions supporting this research. Audit practitioners and business representatives emphasised that human relationships remain of vital importance. Some of them find that the automation of routine work provides an opportunity for human interactions to be more meaningful.

> *'It is clear that some tasks will no longer be done by the auditors. In the long term, it is likely that the profession will see a shift in its focus with more emotional intelligence expected from auditors rather focusing on data testing.'*
> Michal Stepan, Assurance Director, Deloitte Czech Republic

> *'Technology only helps with the visualisation of a problem – people then need to analyse what is typical and non-typical.'*
> Dalimil Draganovsky, Head of Assurance, EY Slovakia

CA ANZ's research *Machines can learn, but what will we teach them?* finds that 'AI brings with it a range of ethical considerations that should not be left to the tech giants to decide' and highlights that 'failing to build an ethical dimension into each stage of our AI journey could bring serious consequences that prove difficult to reverse.' (CA ANZ 2018).

ACCA's research has shown that knowledge of digital technologies tops the list of competency areas where professional accountants believe there are key skills gaps (ACCA 2016). CA ANZ joint research with PwC on talent identified the ability to work with data and technology as a gap (CA ANZ and PwC 2017). Clearly, audit staff need to be comfortable with technology if they are going to realise its potential. But does that extend beyond understanding the system's capabilities and being capable of operating the (increasingly intuitive) interfaces? Where in the organisation should those IT skills reside and how do they interact – organisationally, personally and culturally – in ways that will support the goals and value of audit?

Technological empowerment is a double-edged sword. IT skills are paramount yet extremely short-lived. Even trained IT professionals who find themselves out of the workplace for an extended period rapidly suffer 'skills erosion' and can struggle to re-enter the workplace. A key skill for auditors – at least during the coming years – will be the flexibility to adapt to a working environment which will continue to evolve.

But there are lots of things that machines cannot do. People could end up mirroring the 'gap-filling' role of RPA robots.

'People will need to be more adaptable to change.'
Brian Jackson, Audit and Assurance Partner, Deloitte Ireland

Employers cannot simply delegate this to staff but will need to consider carefully the design of emerging roles, as ACCA's report *The Race for Relevance* (ACCA 2017b) identifies.

'The implementation of technologies such as RPA will make changes in the way that organisations are structured. People tend to be comfortable with role-based structures but RPA focuses on tasks and this can have an impact on the performance management of individuals, who may need incentives for working with a virtual workforce. It will also challenge the traditional spans of control with which leaders at each level are familiar.' (ACCA 2017b).

Apart from fear of headcount reductions, another reason for staff resistance to RPA and other new technology is that employees may see their roles as having been reduced from accomplishing an (albeit boring) task to that of machine minders. Dishwashers may save time but emptying them is much less satisfying than washing dishes by hand. In this relationship it is clearly the machine that is adding the value, and the human is merely tidying up. What we might call 'job optimists' often claim that humans will do the things that AI cannot and simply assume that those things will be interesting and have added value. But there are lots of things that machines cannot do. People could end up mirroring the 'gap-filling' role of RPA robots.

Complex tasks that historically required high-end workstations can now be performed on a train, on a device. Connect to the cloud and the power of a global ERP system can be at your fingertips. Technology therefore has much wider implications across the employee life-cycle, from work–life balance, remote working, and career progression. It will be an 'always on' environment.

Even if the impact of technology such as AI is not to reduce headcount but instead to re-focus auditors on higher-value tasks involving judgement, intuition, experience and communications skills, the question is: where will auditors acquire those skills? The tasks that are being automated are typically currently carried out by entry-level staff at the base of the pyramid.

'Auditors now need to be "hybrids" having auditing and financial skills but also some technological skills.'
Michael Hughes, Director, ISACA Central UK

While performing tasks that use basic technical skills, staff are at the same time acquiring other, more valuable, skills. Many senior accountants speak highly of the exposure their early audit careers gave them to many different companies and industries, which often helped in their later choice of career. Auditors see companies in good times and bad, and often find themselves exposed to very senior people at a very early age. Those experiences help shape the judgements, intuitions and perceptions that they bring to bear on the audit and hone their analytic and communications skills.

Where will auditors acquire the narrative skills needed to 'tell a story' about their work, clearly and succinctly?

According to the *Financial Times* (FT) the need for such skills will lead to 'firms having to develop new intense training environments' (Murphy 2017) but will this be enough to give trainees the sort of 'feel' they used to get for, say, manufacturing business, when drones are flying round the factory counting things for them?

ACCA research provides insights into the required future skills mix and how they may change, including the 'digital quotient', as discussed in *Professional Accountants – the Future: Drivers of Change and Future Skills* (ACCA 2016). This report identifies a range of quotients (in addition to the traditional technical and ethical skills quotient) that will be needed in the finance function of the future.

Communication skills will be among the most important competencies across all specialist areas, and have been identified in ACCA's research as an area where there is a large skills gap.

- **Technical skills and ethics (TEQ):** The skills and abilities to perform activities consistently to a defined standard while maintaining the highest standards of integrity, independence and scepticism.
- **Intelligence (IQ):** The ability to acquire and use knowledge – thinking, reasoning and solving problems.
- **Creative (CQ):** The ability to use existing knowledge in a new situation, to make connections, explore potential outcomes, and generate new ideas.
- **Digital (DQ):** The awareness and application of existing and emerging digital technologies, capabilities, practices and strategies.
- **Emotional (EQ):** The ability to identify your own emotions and those of others, harness and apply them to tasks, and regulate and manage them.
- **Vision (VQ):** The ability to anticipate future trends accurately by extrapolating existing trends and facts, and filling the gaps in knowledge by thinking innovatively.
- **Experience (XQ):** The ability and skills to understand customer expectations, meet desired outcomes and create value.

While technical and ethical (TEQ) competencies remain at the core of the professional accountant's skill, all professional accountants must complement strong technical skills and ethics with strong communication skills. Communication skills will be among the most important competencies across all specialist areas, and have been identified in ACCA's research as an area where there is a large skills gap.

ACCA and CA ANZ offer qualifications that progressively develop students' and members' digital and technology knowledge building the skills to analyse and evaluate financial and non-financial data, with a clear understanding of the professional and ethical obligations that must be met in the use of data and data technology.

A joint paper by CA ANZ and PwC entitled *The future of Talent: Opportunities Unlimited*, identified that employers are increasingly looking for enterprise skills – the ability to solve problems, communicate effectively, collaborate and to lead, create and innovate. (CA ANZ and PwC 2017)

Some traditional auditing skills will decline, others will increase in value.

> *'Problem-solving skills are essential as many other skills can quickly become obsolete.'*
> Brian Jackson, Audit and Assurance Partner, Deloitte Ireland

'Professional scepticism will remain a key competency. We need to apply our sixth sense as accountants and auditors...', commented Patricia Kintu, chief internal auditor, Office of the Auditor General, Operations division, African Development Bank, Uganda.

The role of the auditor will change in significant ways and this will pose an appreciable challenge to recruiters as they seek to attract scarce talent and new personality types to an audit profession that will take some years to transition fully to new models.

According to Brenda Stasiulis of supply-chain applications producer, MIQ Logistics:

'Accounting needs to be seen as more forward-looking, futuristic and high-tech to capture the interest and imagination of young people.' (Forbes and KPMG 2017).

On the other hand, the 'hybrid' skills necessary for future auditors might in fact make the audit profession more attractive to people of different backgrounds. Auditing is still a profession requiring team work and it is the right mix of skills in the team that will be important.

4. Conclusion and key messages

Advances in technology raise many questions about the future of audit, a number of which reflect some long-standing tensions.

Technology offers the ability both to improve the quality of audit and to add value to it: audit is moving from being a reactive, backward-looking exercise to a proactive, predictive, forward-looking one, working in real time. As such, it provides further opportunity to help businesses through timely insights.

Nonetheless, if AI and related technologies are fully implemented, it could raise questions about the auditor's independence. 'A quality audit requires the auditor to maintain independence at all times when performing the audit. At the same time, audit quality is enhanced by the closeness to an audited entity that is acquired through repeated involvement in the engagement.' (ACCA 2018).

Data analytics seems to be the most mature of the advances in technology and is currently used in audit practice, particularly in journal entry testing. The Big Four accountancy firms are already expanding their use of data analytics in risk assessment as well as in testing revenue, receivables, payables, and salaries. Data analytics tools are also easily accessible by SMPs at a reasonable cost.

KEY MESSAGES

- Auditors need to adapt to the changes in business models.
- Among the available technologies, data analytics is currently the most mature and is currently used by most firms.
- The audit profession is still at a very early stage with AI and has not embedded it as deeply as it could.
- The human relationship between client and auditor remains important: not everything can be replaced by technology.
- Auditors will need to be more adaptable to change in future.

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