



# *Big data in Chinese businesses*

INTERNATIONAL PERSPECTIVES

In partnership with

## *About the research parties*

This project has been undertaken by the Big Data and Accounting Research Centre, which was formed in 2016 by ICAEW, the Shanghai National Accounting Institute and Inspur. Based in Shanghai, the Research Centre brings together knowledge and experience from across the fields of accounting, business and technology. It undertakes research projects about the impact of technologies such as big data on accountants working in businesses. In the process, it aims to provide insights into how the profession can contribute to business success with IT and the skills needed by accountants to do so.

**ICAEW (Institute of Chartered Accountants in England and Wales)** is a world leading professional membership organisation that promotes, develops and supports 147,000 members worldwide, who hold the ACA qualification and adhere to the highest ethical standards. Its members work across all areas of the profession, including business and public practice. ICAEW also acts in the public interest, offering insights into business and the economy through its thought leadership work. The ICAEW IT Faculty is a network of members interested in IT issues and is the focal point for ICAEW's work on technology and the profession. More information is available at [icaew.com](http://icaew.com) and [icaew.com/itfac](http://icaew.com/itfac)

**SNAI (Shanghai National Accounting Institute)** was established in September 2000 as a public service institution affiliated to the Ministry of Finance of China. It has trained over 1.4m accountants on programmes such as the National Leading Accounting Talents programme, and the programme for chief accountants at state-owned enterprises. It offers Master's degrees in accounting and auditing, as well as taxation, and runs an EMBA programme in co-operation with Arizona State University. In addition, SNAI is a think tank for national accounting policy and corporate finance, a national aggregator for accounting information and an international platform for communication and exchange in accounting. It also hosts the Asia-Pacific Finance and Development Centre, created by the Chinese Central Government for region-wide capacity building under the APEC framework. More information is available at [snai.edu](http://snai.edu)

**Inspur** is the leading cloud computing and big data service provider in China. Based on Inspur's information software for government, enterprise and industry, as well as end-user products and solutions, its platform provides support for building government, enterprise cloud and vertical industry cloud. More information is available at [en.inspur.com](http://en.inspur.com).

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## *Executive summary*

### **CHINA IS TRANSFORMING ASPECTS OF ITS ECONOMY WITH BIG DATA**

Two features put China in a very strong position to generate and exploit big data - the sheer size of China and its user base, and its rapid adoption of mobile technology, leapfrogging older generations of technology in the process. These features are complemented by a comprehensive plan from the Chinese government, which specifically promotes the use of big data to support economic growth and enable the transformation of traditional industry sectors.

The breadth and size of government ambition is reflected in Chinese companies in both traditional and internet sectors using big data to increase the value that they deliver and radically improve their decision-making capabilities. Our research highlighted many specific examples of new business models and services, especially in financial services, precision marketing, improved capabilities in product planning and greater operational efficiency. As a result, China provides an excellent learning environment about the opportunities from big data.

### **THERE ARE SIGNIFICANT ORGANISATIONAL CHALLENGES IN REALISING VALUE FROM BIG DATA**

Delivering value from new IT systems is a complex organisational task and the research highlighted many practical issues that are common to companies across the world. The case studies also emphasised particular difficulties around big data investments, for example because of the cross-organisational nature of data, and showed that building other capabilities - such as business alignment, data governance and skills - is as important as the technology platforms. As a result, all companies should see these wider complementary resources as an integral part of their big data investments.

Furthermore, the research highlighted how challenging it is to transition from legacy systems and thinking to become a more data-centric organisation. Therefore, while a committed industrial policy can provide a strong base in this area, policymakers also need to recognise and understand these practical challenges for individual organisations in delivering change.

### **ACCOUNTANTS CAN PLAY A STRONGER ROLE AROUND BIG DATA, ESPECIALLY IN DATA GOVERNANCE**

Big data presents many opportunities for accountants to provide new analysis and insights and contribute more value to businesses. Furthermore, the discipline and attention to detail that is fundamental in accounting can greatly help organisations to build better data governance across all functions. This is a difficult task in practice but underpins success with big data.

In order to deliver these contributions, though, accountants need to build more capabilities in IT and data to work effectively with data and technology specialists. These technical skills need to be complemented by the continuing focus on working closely with business functions. This emphasises the role of professional bodies and educators in training new and established accountants to meet changing business needs.

The Big Data and Accounting Research Centre will continue to conduct research into these and other topics to support the development of the profession and help accountants deliver greater value to businesses. To find out more, please contact [itfac@icaew.com](mailto:itfac@icaew.com)

## *Participating companies*

We would like to thank all the participating companies in the research project for their input and insights. Participating companies included the following.

**China Eastern Airlines** is headquartered in Shanghai. It serves nearly 80m travellers annually and ranks among the world's top five airlines in terms of passenger transportation volume. As an official member of SkyTeam, China Eastern has extended its flight network to serve 1,062 destinations across 177 countries.

**China Mobile (Anhui Branch)** is part of the leading telecommunications services provider in China. The Group has the world's largest mobile network and the world's largest mobile customer base - as of 31 December 2016, the Group had 849m mobile customers.

**Jingdong (JD)** was set up in 2004 and in 2014 became China's first successful listing of a large-scale integrated e-business platform on the US Nasdaq. It is China's biggest internet company by revenue and is a member of the Fortune Global 500.

**Shandong Business Group**, also referred to as **Lushang Group**, is headquartered in Jinan City, and is a large state-owned enterprise. At present, group business activities include retail, manufacturing, real estate, hotel, health, education and media. It employs around 200,000 people.

**Tianjin Pharmaceuticals** was founded in 1979, and researches, manufactures and sells Chinese and Western medicines and medical devices in China and internationally. It is based in Tianjin and is a Top 500 Enterprise in China.

**Tencent** was founded in 1998 and is a leading provider of Internet value added services in China. Tencent's Internet platforms cover a range of services including communication, information, entertainment, financial services and others. As of March 2017, the monthly active user (MAU) accounts of its QQ platform was 861m and the combined MAU of its Weixin and WeChat platforms was 938m.

# Introduction

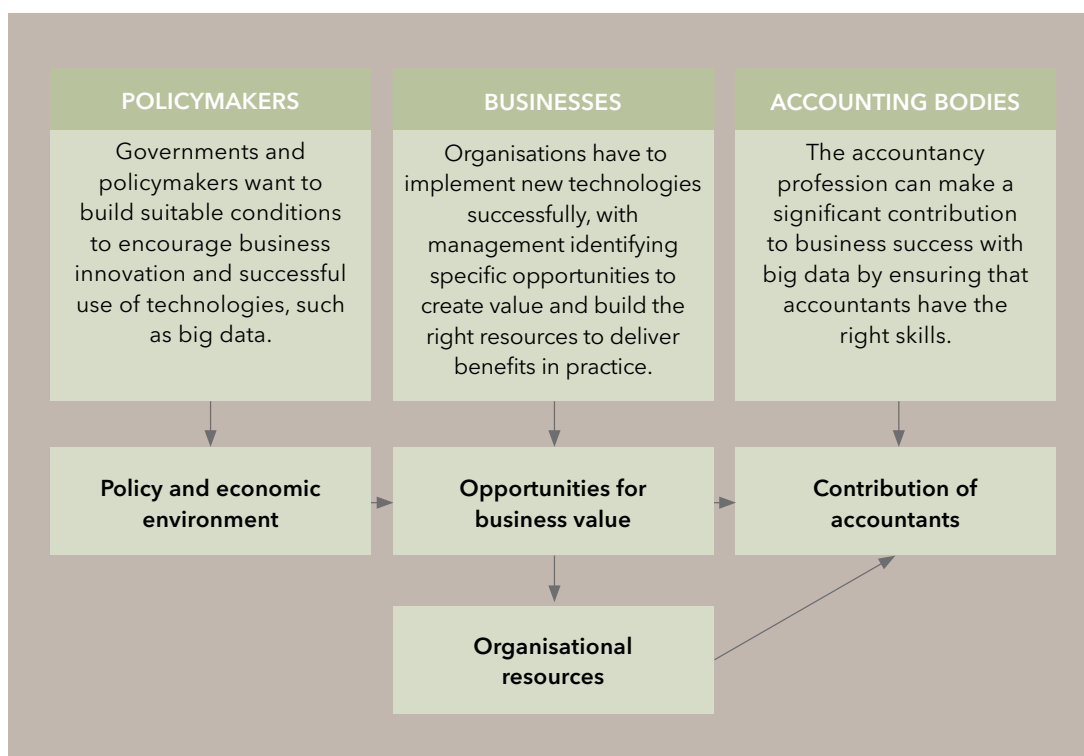
## RESEARCH OBJECTIVE

How can accountants help businesses to make the most of big data?

This is an important and topical question for businesses and accountants. Many businesses are investing significant resources in big data and need to maximise the value of their investments. Accountants can make a significant contribution to that success, if they can adapt to changing business needs and develop the right skills.

This research project explores how accountants working in businesses can better support their organisations as a result of big data, based on real experience in China. While the ultimate focus of our research is on accountants and finance functions, our case studies also give a wider perspective on big data in businesses and economies. Accounting is rooted in the needs of businesses and their stakeholders. Therefore understanding how finance functions are working in practice requires a good appreciation of the business environment.

Our approach captures this broad perspective and consequently provides some reflections for three different audiences, all with an interest in maximising the benefits from big data.



## THE IMPORTANCE OF BIG DATA

While there are many waves of new technology, big data (and associated analytics) is particularly important for accountants. Big data enables radical new business models and ways of working across and between organisations. It enables different ways of making decisions, which are more evidence-based, quicker and more automated. It can improve the value offered to customers and other stakeholders.

Furthermore, data is central to the value that accountants provide to businesses. Consequently, big data provides opportunities for accountants to contribute more value to businesses than has been possible previously. Auditors, in particular, have been leading in their use of big data and analytics to examine entire datasets and focus their analysis on areas of greatest risk. Encouraging and equipping accountants more broadly to work with big data is a critical task for accounting bodies and educators around the world.

#### WHAT IS 'BIG DATA'?

There is no single meaning for 'big data' but broadly speaking, it is used to refer to data with the following characteristics:

- volume - very large amounts of data;
- variety - new sources of data, particularly unstructured data such as text and images; and
- velocity - greater emphasis on speed and real-time data.

Different uses of data highlight different aspects of these characteristics. The ability to process large volumes of data enables analysis of entire datasets, rather than samples, or examination of more granular data. Linking together data from different systems, or data from third parties, can provide fresh insights.

#### THE INTEREST IN CHINA

This research project examines how finance functions are approaching big data in the specific context of China. While the research highlighted many universal themes, the Chinese business environment presents a particularly unique setting for studying the impact of big data.

- The sheer size and scale of China, and its number of internet users, provides vast amounts of data, and presents opportunities for China to play a leading role in innovating with big data.
- The Chinese government has placed a high strategic priority on big data, with a wide range of activity to encourage investment and adoption, and ambitions for big data to transform traditional industry sectors and help in the development of economy.
- The accountancy profession in China is undergoing a rapid period of change, with major investments to improve capabilities and increase the value delivered by accountants working in businesses.

#### OVERVIEW OF RESEARCH APPROACH

The research project built on the experience and knowledge of the three research parties (ICAEW, SNAI and Inspur), publicly available information about China, and interviews with other experts in the field. Our initial findings framed the subsequent fieldwork, whereby the research parties selected around 20 businesses to complete online questionnaires about their use of big data and the impact on accountants.

Based on the feedback, eight companies were selected to study in more detail. The case studies covered both private and state-owned enterprises across a variety of industries, and all had significant experience with big data. Representatives from ICAEW, SNAI and Inspur then conducted face-to-face interviews with senior representatives from finance, IT and business functions in the companies.

This report summarises the main themes drawn from this research. While we provide only limited and anonymised examples from the businesses studied, for reasons of confidentiality, our findings are based on detailed conversations with management.

## *An industrial strategy for big data*

### THE BIG OPPORTUNITY FOR CHINA

Two features put China in a very strong position to generate and exploit big data - the sheer size of China and its user base, and its rapid adoption of mobile technology, leapfrogging older generations of technology in the process.

According to official Chinese figures, there were over 731m internet users in China in 2017. This makes it by far the largest country of internet users, with India second (around 460m) and the US third (around 286m). It has the largest number of mobile phone subscriptions in the world - over 1.3bn in 2017 (statistics from the Chinese Ministry of Industry and Information Technology published at the end of June 2017).

Users are also very quick to adopt new digital capabilities. According to a 2017 report by McKinsey (McKinsey Global Institute, *China's Digital Economy: A Leading Global Force*, 2017), the value of China's e-commerce transactions, for example, has jumped from 1% of global transaction values to more than 40% over 10 years. The value of Chinese mobile payments related to individual consumption was US\$ 780bn in 2016, over 11 times that of the US.

While volume isn't everything, sheer volume of data and users can provide significant advantages in itself. More data can power more accurate predictive models, richer analysis of correlations and patterns and fast scaling of new data-centric business models. It also supports more advanced machine learning and deep learning techniques, positioning China to be at the forefront of opportunities with artificial intelligence.

### THE 13TH FIVE YEAR PLAN

These features are complemented by a comprehensive plan from the Chinese government, which specifically promotes the use of big data to support economic growth and enable the transformation of traditional industry sectors.

China's 13th Five Year Plan was published in 2015 and covers the period 2016-2020. One of the prime aims of the plan is to improve the productivity of the economy in a sustainable way and increase innovation. IT is recognised as playing a vital role in this transformation, which is reflected in a variety of additional IT-specific plans.

The Internet+ strategy, for example, focuses on integrating internet technologies into traditional industries. Internet+Agriculture highlights the opportunities for technology to transform traditional farming methods through better data about the land, weather and markets for selling produce, and so on. This recognises the transformative ways that technology can solve basic human problems, and the role it can play in alleviating poverty and supporting the development of economies. This breadth of ambition is reflected in the range of industries selected in our case studies.

### SELECTED IT TARGETS FROM THE 13TH FIVE YEAR PLAN

TARGET	2015	2020
IT Industry revenue (RMB '000billion)	17.1	26.2
Mobile broadband user penetration (%)	57	85
Online retail sales (RMB '000billion)	3.88	10
Internet users ('00million)	6.88	>10
Basic public service online processing rate (%)	20	80



Advanced information technologies play a key role in this shift, including artificial intelligence, blockchain and the internet of things. The government has targeted big data specifically, with a dedicated plan that recognises big data's potential to spur innovation and provide economic benefits. This is closely linked to investment in cloud computing capabilities, which typically underpin the use of big data.

The plan also recognises the ways in which big data can help the government deliver better public services and improve decision-making and planning. Drawing on data from the government as well as data generated in the private sector, government agencies can analyse trends and get more real-time insight into the performance of the economy. Big data can also help to track compliance with tax and other laws more effectively.

Our research highlighted the work done by companies such as Tencent, which provide many insights to the government to support its planning and other activities.

#### RESEARCH EXAMPLE 1: TENCENT DIGITAL ECONOMY INDEX

Drawing on its own wealth of data, as well as that of partner companies and publicly available data, Tencent publishes an annual analysis of the Chinese digital economy. This analysis has been used by the Chinese government and international agencies. The Digital Economy Index takes into account four sub-indices - infrastructure, industry development, entrepreneurship and city services. It then quantifies the value of the digital economy by industry and city.

Its 2017 report calculated, for example, the value of the Chinese digital economy to be RMB 22.77 trillion (around US\$ 3.4 trillion), which represented around 30% of Chinese GDP. It also ranked cities and provinces against each of the indices. Guangdong Province, in the south of China, was the highest rated province overall. Guangdong Province contains major cities such as Guangzhou and Shenzhen.

#### ELEMENTS OF THE BIG DATA PLAN

The Chinese internet sector has been a powerhouse for economic growth and innovation for many years. Internet search company Baidu, e-commerce companies Alibaba and JD, and social media company Tencent have built their business models, operations and cultures around big data. However, the government's strategic focus on big data has led to many companies in more traditional sectors also investing in big data capabilities.

Building skills is an important step and the plan encourages universities and institutions to offer big data courses and internships. The government has highlighted the importance of building trust in the security and use of sensitive, especially personal, data, and subsequently passed the new Cybersecurity and Privacy Law in June 2017.

There will be new national platforms for big data, which, according to the plan, will provide ways to share data more easily between government departments and make better use of it. In addition, the government intends to allow companies in certain areas, such as finance, to have more access to government data. It also invests in many projects, using big data to solve specific problems in areas such as transport and the environment.

As a result, China provides an excellent learning environment about the opportunities from big data.

## *Opportunities for value from big data*

The breadth and size of government ambition is reflected in Chinese companies in both traditional and internet sectors using big data to transform the value that they deliver and radically improve their decision-making capabilities. Our research highlighted many specific examples of new business models and services, especially in financial services, precision marketing, improved capabilities in product planning and greater operational efficiency.

### **NEW BUSINESS MODELS**

The most transformational way for big data to create value is through new business models, enabling entirely new products and services, or the extension of services into previously underserved markets. In China, these possibilities are greatly enhanced by extensive use of mobile payment systems, with Chinese consumers largely bypassing the card generation of technology. Mobile payment platforms provide a further source of data as well as easy integration for many O2O (online to offline) services.

Sharing business models is a major trend that particularly exploits big data. In 2016, for example, Didi Chuxing became the world's largest car riding service. The bike sharing schemes Mobike and Ofo are used extensively around China and are expanding into overseas markets. There are also sharing platforms for all kinds of items, from umbrellas to concrete mixers. The extent to which these models are financially sustainable in the long term remains to be seen. However, the sheer scale of data and number of mobile payments users in China provides opportunities to try new services that would not be possible in smaller markets.

Our conversations with companies in the internet and banking sectors also showed how the combination of big data and mobile payments systems are shaking up traditional financial services and providing greater access to finance for many individuals and smaller businesses.

### **RESEARCH EXAMPLE 2: BIG DATA TRANSFORMING ACCESS TO FINANCE**

Access to new sources of internet and mobile data – such as payments and social media activity – is enabling much better credit scoring of consumers and small businesses, and opening up new sources of finance to these underserved markets as a result.

Companies such as Alibaba, Tencent and JD are driving this transformation, with their own financial services arms. But traditional financial services providers are also evolving their view of the opportunities – from seeing the internet sector as a competitor to increasingly collaborating with it. In the process, they can gain access to new data and innovation capabilities. Through co-operation with third parties, for example, a bank may be able to use customer address, travel data, real estate data, and other preference data to segment customers, target high-value individuals and improve conversation rates.

This collaboration between sectors works in different ways. An internet company may provide credit for a purchase on their platform to low risk customers, usually making that decision within seconds based on data and algorithms. It may then pass higher-risk customers onto a traditional bank to assess and serve.

Improved access to finance also applies to businesses, and is particularly powerful for small and micro businesses. Most individual farmers or fishermen would not have been able to get finance in the past from banks. But where data shows good sales or yield the previous season, they are much more likely to be able to access some capital to buy new season livestock or crops. This also supports the wider transformation of traditional sectors such as agriculture. Algorithms can help to improve farming techniques by linking animal health with finance. One company described how they can help farmers buy chickens. The chickens then have a device attached to track the number of steps they take (with a target of 1m steps during their lifetime) and thereby ensure healthy animals.

## MONETISING DATA

Another way to generate direct value is to monetise big data, whether by selling the data, selling access to it or selling analysis related to it. Some of the companies studied in this research project were considering this avenue, where they had data about consumer locations, preferences or activities that could be used by other companies in their planning and decision-making. This particularly crossed industries so that individual location data, for example, could be very valuable in all kinds of business decisions, including personalised marketing, investments in new shops or facilities, or planning transport infrastructure.

However, such markets are still in early stages of development. In particular, the standalone pricing of data is very difficult, and therefore companies typically treat it as a way of adding value to existing services rather than as an independent product. Alternatively, they are building consulting or analytical services related to the data.

## SALES AND MARKETING

In most of the companies studied, marketing and sales functions were at the forefront of using big data. Marketing departments have access to new sources of data, particularly through the internet, which provide very specific insights into customer behaviour and preferences and translate into measurable benefits, such as increased sales, increased customer engagement and higher success rate of marketing campaigns. There is also a strong competitive imperative for marketing functions to be actively engaged in data-driven techniques.

### RESEARCH EXAMPLE 3: THE POWER OF PRECISION MARKETING

The companies in our research provided a variety of examples of precision marketing, using big data to understand customers better and thereby target marketing more effectively. For example, they typically profiled and characterised customers based on past activities, and tailored web pages and service offerings accordingly.

One company analysed the regional differences across China to better understand the habits and preferences of different cities, which sometimes led to surprising conclusions. Cities are classified in tiers, from 1 to 5, and some high-value products might be expected to be more popular in the most advanced tier 1 cities. But actually, they fared best in more developing tier 4 cities. These kinds of observations were feeding into marketing campaigns and customer targeting.

Sharing data across the company also provided opportunities for cross marketing that were not previously possible.

## OPERATIONAL EFFICIENCY

In some companies, big data was helping to optimise operations and logistics. Indeed, one company described warehouse management as increasingly like science, due to the way that data and algorithms could enable extremely precise planning and processes. This company was optimising the way that stock was organised in the warehouse, and planning the path taken to pick products to minimise the time involved. Distribution was also highly analysed, with management examining factors including routes, weather and the utilisation of vehicles to optimise logistics.

## PRODUCT PLANNING AND INVESTMENT

In addition, our research highlighted how big data can enable a shift from supply-led planning to demand-led planning. It becomes possible to get a much better understanding into the specific demands of the market and thereby take a more strategic and evidence-based approach to business planning. This represents a significant change to decision-making approaches in some of the companies studied, but they perceived it as a big area of potential value.

For example, one company was investing significant money in external data to help with product planning and identify areas of highest demand or greatest potential profit. Another company was looking for big data to support decisions on whether to expand, retain or close particular business units.

## *Organisational resources*

Delivering value from new IT systems is a complex organisational task. Academic research has established that an organisation needs to invest in many other complementary resources in order to use technology well and achieve benefits from investments. Furthermore, each organisation is unique in its data structures, organisational resources, management processes and competitive positioning, making replication from one company to another impossible.

The research highlighted many practical issues that are common to companies across the world. The case studies also emphasised particular difficulties around big data investments, for example because of the cross-organisational nature of data. Additionally, it showed that building other capabilities – such as business alignment, data governance and skills – is as important as the technology platforms.

We focus on four consistent themes in this regard, which reflect the broader academic literature on delivering value from IT:

- alignment with business needs;
- data governance;
- organisational processes and culture; and
- people and skills.

### **ALIGNMENT WITH BUSINESS NEEDS**

All of the companies studied were using big data internally to support decision-making. Alignment in this context means clarity about what specific data will influence what specific decision.

This is a two-step process. First, the company needs to define what information will help to improve the quality of decisions. When they are clear on these needs, they can then look for data that will provide evidence on the matter. This is a complex and iterative process, and there is a role for just playing with data to see what turns up. However, a lack of focus on the outcome often leads to data overwhelming companies, which have little idea of what to do with it all.

How to identify value in data was a consistent theme in the research, and the companies showed very different levels of maturity here. Some companies were still in early stages of understanding how they could use all the data that was now available to them. Others had developed a good vision of the opportunities from big data and were working through a range of practical, implementation issues. A few companies were highly skilled in their use of big data and had a deep understanding of the value it could deliver.

A related issue is identifying the return on investment for big data projects. Because of the intangible and indirect nature of many of the benefits from big data, financial returns are likely to be hard to identify and predict even in the most mature companies. Management may need to accept big data as a more strategic and long-term investment with no clear or short-term pay-out. However, some companies reported that difficulties in defining the return on investment were slowing investments in practice, and that better understanding of the value of data was needed. Accountants could potentially help businesses improve their thinking, analysis and confidence in this area.

## DATA GOVERNANCE

Most technology investments seen in our research focused on building big data platforms, by using new technologies to bring together data from multiple sources. While this sometimes included data from third parties, it often focused on internal data from different systems.

However, this was not a straightforward task. A consistent theme throughout the research was the lack of data standards across companies. Internal systems were usually built to meet the needs of individual departments, which made it difficult to integrate data from different systems and departments in practice.

These problems were often compounded by long-standing issues around data quality. Good quality data underpins good use of big data. The old adage 'garbage in, garbage out' continues to ring true, despite all the advances in technology. Frequently these problems related to poor processes or staff training so that data entry was not accurate or complete. As a result, while data could be cleansed at a later date, the root cause of the problem required deeper business change.

Consequently, a key part of success with a big data platform was strong central governance over data quality and standards. This was broadly recognised by the companies in our research, with many examples of projects to instil effective data governance across the organisation. However, this is also a major challenge in practice and requires a lot of collaboration across departments.

### RESEARCH EXAMPLE 4: DELIVERING COMPLEX CENTRAL DATA GOVERNANCE PROJECTS

Many of the companies interviewed were running specific data governance projects, which demonstrated some of the practical organisational and skills challenges.

In most cases, the data governance projects were run by the IT department, as part of the investment in big data technologies. Some of the tasks required technical knowledge about data and therefore this seemed a natural fit. However, defining data standards is fundamentally a business task, which needs good knowledge of business processes and requirements, and therefore cannot be done by IT alone.

In one case, the finance function was asked to take the lead. It was felt that accountants were well placed to understand processes and requirements from across all business functions, and were already focused on the quality of financial data. However, they lacked the technical knowledge around data and needed to lean heavily on the IT function for support.

Furthermore, defining central data standards is a major business change activity. Business units need to change the way they do things to meet central standards and there may be resistance. Different business units will also have to negotiate to agree on the standards. Therefore, the project will need strong, business management support, as well as the right mix of technical skills and business knowledge. Accountants can play a valuable role here too.

Linked to data governance are information security and privacy. Although important, security was generally seen as the responsibility of the IT function. Privacy was a more widespread concern, given the extensive use of personal data in big data activities. This was reflected in concerns about the regulatory environment and legal restrictions on use of personal data, as well as the response of customers to the use of their data by companies. As a result, appropriate governance also needs to be in place around the security and use of data, especially personal data.

## **ORGANISATIONAL PROCESSES AND CULTURE**

Academic research has shown that being a 'data-driven organisation' can deliver tangible benefits. While 'data-driven' has a large technology component, it also encompasses wider organisational and cultural elements. The research emphasised two particular aspects of this.

All of the companies interviewed highlighted the importance of collaboration between departments to deliver benefits from big data. For example, a number of companies were linking data from HR systems and finance systems. This combination of data enabled a far more complete and granular analysis of staff costs, taxes and benchmarks. It also needed collaboration between finance and HR departments to understand the data that was being used, and the processes that had generated it, to ensure appropriate insights were drawn.

However, most organisations still operated based on individual departments. This made sense, as it enabled expertise and efficiency, and there may have been little historic need for more collaborative working. But greater sharing of data meant new ways of working, with less focus on individual departments, and a much deeper change in organisational culture and process.

Big data also changes decision-making cultures. It enables more real time decision-making. It puts a greater premium on asking questions, building evidence and trying things out. It leads to more accurate predictions, greater automation of decision-making and less need for human judgement.

It also changes power structures in organisations. In financial services, for example, individuals in branches have traditionally made loan decisions based on their personal judgement. Greater reliance on data models will fundamentally change the mode of decision-making in the organisation. In particular, it will shift power from branches to central office.

Management in some of the companies interviewed were thinking deeply about these issues. For example, how do the benefits of data and algorithm-based decisions compare with the role of human judgement, and how should companies best connect systems and data with humans? While no one expected systems to take over all decisions, and there was broad consensus that human intervention would continue to be important, the balance would certainly be different in the future.

As a result, leading companies recognised the need for wider organisation and cultural transformation, and the adoption of big data across the company was typically sponsored by the chief executive officer. Where big data investments were being driven primarily by IT departments, they were much less likely to achieve their full potential.

## **PEOPLE AND SKILLS**

Exploiting big data requires three skill-sets:

- IT skills in data, big data technologies and integration of systems;
- statistical skills for the analysis and mining of the data; and
- business skills to ask the right questions and interpret the results in the specific context of the business.

Data scientists cover all of these elements to some degree, although they typically come from a statistics or IT background. But exploiting big data requires multidisciplinary teams working across subject areas.

Putting aside the largest internet companies, who employ very large numbers of data specialists, most of the companies interviewed were building small specialist big data teams in the IT function, with data scientists working closely with business functions on specific requirements and projects.

There were skills gaps, though, particularly in specialist areas. In some cases, existing IT staff were being retrained from legacy IT systems into new big data technologies. There was also strong

competition for data science talent, and companies in more traditional sectors found it harder to recruit and retain good candidates, compared to higher-paying and more attractive sectors such as internet companies.

### BEYOND ORGANISATIONAL BOUNDARIES

The four themes highlighted so far in this section are common to most IT investments. A fifth theme that emerged from the research was more specific to big data and reflects the fact that companies can gain further benefits from big data by working with third parties.

- Getting access to third party data provides new sources of analysis and insights.
- Where data can flow automatically between organisations, efficiencies can be created.

This could mean creating bi-lateral partnerships or joining particular organisations that provide frameworks for sharing data. The research highlighted particular concerns about compliance with legal frameworks, especially concerning personal data, as well as the quality of data provided by others. There were also economic questions about paying for access to data. Given the difficulties in calculating the return on investment described earlier, companies were generally quite conservative about this.

Data standards are also needed to enable interfaces between systems and the smooth flow of data. The creation and adoption of voluntary data standards is another complex process, though, and regulators or governments may need to mandate the use of specific standards to achieve quick adoption.

#### RESEARCH EXAMPLE 5: E-INVOICING AND THE FLOW OF DATA

JD was the first company to issue e-invoices in 2012, followed by other companies. They are used both on online platforms as well as offline, where receipts contain a QR code which can be scanned to produce the e-invoice.

The benefits of e-invoicing are:

- reduced paper, so it is more environmentally friendly and cheaper;
- data which can be used for other reasons, such as credit ratings;
- fair trading and helping consumers get redress especially online; and
- tax compliance and understanding of the real-time economy, as the government can potentially access the data for their own analysis.

While it is popular, though, the system has not yet reached its maximum potential for a number of reasons. Many companies, for example, still require the paper receipt for reimbursing expenses. Furthermore, there are no data standards for e-invoices so accounting systems have not been able to create interfaces to enable the direct flow of data. Consumer behaviour also needs to change to increase adoption, with mechanisms to ensure that they trust the system.

As a result, while individual company innovation can provide benefits, links across the entire ecosystem require co-ordination among different parties to maximise the benefits of big data.

The role of things, such as standards, emphasises the importance of governments, industry bodies and other mechanisms to facilitate this kind of co-operation and co-ordination.

## *Finance functions and big data*

Accounting underpins the efficient management of financial resources and accountability for financial decisions. This report focuses on the role of accountants working in businesses, rather than public practice. We recognise, though, that auditors in particular are also making increasing use of big data technologies to analyse entire datasets of transactions, rather than samples, and therefore interest in big data goes across the entire profession and beyond the scope of this specific research project.

### FINANCE ACTIVITIES IN ORGANISATIONS

Accountants that work in businesses play many different roles, from basic transaction processing to supporting business units in their planning and decision-making. ICAEW's finance function framework provides a way of analysing the range of activities involved in this, and how they can be organised, based on a variety of business and organisational features. The basic activities are:

- accounting, including transaction processing, financial reporting and financial control;
- compliance, including regulatory compliance and tax;
- management and control, which covers the development and use of financial and non-financial information to inform, monitor and instigate operational actions, and includes internal audit;
- strategy and risk, including mergers and acquisitions;
- funding, including investor relations and debt financing; and
- management of resources, including systems, people and shared service centres.

Working effectively with business functions is essential for many of these tasks, especially those that support business decision-making, performance management and strategy development. Terms such as 'business partnering' capture the different ways that accountants work with business functions to help drive success.

### THE ACCOUNTING PROFESSION IN CHINA

The accounting profession in China has developed very quickly over the past 30–40 years in response to growing demands from capital markets, businesses and the government, as the economy has opened up. The Ministry of Finance has set out a wide-ranging programme of activities to build the profession, including training significant numbers of accountants, developing a professional body and qualification for China, adopting accounting standards and encouraging local audit firms.

More recently, there has been greater focus on accountants working in Chinese businesses, as distinct from accountants working in public practice. The Guideline from the Ministry of Finance in 2014 outlined a variety of activities for improving management accounting, including training and leadership development, creation of information systems, guidance and tools for management accounting and working with the academic community for research into the theory of management accounting in China.

This programme emphasises moving beyond bookkeeping, compliance and internal control activities to greater emphasis on decision support and the integration of accounting into business activities. Shared service centres are a popular way of maximising the efficiencies in transactional work, especially across complex businesses with many different subsidiaries.



## HELPING TO BUILD ORGANISATIONAL RESOURCES

This report has outlined some of the organisational resources needed in order to realise the benefits from big data investments, and accountants can play an important role in building these resources.

One area that the companies in our research highlighted was data governance. This is a critical underpinning for big data and is difficult for large, complex organisations to achieve. There is a great opportunity for accountants to help more in this area, based on the discipline, rigour and structure in thinking that accountants already have around financial data. Furthermore, finance functions have a unique position that provides an overview of the business and enables it to understand the controls and processes in place in other functions. As a result, accountants should be well placed to take a stronger role in data governance activities.

Another potential opportunity for accountants is the return on investment for big data, helping businesses to better understand the potential business case. While it may be difficult to pinpoint tangible returns, accountants can help businesses to develop more structured thinking about the potential uses of big data and their links into business performance. They can also build more effective monitoring of the realisation of benefits and encourage learning between functions on their uses of big data.

## USING BIG DATA TO SUPPORT BUSINESS DECISIONS

Accountants work with other business functions to support effective planning and decision-making. This can take many forms. Accountants may provide analysis to help business functions understand the financial implications of their activities or plans. They may help business functions improve the quality of business information that goes into financial decision-making processes.

Big data provides many opportunities for better analysis and new insights to support these activities.

### RESEARCH EXAMPLE 6: IMPROVING COST MANAGEMENT AND FORECASTING

Our research highlighted a number of examples of accountants working with business functions on cost analysis, to improve understanding of cost drivers and manage costs better.

Greater digitalisation of processes and new sources of data (eg, from sensors) enabled analysis of much more granular data. One company was able to change the time period of its cost analysis, from weekly and monthly-based to daily and even shift-based. Another company highlighted how this granular analysis helped with the allocation of shared costs to individual customers or products, improving the analysis of customer profitability and reducing the amount of unallocated overhead cost.

Our research also emphasised opportunities to improve forecasting based on more data and better predictive modelling. One company, for example, had developed a dynamic income forecasting system, which took into account 16 factors and was updated every day with actual results. This provided much more accurate information to support decision-making in areas such as pricing and discounts.

The most effective results from big data in this context showed accountants working closely with business functions, often characterised as being at the front line of the company. They were able to understand the key priorities of the business and work effectively with them to manage costs better, based on the insights from data. There was also examples of close working with product development functions, giving quick evaluations on potential new products, and helping with the risk management processes.

Consequently, there was a strong consensus that working with big data is part of the move for accountants towards more value-added tasks in organisations. Trends such as automation can free up the time of accountants and big data provides the means for new and better analysis and insights. However, technology skills must go hand in hand with greater business and commercial awareness for accountants to get the benefits from big data.

**USING BIG DATA IN ACCOUNTING, CONTROLS AND COMPLIANCE ACTIVITIES**

Accountants can also improve more transactional accounting activities by using big data. Alongside cost analysis, our research found that this was the most common way of accountants using big data.

**RESEARCH EXAMPLE 7: IMPROVING ACCOUNTING ACTIVITIES**

A number of companies were employing much more sophisticated capital management through big data. One company, for example, had developed a platform that linked group systems with bank payments systems, providing real-time information to feed into forecasts for cash requirements. More generally, better prediction and more granular data enabled more accurate understanding of capital requirements, better management of foreign currencies and exchange rates, and optimisation of working capital.

Big data also helped tax compliance activities. One central group function had much better visibility of the activities of subsidiaries and could very quickly identify failures to comply with tax requirements, or sharp changes to the tax burden. Another company was able to analyse tax liabilities for its payroll and compare the impact of different government policies.

Another area of analysis was expense management. One finance department was examining individual claims in much more detail, comparing them to broader trends and identifying specific compliance and controls issues.

**IT CAPABILITIES AND ACCOUNTANTS**

A strong and consistent theme throughout the research was the desire for accountants to have more IT skills. This did not generally mean that accountants should develop deep technical skills in data, programming or other IT areas. Rather, companies typically wanted accountants to become more comfortable with the use of IT systems and data, and the high-level way that systems work. This would make it easier for accountants and data scientists to have good quality conversations about how accountants could use data, and enable them to frame their requirements better.

It would also enable accountants in the longer-term to do more analysis themselves. In most of the companies studied, the IT departments had big data teams, including data scientists, that did the majority of analytics and modelling work. They wanted to keep things as easy as possible for the user and just provide good tools for them. However, if accountants acquire more skills around data, that balance could change in the future.

**RESEARCH EXAMPLE 8: TRAINING ACCOUNTANTS IN IT AND DATA**

Different companies employed a variety of mechanisms to help accountants build their IT knowledge and improve the communication between departments.

For example, rotation and training were common. IT staff were frequently seconded into accounting departments to help train accountants and work with them on defining their requirements. Encouraging cross departmental working and social activities were also common, especially in the more advanced companies.

One company had a 'data lab' programme, which helped all business staff better understand the kinds of things they could do with big data and the limits of such analysis. For example, analysis might highlight correlations and questions for further analysis but would not provide absolute answers. Predictive models based on probability have to be understood and used on that basis.

## *Implications from the research findings*

### **IMPLICATIONS FOR POLICYMAKERS**

While our research did not focus on the Chinese government's approach to big data, it is impossible to study the use of big data in Chinese companies without recognising the important context of the Five Year Plans and associated actions.

There is a lot of investment into big data systems and projects across many sectors of the Chinese economy, and the pace of change is high. This is leading to tangible benefits in some companies and transforming other sectors. It is building an enormous amount of data for new technologies, such as artificial intelligence, to exploit. It is also providing the government with a wealth of data to support future planning and decision making, as well as improve public services. This demonstrates the potential power of a joined-up and long-term approach to industrial planning.

Furthermore, China benefits from the size and scale of the country, which has particular advantages in this field. For smaller countries, greater emphasis on cross-border data sharing, for example, is needed in order to build greater scale. However, this brings other challenges around how those are regulated.

Individual case studies also show the real practical difficulties of implementing IT solutions effectively in organisations and achieving tangible benefits. Even if new technologies can be implemented quickly, it takes time to transform organisations with the wider resources needed.

Some of the issues raised, such as shortage of specialist skills, can be resolved through more training and education. However, resolving some of the cultural aspects is more complex.

Broadly speaking, businesses that are built around digitalisation and data have a significant advantage. The research highlighted how challenging it is to transition from legacy systems and thinking to becoming a more data-centric organisation. This particularly stems from entrenched data flows, associated business processes and the skills in place to manage those.

Therefore, while a committed industrial policy can provide a strong base in this area, policymakers also need to recognise and understand these practical challenges for individual organisations in delivering change.

### **IMPLICATIONS FOR BUSINESSES**

The research project highlighted a number of organisational resources that underpin achieving value from investments in big data. As well as creating the technology capabilities, companies need to build the right processes, cultures and skills, as well as understand the alignment between big data and business needs. These observations are common around the world, and all companies should see complementary resources as an integral part of their big data investments.

The particular complexity of big data was also emphasised, especially the indirect nature of benefits from big data, and the need for collaboration across organisations and with third parties to maximise the benefits.

Most importantly, the best companies in this space have a leadership team that intuitively understand the power of big data and the potential for their organisation – they simply 'get it'. That starts with identifying how big data can deliver value in business models or decision-making processes and filters down into the broader processes and culture of the organisation. While companies can still achieve benefits through more tactical or short-term approaches, maximising the value of big data requires a more fundamental organisational transformation.

**IMPLICATIONS FOR ACCOUNTING BODIES**

Our research highlighted a strong recognition in China for accountants to add greater value to companies and spend less time on traditional 'record and report' activities.

Big data can help to accelerate this shift. Our case studies highlighted many examples of big data generating new insights for accountants across a range of finance activities. Furthermore, the discipline and attention to detail that is fundamental in accounting can greatly help organisations to build better data governance across all functions. This is a difficult task in practice but underpins success with big data.

In order to deliver these contributions, though, accountants need to build more capabilities in IT and data and work effectively with data and technology specialists. This needs to be complemented by the continuing focus on working closely with business functions, which will enable accountants to understand their key questions, and then identify how they can use big data to provide answers.

In more mature and technology-savvy business environments, staff may already be well-equipped to move into more analytical roles and make use of big data. However, in companies with more traditional accounting staff, a big investment in skills and training will be needed, alongside wider cultural transformation.

This emphasises the role of professional bodies and educators in training new and established accountants to meet changing business needs. Many universities in China and other countries have developed new curricula and courses in data analytics, and there are opportunities to integrate these into accounting education more broadly.

**INVITATION FOR ENGAGEMENT**

This research project has highlighted many common themes for the profession around the world, as well as businesses and policymakers. In taking its work forward, the Big Data and Accounting Research Centre is keen to engage with other interested parties to build further understanding around the opportunities and challenges in big data, such as the following.

- How policymakers in other countries are creating an infrastructure to support big data.
- How other companies are generating value from the use of big data in their business models and decision-making process.
- How finance functions in other companies are working with big data to provide greater value.
- How other companies are building the organisational resources required and where they are encountering challenges.
- Where accountants are adopting new skills or mindsets to work effectively with big data.
- How other parts of the profession, such as auditors, are making use of big data.

We will continue to conduct research into these and other topics to support the development of the profession and help accountants deliver greater value to businesses.

To find out more, please contact [itfac@icaew.com](mailto:itfac@icaew.com)

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## Further reading

### For more information about China's plans and its experience with technology, see the following:

The 13th Five-Year Plan for Economic and Social Development of the People's Republic Of China 2016 - 2020, translated by Compilation and Translation Bureau, Central Committee of the Communist Party of China, Beijing.

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### For more academic research on the potential of big data and complementary organisational resources, see the following:

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Melville, N., Kraemer, K., and Gurbaxani, V. (2004): Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly*; 28(2), pp. 283-322.

### For more ICAEW resources relevant to the themes in this report, see the following:

Gillon, Kirstin, (2017), *Big data and the profession: what have we learnt?*, blog series

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