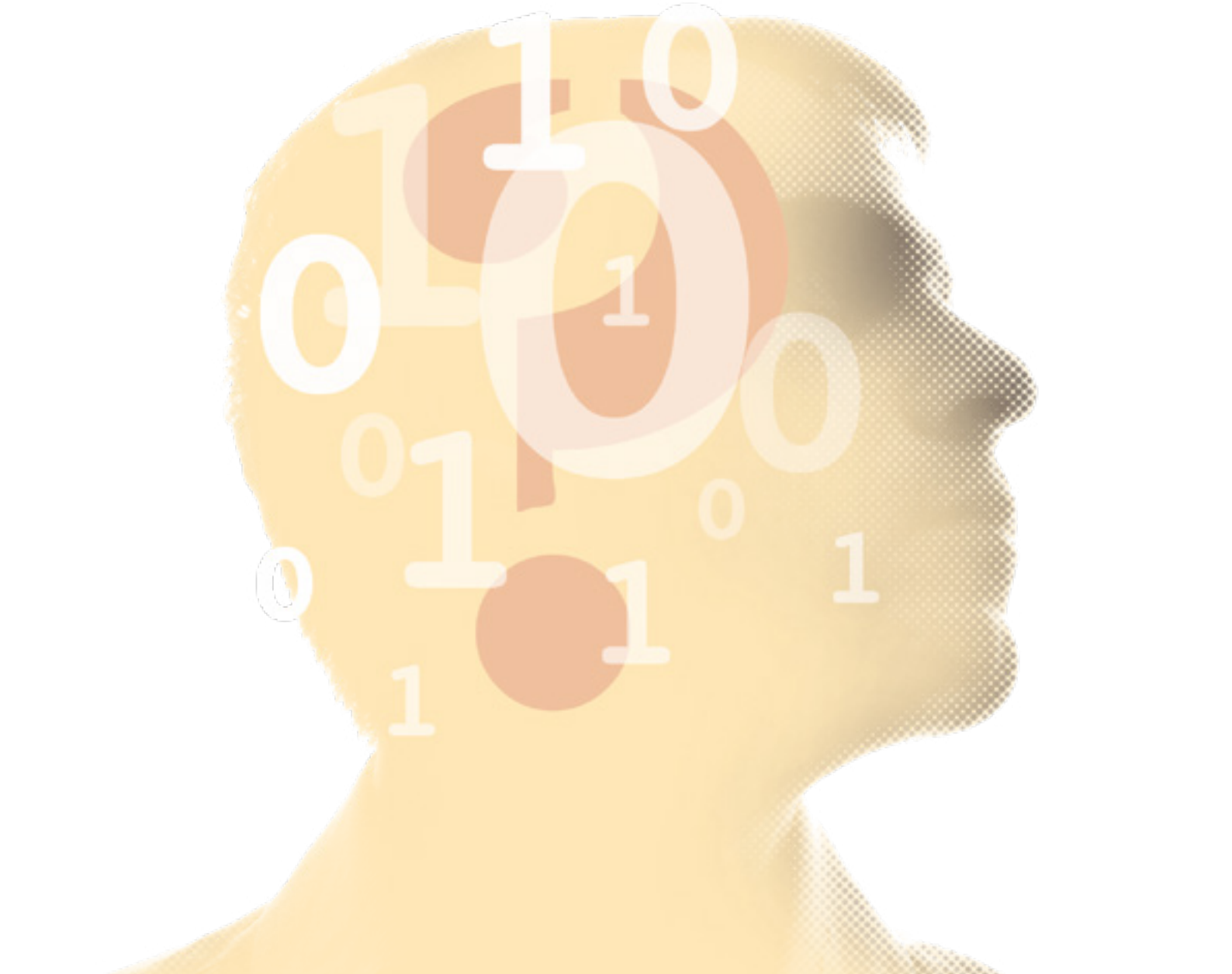
ICAEW THOUGHT LEADERSHIP
TECH FACULTY

Big data and analytics: the impact on the accountancy profession



Contents

KEY POINTS

- The trend of big data is being propelled by enormous growth in computing power, new sources of data and the infrastructure to enable innovative knowledge creation.
- Applying analytics to big data creates many opportunities for businesses to gain greater insight, predict future outcomes and automate non-routine tasks. It also provides opportunities for the accountancy profession to deliver greater value and to help businesses transform their decision-making in many different areas.
- We need to ensure the use of big data and analytics is appropriate and subject to robust challenge, especially where predictive models are being relied upon. We also need new thinking about the ethics, governance and regulation of big data, to ensure sufficient transparency and to encourage confidence in its use.
- Businesses require greater skills in data and statistics in specialist data disciplines, across a wide range of business functions that are using big data, and among accountants.

Introduction

There has been a lot of talk about big data and analytics in recent years, but what does it really mean in practice? Businesses have always used data and information to support decision-making and manage operations. So what's new or special about big data? And how are businesses generating value through it?

When analytical techniques are applied effectively to big data, businesses can potentially achieve many improvements – personalised services, optimised operations and better risk management, for example. Data can enable businesses to base their decision-making more on hard evidence and fact, with less emphasis on guesswork and assumptions. Furthermore, the sheer volume and breadth of opportunities to use data is increasingly transforming the business environment and providing opportunities for disruptive new business models.

As a result, it's important to build our understanding around what big data means, what analytical techniques can do and how businesses and accountants can exploit these trends. This short report aims to inform decision-makers in business and government about the opportunities and risks arising from big data and analytics, and it considers the impact on the accountancy profession.

Our framework for analysis is shown in the image below and focuses on three questions.

- What's creating big data?
- What are the opportunities and risks?
- How do we exploit big data?

What's creating big data?

There is no doubt that the world is producing enormous amounts of data. But 'big data' isn't just about volume. After all, scientists and industries such as banking have been coping with very large amounts of data for many years. Big data is also about complexity and speed, and is often characterised by the '3 Vs' – large volumes of data, high-velocity data flows, and a wide variety of data, especially unstructured and semi-structured data such as text and images.

The trend of big data is being propelled by three factors:

- growth in computing power;
- new sources of data; and
- infrastructure for knowledge creation.

Big data is an important trend not just in its own right though. It has been a key enabler to improvements in machine learning in recent years, supporting the spread of artificial intelligence across a variety of business areas.

COMPUTING POWER

The core enabler of big data is the enormous growth in computing power and storage, which is making possible the capture and processing of entire data sets, regardless of their size and complexity. This is often described in terms of exponential growth in computing power.

MAKING SENSE OF EXPONENTIAL GROWTH

The impact of exponential growth is commonly illustrated through an ancient Chinese story about a chessboard. As a reward from the emperor for a particular task, a man puts one grain of rice on the first square of a chessboard and asks for the emperor to double it for each square – going from one to two to four and so on. While this seems an innocuous request, which is quickly granted, the rice quickly mounts up. By the last square on the chessboard, the man is owed 18,446,744,073,709,551,616 grains of rice. This story illustrates that while growth by doubling starts off with small changes, it soon leads to very large increases which can become difficult to comprehend.

In their book *The Second Machine Age*, Erik Brynjolfsson and Andrew McAfee argue that this is exactly what we are now seeing with computing technology. Rules of thumb such as Moore's Law show that all kinds of computing capabilities have been doubling every year or two since the early days of business computers in the 1960s. Brynjolfsson and McAfee argue that we are now effectively in the second half of the chessboard, which is resulting in very large improvements in short periods of time.

The cloud computing model further supports the widespread use of big data. Cloud computing is based on a model of pooling and sharing computing resources across a business (private cloud) or between a number of different customers (public cloud). The cloud model can provide businesses with more efficient and flexible access to substantial computing resources. By using a cloud, a business doesn't need to buy all the computing resources it might use; it simply accesses them when needed.

Software advances have complemented these developments in processing and storage capability. For example, new types of software support large and unstructured data sets better than traditional database management systems. Capabilities in handling unstructured data, such as video and text, have improved greatly.

DATA SOURCES

Increases in computing power are making it economically viable to collect and process data from many new sources, such as the following:

- The internet provides a variety of clickstream data, such as searches, sites visited and goods viewed, as well as actual transactions.
- Social media has created new types of data, including status updates, comments and likes, photos, videos and networks of contacts.
- Mobile technology provides more opportunity to create social media and internet data, and generates new data about the location of individuals.
- Open data refers to the release of large amounts of primarily public sector data, such as geo-spatial data, transport data, government financial data and public service data.
- The internet of things involves embedding computer chips and sensors in physical assets, such as machines, buildings, domestic appliances and clothes, which then generate data.

As businesses increasingly use digital technology in areas such as sales and marketing, customer management, supply chain and internal communications, they are also generating more data internally which they can use. Furthermore, the improvements in the management of semi-structured and unstructured data enable businesses to make better use of a variety of existing and new data sources, such as email and text, CCTV, pictures and voice.

Consequently, we are seeing a massive 'datafication' of activities, for example, goods that we look at but don't buy, our daily travel routes or photos we take. While these activities have always happened, it hasn't previously been technically possible or economically viable to capture and analyse data about them on a systematic basis.

INFRASTRUCTURE

The digital infrastructure has enabled new types of collaboration and knowledge creation, as evidenced through trends such as crowdsourcing and open source software. This sharing of knowledge has brought together new communities and led to insights in data from unexpected places. Sometimes, insights have come from data specialists who know nothing of the topic but can spot patterns in data. Other times, insights have come from domain specialists who really understand the field and have used fairly basic data techniques to solve problems. But the flexible nature of the digital environment enables all kinds of new knowledge sharing and creation.

The emphasis on applied research, especially in conjunction with commercial use and research challenges, has also enabled significant progress in specific fields. Advances in automated language translators, for example, have flowed from the insight that word-for-word translation is not very effective – in many cases, a single word translates into a number of words. As a result, researchers moved on to phrase-to-phrase translation. This has in turn been superseded with neural network-based approaches which translate entire sentences at a time. These advances have come from new understanding of specific problems rather than breakthroughs in general theory.

ANALYTICS TECHNIQUES AND TOOLS

Big data by itself doesn't get us very far. We also need analytics to help us make sense of it and gain insights from it. Analytics and visualisation tools have got more user-friendly, enabling more self-service in businesses and less reliance on technical experts to run queries. The costs have also come down, with all kinds of free or cheap tools increasingly available, often linked to cloud applications.

In some cases, the simple ability to see large amounts of data, using good visualisation software, helps users to see patterns, outliers and exceptions more easily. Similarly, better tools have made it easier to link together data from different sources, which in itself can provide new insights. These tools are also making it possible to do increasingly advanced statistical analysis of data, using more variables, more real-time data and more sophisticated modelling.

What are the opportunities and risks?

These trends enable businesses to use data in ways that were not previously possible or viable. We separate out three broad ways in which big data is being used to improve business decisions:

- to gain insights;
- to predict the future; and
- to automate non-routine decision-making.

In each of these areas, there are opportunities to create value for a business. However, there are also risks in using data in these ways, and care needs to be taken to avoid unjustified conclusions, ensure appropriate reliance on predictive models and manage the impact of growing automation.

INSIGHT

Businesses can use big data to enhance their understanding of their operations, customers, risks and markets, including the following:

- Using new sources of data to gain new or enhanced information, for example using more granular data about customers to understand their preferences, activities and location.
- Exploiting the real-time nature of big data to improve services and operations, for example through personalising responses and offers.
- Applying analytics to gain new insights and interrogate entire data sets, eg:
  - recognising new associations and patterns;
  - linking data from disparate sources; and
  - identifying exceptions, unexpected behaviour and outliers.

By using big data, businesses can obtain a level of real-world evidence that was previously not possible. This can help them to reduce their reliance on assumptions and guesswork, and provides many opportunities to improve business decisions about customers, suppliers, employees, strategy and risk.

Accountants have increasingly been making use of some of big data's capabilities.

ACCOUNTING USE OF BIG DATA AND ANALYTICS

Data is at the heart of accounting, and therefore big data can help accountants deliver more value to businesses.

Auditors – internal and external – have been at the forefront of accounting's use of big data. The ability to analyse entire data sets – in some cases billions of transactions in a ledger – is changing traditional approaches to audit, which are based on sampling. While auditors will still do detailed work on smaller samples of data, audit analytics enables them to identify outliers and exceptions and focus on the areas of greatest risk. They can also use a wide range of analytics tools to visualise the data, connect financial and non-financial data and compare predicted outcomes with the real world.

Accountants in businesses also have many opportunities to use different sources of data and new analytics tools. These can help to improve forecasting, for example, drawing on non-financial data or using more real-time data. Likewise, linking non-financial and financial data can enable better analysis of cost drivers. Granular data can help with detailed analysis of controls and operational processes, identifying failures or pressure points which can be improved. Furthermore, these tools can be used by accountants in advisory roles, to help businesses with their business planning or operations.

Another set of beneficiaries of this data insight are regulators, who have increasingly pushed for more and more data from businesses, as well as other sources. Access to this data provides opportunities for regulators to focus their resources more effectively and identify what needs further investigation.

REGULATORY EFFICIENCY

The UK government's tax authority, HMRC, has been at the forefront of using big data to combat tax fraud. Its Connect system draws on data from many sources, enabling sophisticated analysis to identify outliers and anomalies. As well as data from tax returns, it uses data from the internet, social media sites, land registry records, international tax authorities and banks. The ability to connect together disparate data about individuals is seen as the key to success. While this was always possible, the time involved in making such connections manually was prohibitive.

Regulators in many other areas are also using new data and more sophisticated analytics tools to increase understanding of business operations and risk, and focus their resources accordingly. For example, the Securities and Exchange Commission in the US has a strong focus on data analytics to help focus investigations and resources, and identify insider trading more easily.

These new capabilities can be extremely powerful, but there are also well-established risks of using data in this way. For example, management information systems have always been hampered by data which is inaccurate, inconsistent, duplicated or out of date. These problems can be significantly amplified by big data, as many of the new sources of data, such as social media, can be unreliable or become outdated very quickly.

Traditional responses to poor-quality data emphasise cleansing data, or disregarding it entirely where the quality is very poor. Big data commentators argue that the sheer volume of data makes granular quality less important. Analysis will still show the general trend, even if individual data items are of variable quality. In order to make the most of opportunities with the data, it is argued, we instead need to work with some degree of ambiguity around the accuracy of some data.

However, there is a trade-off between data volume, speed and granular quality, and there will be different conclusions depending on the specific context. Where data is being relied upon to make important decisions about specific individuals or organisational resources, ensuring appropriate levels of quality will remain vital. By contrast, where analysis aims to identify trends, or respond quickly to customer demands, some data inaccuracy is more likely to be acceptable. Decision-makers need to understand the standard of quality required in different contexts and ensure that the data used meets that standard.

Another risk relates to the selection of data and parameters of the analysis. One advantage of big data techniques is that they enable the analysis of entire data sets, rather than samples of data. This may allow users to spot new patterns or outliers. It also overcomes the risks of using smaller data samples. While the analysis of samples is valid, this needs to be done carefully to ensure that there is no bias in the sample and to enable the results to be extrapolated to a wider population. By using entire data sets, big data can avoid these sampling risks.

But all data sets, to some extent, represent a specific selection of data and therefore care needs to be taken to ensure that broad conclusions are justified. There may be other relevant data that is not captured in the data set, for example data from an earlier period or data about individuals who do not participate in particular activities. Social media data is often cited in this context – researchers may be able to interrogate entire data sets, but they are not representative of the entire population.

Care also needs to be taken to understand what the data really tells us. Big data may highlight new associations and patterns but they may be spurious. The urban myth of a correlation between buyers of nappies and beer at particular times of the day is well known, but it's not clear what insight that would really give. There are also many statistical traps to be avoided, such as relying on averages which hide large variations.

PREDICTION

Big data analytics particularly focus on the prediction of future outcomes and embedding predictive models in business operations. While businesses have always been trying to predict the future, big data opens up new possibilities. New sources of data mean that it is possible to make predictions in new areas, and machine learning techniques increase the accuracy of prediction models. As a result, greater reliance can be placed on models.

Search engines, for example, predict the information that will be most useful to the individual. That prediction will be based on other links to the material, the proximity to the search term and the extent to which others have clicked on the link. It may be personalised, based on location, gender, age and previous search history, where these are known. Increasingly, search engines predict what you're searching for, as you type.

Many customer service functions personalise services based on predictions about individual customers. Recommendation engines use information about previous transactions, similar customers and the qualities of products and services to predict products you are likely to enjoy. They may be able to predict when customers are likely to shift loyalties elsewhere or how they will respond to a particular offer.

Other businesses are making use of predictions about the wear and tear of physical assets. This enables efficient scheduling of repair and maintenance to minimise faults and prolong the life of assets. Sports teams and commentators are using data to predict the future performance of individuals and teams.

So there are many uses for predictive models, and they are becoming increasingly widespread across all kinds of businesses. But there is a big step from merely gaining insight from data to predicting future activities. Can such models really be relied upon?

At the heart of this debate is the risk of relying on correlations rather than understanding causation. Big data predictive models use associations between elements (correlations) and patterns to predict future outcomes. They are not necessarily based on any deep understanding of why particular outcomes occur.

While correlation models can be extremely accurate, there are dangers of relying entirely on correlations with no reference to underlying theories of causation. The links found may be spurious and result in false positives or negatives. Systems based on correlations can be gamed to get a particular answer. If conditions change but the underlying model assumptions remain the same, the model can suddenly produce highly inaccurate predictions.

In order to understand when predictive models are most valuable, we need to consider when having more data leads to more accurate predictions. Predicting the path of hurricanes, for example, has improved significantly in recent years, due to more data from more sources, such as satellites. However, predicting the intensity of hurricanes has seen very little improvement, partly because data that might help, such as data about oceans, is not yet captured sufficiently well.[1]

[1] Mark Bourassa and Vasu Misra, 'How meteorologists predict the next big hurricane', *The Conversation*, 12 September 2018.

Relying on algorithmic predictions when making decisions also raises ethical concerns, especially around bias and unfair outcomes.

BIG DATA AND ETHICS

In her book, *Weapons of Math Destruction*, Cathy O'Neil outlines a variety of examples of algorithmic-based decisions which are based on faulty models and which give biased or unfair outcomes. Typically, models draw on a range of data to classify people, based on particular similarities, and use that classification to make predictions about people's future behaviour. Some of the common problems highlighted include:

- not enough data to be statistically valid;
- lack of feedback loop to pick up errors or changes in the environment;
- opaque use of data, often using sensitive data that would otherwise not be allowed;
- confusing correlation with causation; and
- using data that is cheap and easily available, rather than data that is most relevant but hard to capture.

These problems result in models, and decision-making, which can discriminate against disadvantaged groups, for example in criminal justice. It can also have far-reaching impacts on behaviour, as people try to game systems. In this regard, she cites the ratings of US universities, and how the selection of data used in the process drives universities to spend lots of money on sports facilities, for example, but provides no incentives to keep fees low.

AUTOMATION

The third broad use of big data builds on these predictive capabilities to automate routine and non-routine decisions and tasks.

Driverless cars have received a lot of publicity as the technology has improved rapidly in recent years. They rely on a wide variety of data from sensors, mapping applications, satellites and other sources to navigate their way, and they are becoming increasingly reliable in their decision-making. Indeed, they are often seen as a way to improve road safety, as they remove the risks related to human fatigue, carelessness and poor-quality driving.

We also see growing automation in professions such as law and medicine, as computers take on more tasks which have previously been difficult to computerise on the basis of predefined rules. For example, healthcare companies are starting to exploit machine learning techniques in areas such as medical diagnosis. Computers can hold far more information than humans and can quickly and accurately work through the possible scenarios based on the presenting symptoms to identify the most likely cause. In the legal profession, models can scan through vast amounts of potential evidence much more quickly and accurately than humans.

Automation is also having an increasing impact on accountancy. Significant areas of bookkeeping and compliance work are being automated, and machine learning techniques will enable even more complex and less standard tasks to be automated.

The rapid development of these technologies and techniques raises deep questions for professions such as accountancy and law around how far automation can go – when are computers better decision-makers, and when does human knowledge remain vital?

There are also clear risks where automation goes wrong. How do you know something has gone wrong? Who is responsible? How do you correct errors? Furthermore, by automating more decisions and actions – and thus reducing the role of human intervention – businesses could in fact increase the potential impact of hacking and rogue machines. To manage such risks, businesses need to put greater emphasis on cyber security.

How do we exploit big data?

While there has been a lot of publicity around big data, it has been exploited mainly by big companies, often those at the leading edge of data and technology, such as internet companies or major retailers. Many other businesses, especially SMEs, are a long way from utilising big data.

This section outlines some of the challenges and priorities in exploiting big data for three distinct groups:

- businesses
- accountants
- policymakers.

BUSINESSES WORKING WITH DATA

Many businesses struggle to know where to start with data, especially big data. For smaller businesses in particular, the concept of big data may appear to be irrelevant, as they may not have very much data. Alternatively, they may have lots of data but struggle to identify what is useful. This is made harder by the way that the real value of data often comes from reuse or in combination with other data.

While there can be value from playing with data and just seeing what comes out of it, the general advice from experts – especially for those businesses just getting started with big data – is that it is better to start by defining useful business questions.

Once the questions are clear, management can then identify all the possible sources of data that could help the business answer those questions. Some of those may be existing sources of internal or external data. Some of the data may not yet exist but could easily be collected by tweaking systems or processes. Some data may need longer-term planning to collect and therefore require some cost-benefit analysis.

For most organisations, getting data into a good enough state to enable analysis is a major practical issue. Data may need to be drawn from multiple systems and spreadsheets which may not be very compatible and may often require a lot of manual effort. Data quality may not always be good and a lot of work can be needed to clean up data. There may be a lack of data standards across the business, making it hard to connect together data from multiple sources. As a result, data projects typically require a lot of time and effort to sort out the data.

Where businesses have more experience in exploiting data, the challenges shift to embedding a data-conscious culture and building the right structures to maximise the opportunities and manage the risks. There is, for example, a shift from traditional decision-making cultures, sometimes termed 'highest-paid person's opinion', to cultures which are more reliant on data. Indeed, academic research suggests that companies which are data-driven are likely to have higher output and higher productivity than companies which are not making use of new technologies. However, there are tensions in becoming more data driven. For example, data can be overwhelming and result in paralysis. It can also stifle innovation and risk-taking.

Another challenge relates to the organisational structure around big data, given the need to access many different skills. Building interdisciplinary teams is a key element of success and a variety of approaches have been taken to achieve this. Some businesses have set up centres of excellence that lead initiatives and share experience and best practice, working with other business areas as needed. In other cases, functional areas, such as marketing or operations, which are making real use of big data, may lead organisational capabilities. IT functions may also take the lead in some cases.

SKILLS TO EXPLOIT BIG DATA AND ANALYTICS

Exploiting big data requires a combination of skills, spread across three broad areas:

- statistical skills to build the algorithms and understand the robustness of models;
- data and technology skills to extract and manipulate the data; and
- domain knowledge to ask the right questions and gain insight from the analysis.

Some of these skills can be bought from third parties, and smaller businesses are likely to benefit from working with data and analytics service providers, rather than attempting to build high levels of technical skill internally. The cloud model also provides a way for smaller businesses to access the technical resources required without investing in substantial hardware themselves.

But many businesses struggle to build cross-organisational ownership and sponsorship of data projects and investments. Business units are typically focused on their own projects and data, which means that building common tools and data definitions and sharing skills and knowledge can be challenging.

Furthermore, to what extent do businesses have the controls and governance in place to ensure that data models are used appropriately and in a way that will create sustainable value?

There are many governance issues to consider here. When computer programs are based on rules, it is possible to unpick what has been done, identify any errors and exercise control over the outcome. However, when outcomes derive from machine learning in particular, it is more complex. There may be many different correlations that are involved and the algorithm will evolve as it refines its models and hones the probabilities involved. Who will understand exactly how the algorithm works and the assumptions that have been made in the process? As data and algorithms increasingly contribute to corporate value, investors may want assurance around their long-term sustainability.

ACCOUNTANTS

Accounting tasks are grounded in data. Therefore, improvements in the ability to capture, process, store, analyse, visualise and share data will have particular relevance to how accountants undertake their work.

New capabilities in data enable the accountancy profession to radically improve decision-making across organisations. There are many examples across the profession of the use of big data to enable new insights about businesses, to focus work on areas of greatest risk and to improve prediction and forecasting. This can help accountants provide greater assurance over financial statements, improve their management of financial resources and increase the decision support that they can give business functions. However, in practice, many accountants are in the early stages of their use of big data and more advanced analytics, and there are significant opportunities still to be realised.

Data also provides an opportunity for accountants to transform their role into a much wider guardianship of data across the whole organisation. The discipline, structure and ethical approach of accountants means that the profession is well placed to help organisations make effective use big data and advanced analytics. And accountants' natural prudence and scepticism can help to ensure the robust and appropriate use of big data.

Accountants are not the only ones who could potentially take on a bigger role around data across organisations, though. Marketing or operations specialists in many organisations are taking the lead in using big data and therefore may assume a more dominant position than finance around big data. Of course, data science and IT functions also have a strong role to play around data. Indeed, any failure of the profession to keep up with new developments in data leaves open the possibility of accountants being marginalised in decision-making, with data scientists, for example, playing a greater role.

There are also risks that financial reports becomes less important for investors and other stakeholders as the impact of big data grows. Already, there is a major market for 'alternative sources of data' which investors plug into predictive models to identify opportunities to generate profits. While audited financial accounts are likely to remain important for confirming company results, the profession could, again, become more marginal to decision-making processes, with other sources of data becoming more important.

Exploiting big data requires greater knowledge in the theory and practice of statistics than many accountants currently have. While the degree of knowledge will vary, accountants will need at least enough statistical knowledge to be an 'intelligent buyer' and ask good questions of suppliers or other parts of the business. Accounting qualifications such as the ACA are recognising the importance of data and analytical skills, increasing the technical content in these areas.

A shift in mindset may also be needed. This can be described in various ways – a desire to play or experiment with data and see what comes out of it, rather than simply providing reports, for example, or taking a more iterative approach to decision-making, focusing on testing ideas with real-world data.

ACCOUNTANTS AND DATA SCIENTISTS

While most in the profession would agree that more skills in data and statistics are important, how much do accountants need to know to work effectively with data scientists? There will be a wide variation, depending on the specific role and particular interests of the individual. A joint workshop between ICAEW and Centrica's internal audit function highlighted the skills that their accountants were developing to work effectively with data scientists. These included:

- Understanding the opportunities and limitations of what can be achieved through data and how data science can add value.
- Understanding and defining the business problems data can help to solve.
- Interpreting the outputs produced by data analytics. This includes understanding data provenance, modelling assumptions, inherent biases in the analysis and, perhaps most importantly, what decisions can justifiably be made based on the analysis.
- Presenting and communicating the results to the business, including the use of visualisation.
- Awareness of the data landscape, different data types, what data might be useful and where and how it can be obtained.

However, our research into big data and the profession has also emphasised the importance of business and commercial skills, and the opportunity for accountants to play a bridging role between data science and other business functions. As a result, while data and statistical skills are important, they are only part of the picture.

POLICYMAKERS

There are a number of different elements for policymakers to consider. Big data provides many opportunities to improve policymaking, public services and government. Governments are some of the biggest users of IT systems, and they generate enormous amounts of data about citizens and services. This will increase as more government services move online, providing many opportunities to personalise and improve services, target resources and interventions and inform citizens. Big data can support evidence-based decision-making, by enabling deeper analysis on the impact of policies. It can enhance democracy and transparency through the release and use of open data.

Policymakers should also be concerned about building the right skills across the economy to enable widespread use of big data. 'Data scientist' describes an individual who combines some of the skills highlighted in this paper to analyse big data. There are many concerns about a shortage in these specialist skills in the coming years.

However, it's not just specialist skills. Many workers will need to gain better statistical skills in order to make appropriate use of big data. This report has outlined a variety of dangers around big data, such as data quality, selection of data sets, and reliance on correlations. Business use of big data needs to be grounded in a good understanding of what the models are doing, the assumptions that have been made in building the models, and their limits. Without better statistical skills across many business functions, there are significant risks of inappropriate reliance on data and models.

The successful use of big data also requires the ability to ask and frame good questions in a particular area. Creativity and imagination are therefore important characteristics. Fostering these capabilities and encouraging experimentation will be vital.

Furthermore, the regulatory framework needs to be carefully considered. In a world of big data, decisions about individuals will increasingly be made on the basis of patterns and profiling. Therefore, big data has deep social implications and raises questions about when it is acceptable to judge people based on data about past behaviour, personal characteristics and similarities to others. This is strongly linked to debates about privacy. Data profiling, especially where large amounts of personal data are aggregated together, provides very deep insights into individuals. The benefit of these activities is cheap (or free) personalised services, and to date, many consumers have been content with this trade-off. However, greater concern may be shown as analysis goes deeper into our activities and personal lives.

Summary

The trend of big data is being propelled by an enormous growth in computing capability, our ability to capture, store and apply sophisticated analytics to data from many new sources, and innovative ways to share and develop our knowledge. This is creating many opportunities for businesses to gain greater insight, predict future outcomes and automate non-routine tasks. Big data also provides great opportunities for accountants to deliver more value to businesses and to help businesses exploit big data.

But the use of big data and analytics needs to be appropriate and subject to robust challenge. There are many dangers around the quality of data, selection of data sets and construction of models that need to be properly understood when using big data. This requires greater skills in statistics, both in specialist disciplines and across business functions which are using big data.

We also need new thinking about the ethical and regulatory framework around big data, as it will increasingly impact on the lives of individuals and underpin customer service, innovation, quality and business operations. Businesses will need to have appropriate governance to manage the risks and ensure data is used in acceptable ways. Policymakers also need to consider the regulatory framework carefully, and encourage the range of skills needed to exploit big data.

But any business can get started with big data by asking good questions about its operations, strategy and stakeholders, and by understanding how different data can help it to find answers.

Next steps

ICAEW's Tech Faculty has an ongoing programme of research into how big data and advanced analytics are impacting on accountants working in all parts of the profession. Our work explores these questions in more detail, based on the following three themes:

- **Opportunities:** how are accountants, and businesses more generally, using big data and analytics; what are the specific benefits being realised; and what is the impact on the roles of accountants?
- **Risks:** what can go wrong in the use of big data and analytics; what are the ethical concerns being raised; and what steps can organisations take to mitigate these risks?
- **Exploiting big data:** what are the practical challenges in exploiting big data; how can organisations build the right mix of skills; and what are the key cultural features of successful businesses in this context?

We conduct structured research projects, such as our research collaborations on big data in China with the Shanghai National Accounting Institute and Inspur. We work with other specialists in ICAEW, such as audit, to share knowledge and understand how big data is changing their specific area of the profession. We also interview individuals working in this area to build an in-depth understanding of the use of big data in organisations, and share insights with members and others.

If you are interested in participating in our research and discussions, please contact techfac@icaew.com

Further reading

ICAEW RESOURCES

Accountants and data scientists – collaborating for success

Artificial intelligence and the future of accountancy

Audit insights: cyber security series

Audit insights: data analytics

Big data in Chinese businesses

Data analytics for external auditors

Internal audit in the age of data analytics

The internet of things and accounting: lessons from China

New technologies, ethics and accountability

Tech essentials: data analytics

icaew.com/data

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OTHER RESOURCES

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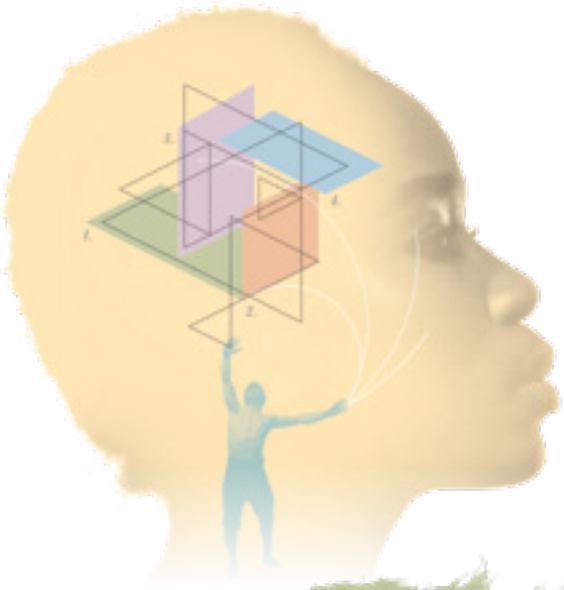

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