



Big Data, big capabilities: Navigating Big Data journeys to develop the finance professionals of the future

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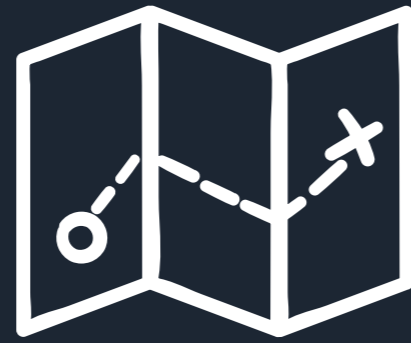
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Big Data, big capabilities

How can you harness the benefits?

Big Data isn't just for huge corporations. But what capabilities do you need as a senior finance or accounting professional in a medium-sized organisation – and how can you best acquire them? We highlight some of the main findings from this project.



1. ADOPT PROOF-OF-CONCEPT CASES, AND LEARN FROM EXISTING USE CASES

If you're at an early stage of your Big Data journey, start with proof-of-concept activities to show the viability of Big Data and its value for the business. Ensure that data are consistent. It's helpful to consider Big Data use cases from your own as well as other organisations, to learn about new applications of Big Data, and successful and unsuccessful practices in the community.

2. BUILD BIG DATA LITERACY

Critical thinking and creative thinking skills are essential tools as your organisation adopts new approaches based on Big Data. Bespoke Big Data literacy training for senior finance professionals can help make a shift towards a data-driven culture. This can combine good practices and experiences of other senior figures inside and outside the organisation. It could include training in how to interpret Big Data analysis; ensuring access to BD experts, within and outside the finance team; and unpacking case studies on how successful Big Data projects have been delivered.

3. BUILD AWARENESS OF BIG DATA AND ITS POTENTIAL TO SUPPORT THE ORGANISATION'S STRATEGY

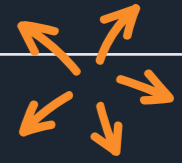
Big Data are often viewed as a specialist theme for data analysts, rather than an asset for the whole organisation including the finance team. Treating Big Data as a cross-cutting topic can drive improvement in the finance team's performance. Make data strategy and data governance part of the organisational strategy. Link any positive impacts of Big Data initiatives to KPIs, to encourage the C-Suite to pursue Big Data investments.

4. FOCUS ON INSIGHTS AND BENEFITS FROM BIG DATA, SUCH AS OPPORTUNITIES FOR REVENUE GENERATION

Adopt a more forward-looking approach, to encourage finance teams to capitalise on newly available data and technology. The senior team can use tools such as scenario planning to gain insights into future opportunities afforded by Big Data.

5. ESTABLISH METRICS, KPIs AND BUDGET LINES THAT SHOW THE VALUE OF BIG DATA TO THE ORGANISATION

Embed Big Data analytics within the organisation's KPIs. Big Data can inform the creation of value for the finance team and the organisation. Establish a budget line for investments in Big Data infrastructure, and treat Big Data as an asset rather than a liability. Create a communication plan to explain the costs, the return on investment and the benefits of Big Data for the finance team and the whole organisation.



6. TAKE AN EXPERIMENTAL AND FLEXIBLE APPROACH

Improve your understanding of Big Data by adopting a 'trial-and-error' approach. Use case studies from successful Big Data projects (ideally in a finance/accounting context) as evidence to educate and persuade senior professionals who are curious about the benefits and want to learn more.

7. BUILD STRONG CONNECTIONS ACROSS FUNCTIONAL SILOS

A 'silo effect' can hinder the acquisition of Big Data capabilities. Set up a data working group involving senior staff across the organisation as a starting point for the finance team to learn and share ideas with other teams.

8. IDENTIFY AND FILL SKILLS GAPS

Run an audit exercise in the finance team and across the organisation. Identify gaps in capabilities at the senior level, including the Board/C-suite. Write an upskilling plan, identifying actions to fill Big Data skills gaps. This can include training existing staff, hiring new staff with Big Data skills or outsourcing certain roles.

9. RUN WORKSHOPS AND NETWORKING EVENTS, INTERNAL AND EXTERNAL

Senior professionals can learn from finance teams in other organisations, including practical examples of beneficial Big Data initiatives. Internally, the C-suite can meet to share their data needs and capabilities. These exercises can inform a comprehensive Big Data plan, to build awareness at a senior level of Big Data's role in creating value and improving performance.

10. SET UP EXECUTIVE COACHING AND MENTORING PROGRAMMES

Coaching programmes designed for senior leaders can include sessions on the Big Data journeys of other organisations. These might cover how to create an environment that supports Big Data, and providing opportunities to share Big Data challenges and aspirations. Coaching is likely to be short-term and performance-driven, while a mentoring programme may be longer-term and development-focussed.

Acknowledgements

We thank ICAS for funding and supporting this research. We are grateful to Sylvia Uche for her research assistance during the project. In particular, we would like to thank the participants, without whose cooperation and valuable time the study would not have been possible. We are also grateful to the ICAS Research Panel and Marie Gardner for their valuable feedback.

Summary

The growth of Big Data (BD) has had a significant impact on what information accounting and financial professionals at all levels can access and use to inform their decision-making, and how they should do so. BD can lead to a variety of benefits for the professions. For instance, BD can provide real-time reporting, improve risk management, enhance understanding of customer behaviour and market patterns, and contribute to strategic decisions.

Professional bodies (such as ICAS, 2019), policy-makers (such as House of Commons, 2016) and researchers (including Akter *et al.*, 2020) raise the need for new capabilities that should be acquired by financial professionals if they are to make more informed decisions by using BD in their decision-making processes.

This project analyses the BD capabilities that senior finance and accounting professionals in medium-sized UK-based organisations require to maximise the benefits of BD; **examines** the main enablers and obstacles to the roll-out of BD capabilities; and **proposes** how senior finance and accounting professionals in such organisations can acquire and develop a portfolio of valuable BD capabilities.

In order to fulfil these research aims, the project adopted a **qualitative approach**. We conducted semi-structured **interviews** with senior accountants and finance professionals working in medium-sized UK-based organisations, and we ran two **workshops** to validate and develop our preliminary findings. 35 participants contributed to this project, including CEOs, CFOs, Finance Directors and Heads of Digital.

We found that senior accounting and finance professionals in medium-sized UK-based organisations are on different **Big Data journeys**; their organisations currently have different levels of BD use, which we can characterise on a range from low to high. To demonstrate these different trajectories of BD use, we present three use cases illustrating the different BD journeys that medium-sized companies and senior finance and accounting professionals are currently exploring. Each use case also elucidates the **Technology, Individual, Organisation and Environment** dimensions influencing BD adoption, in line with previous literature.

We have identified a **range of enablers and barriers** to acquiring BD capabilities, which we summarise under the four dimensions mentioned above (Technology, Individual, Organisation and Environment). Senior accountants and finance professionals in such organisations can overcome these barriers and leverage enablers to acquire BD capabilities and maximise the benefits of BD. We note, however,

that there are likely to be challenges which are peculiar to smaller and medium-sized organisations in implementing BD, in comparison with larger organisations. The latter are more likely to have advanced enterprise resource planning, sophisticated data platforms, capabilities and resources. Large organisations may also have the capacity to make significant investments in terms of time and cost, for example to acquire knowledge and other resources and to train relevant staff, as well as integrating and analysing different sources of BD. SMEs may find it more challenging to fully resource and support such BD interventions.

The **enablers** of BD capabilities acquisition (categorised by the four dimensions) are:

- **Technology:** beginning with 'proof-of-concept' cases; building BD literacy
- **Individual:** adopting critical thinking and creative thinking approaches; embracing experimentation and flexible approaches
- **Organisation:** viewing BD as a key asset; using training, hiring and outsourcing to build BD skills
- **Environment:** drawing on continuous support from professional bodies; supporting the role of the CFO in value creation via BD.

The **barriers** to BD capabilities acquisition are:

- **Technology:** lack of awareness of BD and its potential; lack of trust and confidence in BD
- **Individual:** commitment to the status quo; resistance to change
- **Organisation:** fear of high costs and a lack of returns; strong organisational silos
- **Environment:** gaps in accounting standards and guidelines; gaps in training or professional development.

This project aligns with **ICAS policy themes** by engaging with the **public debate on BD** in the finance and accounting profession. By acquiring new BD capabilities, senior accounting and finance professionals in medium-sized UK-based organisations are better able to leverage the enablers and overcome the barriers to using BD in their decision-making process.

This project contributes to **ICAS policy themes** by supporting and encouraging **sound governance practices and procedures** through the use of BD. The identification of barriers and enablers, based on Technology, Individual, Organisation and Environment dimensions, can support senior professionals and organisations in taking BD use to the next level in their own organisations. For instance, they can re-think the structure of the finance team by creating sub-committees with other functional areas (such as the IT and marketing functions). This can help to address individual and organisational barriers, including commitment to the status quo or organisational silos. Another solution is to connect and interrogate datasets that were once separate, resulting in better decisions for the business. This can help to address some technology and environmental barriers, such as a lack of BD awareness and professional development.

This project contributes to the **Business Policy Panel** position by aiming to create a positive business environment, and establishing clear principles regarding the barriers and enablers to acquiring BD. Our findings indicate that organisations need to move away from 'old' ways of thinking and defensive corporate positioning. New technologies, such as BD, can both support and challenge businesses to strengthen novel approaches to corporate governance. However, organisations need to audit BD skills in-house and identify gaps; and better communicate the costs and benefits of BD investments to the C-suite and the board of directors.

This project contributes to **Technology Thought Leadership**: BD offers great opportunities for business and financial professionals, while also requiring the development of new skills. As noted by ICAS, BD are a critical aspect of decision making; ‘how we use it and create value with it is vital for the next wave of professional services’ (ICAS, 2020). Our project contributes to this debate by suggesting that every senior professional and organisation is on a BD journey; our findings indicate that, depending on their current levels of BD use, they can put forward a range of strategies such as designing ‘proof-of-concept’ cases, building BD literacy or establishing suitable metrics and KPIs showing the value of BD.

This project seeks to elicit a change in **organisational culture** on BD by providing evidence that helps accountancy bodies and senior finance and accounting professionals to strengthen their application of BD. This project increases awareness that BD are not only for IT experts, but for all financial professionals, including senior professionals.

Our findings suggest that **bespoke training** activities are required, on the basis of where senior accountants and finance professionals are in their BD journey. For instance, those who have experienced low levels of BD use in their organisations to date may benefit from exploring further convincing examples of good practice on the benefits that BD can offer to address accounting/finance and business challenges.

Most senior professionals prefer to learn **in their own time, at their own pace, and in a collegial way**. This can be supported by establishing a “community of practice”¹ around BD: i.e. a group of senior professionals who share common interests in BD, with the aim of building capabilities and learning from the successes and mistakes of others. Many existing training programmes are designed with junior/middle accountants in mind, for example offering courses focusing on ‘hard’ BD skills, such as techniques for business analytics, data ethics, programming and coding. However, senior accountants and finance professionals are likely to benefit from a different approach, based on an ‘ecosystem’ of other senior colleagues and external experts, allowing for a mix of digital and in-person activities including coaching and mentoring. Digital technologies can be leveraged to offer innovative L&D (learning and development) activities for senior colleagues on the topic of BD, allowing flexible and tailored learning opportunities designed to strengthen a BD mindset. Via a platform-based digital learning ‘ecosystem’, insights from the community – such as other senior accounting and finance professionals with an interest in BD – can be shared and aggregated.

1 See for example <https://adaptmethodology.com/communities-of-practice/>

Background

Context and definitions

With technology expanding, accountants and finance professionals are going through significant changes that are transforming traditional accounting models. Data are recognised as a critical element for businesses and accounting (ICAS, 2022a), and the growth of Big Data (BD) has opened up many possibilities and opportunities for the profession (ICAS, 2021). BD can help managers to make better business decisions; for instance, algorithms can be used to identify patterns in data, and manual errors resulting from behavioural influences and other biases can be reduced. BD can help managers to understand customer behaviour, needs and preferences, allowing organisations to take advantage of new strategies, enhance their products and improve customer satisfaction. Operational risk management and fraud detection can be strengthened by using BD to help solve problems and meet regulatory and compliance goals (Corporate Finance Institute, 2022).

What are Big Data?

Big Data are high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing, enabling enhanced insight, decision making, and process automation (Gartner, no date). To be considered “big”, data must be characterised by at least one of the following 3Vs: Volume, Variety and Velocity (see Table 1 for further details).

BD are often characterised as structured or unstructured; and internal or external to the organisation. *Structured data* are well organised, and can be easily included in a database or spreadsheet (Richins *et al.*, 2017). Structured data include financial data, point-of-sales data (POS), and data from inventory management systems or customer/supplier relationship management (CRM and SCM) systems. Structured data are currently the source of most business insights; however, they are often referred to as ‘old hat’ (Marr, 2017). *Unstructured data* are not easily organised into columns and rows. They are generated from audio, video, image and textual sources, including social media and websites, mobile phones (e.g. GPS) and sensors. They typically need further processing and analysing before they can be utilised for decision-making and reporting (Warren, Moffitt and Byrnes, 2015). *Internal data* refers to the data that is generated within an organisation, or that the organisation can easily access. This may include financial and customer data on sales of goods or services, tax liabilities, customer feedback, CCTV video data, etc. *External data* refers to data originating outside an organisation, whether it is publicly or privately available. Examples include data arising from internet sources and devices which are fed by third parties outside an organisation (Arnaboldi, Busco and Cuganesan, 2017).

BD can help managers to make better business decisions (Merendino *et al.*, 2018); for instance [...]

What are Big Data capabilities?

At an organisational level, BD capabilities refer to the ability to collect, process, store and analyse large volumes of data to provide relevant information to decision-makers. BD capabilities in accounting are conventionally divided into hard and soft capabilities (La Torre *et al.*, 2018; Sarkar *et al.*, 2021). Hard or technical capabilities include data management (comprising an understanding of data ethics, extraction, preparation, reconciliation and cleansing), data modelling (applications of different technologies and data analytics), data visualisation and financial management (ensuring datasets are consistent and systems and information sources can therefore be interrogated in order to draw BD insights from them) and coding of analytics routines. Accountants should also have capabilities in the area of data quality management, i.e. assessing the quality, reliability and trustworthiness of data (Deniswara, Handoko and Mulyawan, 2020). Assessing the quality of data requires certain internal resources, such as ‘human capital’ – experienced and technical staff able to manage and process data. Specialised employees can help finance professionals to understand how data is analysed and to interpret the information generated, so that finance professionals will be able to rely more on data and make decisions which are data-driven (La Torre *et al.*, 2018). Another important set of BD capabilities is related to data security and cyberattacks. A data breach or cybersecurity issues can have detrimental consequences for an organisation, including its finance and accounting function, such as reputational damage and loss of customer trust (Ibrahim, Elamer and Ezat, 2021). While senior finance professionals are unlikely to require specific execution competencies in all of these areas, it is important for them to have sufficient knowledge and understanding of BD to work closely with colleagues who do have specialised BD skills – which brings us to soft BD capabilities.

Soft capabilities include awareness and understanding of BD applications and benefits, so that the finance professional can exercise appropriate oversight and management responsibility for BD and its analysis. The term soft capabilities also refers to relationship building with other teams; given the complexity of BD, senior finance professionals need to cooperate effectively with other colleagues and teams (Deniswara, Handoko and Mulyawan, 2020). An important soft BD capability in accounting is business systems thinking, i.e. ensuring that single business decisions are made based on a systematic and holistic approach (Bhimani and Willcocks, 2014). In a similar vein, other scholars (Sarkar *et al.*, 2021) argue that an integrated mindset, or ability to think in systems terms, is paramount to realising the benefits of BD (Dzurinin, Geerts and Lenk, 2023). An additional soft BD capability, underpinning much of the above, is effective communication, i.e. the ability to convey clear messages to fellow accountants and other staff to facilitate the smooth running of financial and accounting processes. Recent research summarises the above soft skills for accountants under the umbrella term of a ‘data analytics mindset’ (Dzurinin, Geerts and Lenk, 2023). This underlines the importance to the accounting profession of a sound understanding of BD and data analytics, including an ability to ‘ask the right questions’, communicate effectively and adopt a holistic approach to data analysis.

Within this study, we focus on the BD capabilities of *senior accountants and finance professionals in medium-sized UK-based organisations*, exploring the ability of such senior managers to understand and use BD in operational and strategic decision-making. The learning process of such capabilities refers to the transformation of data into knowledge by using technologies and ‘soft’ and ‘hard’ capabilities to ultimately support the decision-making process (Meadows *et al.*, 2022). For instance, explorative learning processes concern all those activities that bring senior professionals close together to promote mutual benefits and build trust amongst actors (Lin and Lee, 2005).

Table 1 – Key concepts

What are Big Data?	Big Data are high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision-making, and process automation (Gartner, n.d).
The 3+ Vs	Big Data can be defined by using the 3Vs+ specification. Volume refers to the magnitude of data; when datasets are extremely large, traditional tools are inadequate (Gepp <i>et al.</i> , 2018). Variety reflects the diverse data formats of BD, such as quantitative, text-based, and mixed forms, as well as images, video, and other formats (Arnaboldi, Busco and Cuganesan, 2017). Velocity measures the frequency at which new data becomes available, which is increasingly at a very rapid rate. Other Vs have been added (Shafer, 2017); however, the next most utilised Vs are “Value” and “Veracity” (Fosso Wamba <i>et al.</i> , 2015). Value refers to the potential economic value that data can produce. Veracity refers to the accuracy or trustworthiness of a dataset.
Structured Data	Structured data are located in a fixed field within a defined file (e.g. databases and spreadsheets); an example is financial data.
Unstructured data	Unstructured data are not easily inserted into columns and rows. They are generated from audio, video, image and textual sources and need further processing and analysing before they can be utilised for decision-making and reporting.
What are Big Data capabilities?	The power and the ability to use and understand Big Data. Hard capabilities: data management, data modelling, data visualisation and financial management. Soft capabilities: awareness and understanding of BD applications and benefits, relationship building and business systems thinking.
Why accounting and senior finance professionals?	The finance and accounting team is the ‘golden thread’ of each organisation; they have the potential to connect every functional area, given their oversight of the organisation’s finances, including budgeting, accounts, forecasting and audits.

Big Data application in accounting

This section gives a brief overview of some BD applications in accounting, namely financial and managerial accounting (ICAS, 2022b), before introducing the Technology, Organisation and Environment (TOE) plus Individual (TOE-I) framework adopted in the data analysis that follows.

Financial accounting

BD has the potential to enhance understanding of company assets, features and conditions, and hence support ‘fair value’² (Moll and Yigitbasioglu, 2019). Unstructured data (such as video data) may provide a more accurate record of the real-time value of an asset (Warren, Moffitt and Byrnes, 2015). Sensory data may offer a more reliable valuation of any intangible assets that organisations are not required to include in their financial statements, such as data on their customer base, any trademarks and trade names developed internally, and company reputation. With the assistance of BD and predictive analysis, better forecasting and management of future risks can be developed.

Managerial accounting

BD can have important implications for managerial accounting tasks such as internal financial reporting, analysis and decision-making. For example, many organisations have a wealth of data that is currently under-utilised, because it is not clearly linked to an economic transaction; such data has the potential to provide further insight into customer preferences and purchase decision-making (Bhimani and Willcocks, 2014). BD can be used in new product development, and can help organisations customise their marketing strategies and understand changes and trends in customer preferences (Bhimani and Willcocks, 2014). The performance of the business can be monitored using BD by defining new key performance indicators (KPIs), and market trends and patterns can be analysed to stay ahead of competitors (Warren, Moffitt and Byrnes, 2015). Real-time data in managerial accounting can improve operations and services by identifying unexpected patterns and linking different data sources (Moll and Yigitbasioglu, 2019). Other applications of BD include but are not limited to asset and liabilities assessment (Rezaee and Wang, 2019), fraud detection (Cockcroft and Russell, 2018), financial reporting (Warren, Moffitt and Byrnes, 2015) and forecasting (Ibrahim, Elamer and Ezat, 2021).

Technology, Organisation, Environment and Individual framework

The Technology, Organisation and Environment (TOE) framework (Tornatzky and Fleischer, 1990) describes the dimensions that influence the process of adoption of BD. The **Technology context** describes the internal and external technologies an organisation can use. The **Organisational context** includes the resources and characteristics of an organisation. The **Environmental context** refers to the structure, the type and the features of the industry, competitors and policy-makers. Finally, another factor influencing the adoption of BD is the perspective of the Individual. **The Individual context** includes the beliefs, attitudes and behaviours of individual managers or directors towards technology or BD acceptance.

² For a thorough examination of the concept “true and fair” view, please consult the FRC sources: <https://www.frc.org.uk/accountants/accounting-and-reporting-policy/true-and-fair-concept>

Research aims

The study addresses the following **aims**:

- a) To examine the main capabilities that senior finance professionals/accountants need to make good use of BD in their decision-making
- b) To analyse the main obstacles to the roll-out of BD capabilities
- c) To propose how senior finance professionals/accountants can acquire and develop a portfolio of these new capabilities.

Research approach

The project applied an in-depth, qualitative approach, given the complexity and novelty of the topic. The project was divided into three phases: literature review, interviews with senior finance professionals/accountants in medium-sized UK-based organisations, and two workshops on BD capabilities.

The first phase examined existing research and knowledge on BD capabilities. It reviewed the current debate on the BD capabilities of finance professionals/accountants, both in the academic literature and practice, through a desk research method. The findings of this phase informed the second phase of the study and assisted the research team in designing the interview guide used in the second phase; this comprised in-depth interviews to gain a more nuanced understanding of i) which BD capabilities finance professionals/accountants need to develop in order to make good use of BD in their decision-making; ii) the main obstacles to the acquisition of BD capabilities. We conducted one-to-one interviews with 30 senior finance professionals and senior accountants, mainly in medium or medium/large companies in the UK.

Medium/large companies are those that are beyond the definition of ‘medium’ as per the Companies Act 2006, e.g. over 250 employees – the smaller end of large companies in the UK.

Internal and external audit companies, financial analysts and investors, and public sector organisations were excluded from the sample. Ten pilot interviews were initially conducted to test the interview guide, which was then adjusted and adopted for the 20 remaining interviews.

In the third phase, two online workshops were held with 16 senior finance professionals and senior accountants from medium-sized UK companies. The aim of the workshops was to validate our initial findings and to gain the input of senior finance professionals/accountants in order to explore how they might be able to acquire the portfolio of capabilities identified during the previous phases.

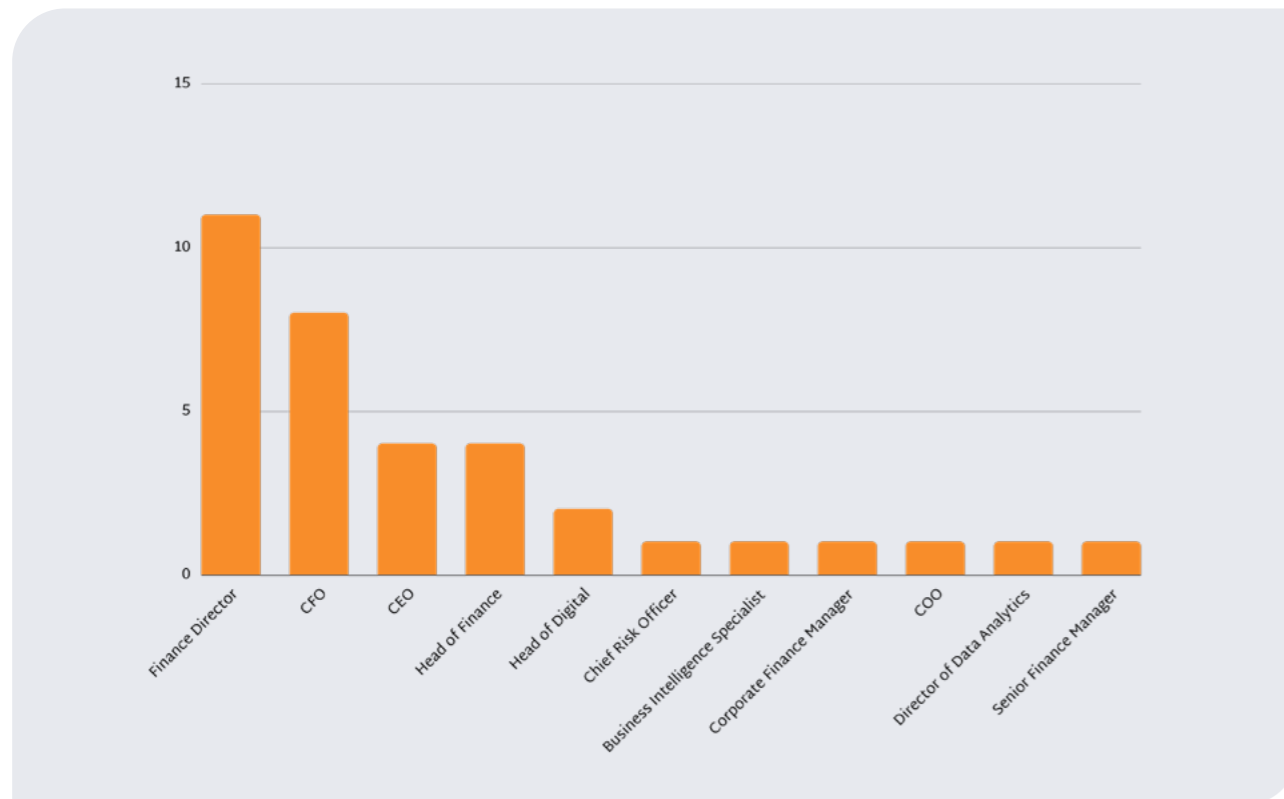
As per the ethics protocol and authorisation, all participants and data are fully anonymised.

Sampling and demographics

Job role

All 35 participants in the study held a senior role in their organisations; the majority (23 out of 35) were finance directors, CFOs or CEOs. Other participants were, for instance, Heads of Finance or Heads of Digital (Figure 1).

Figure 1 – Job Role

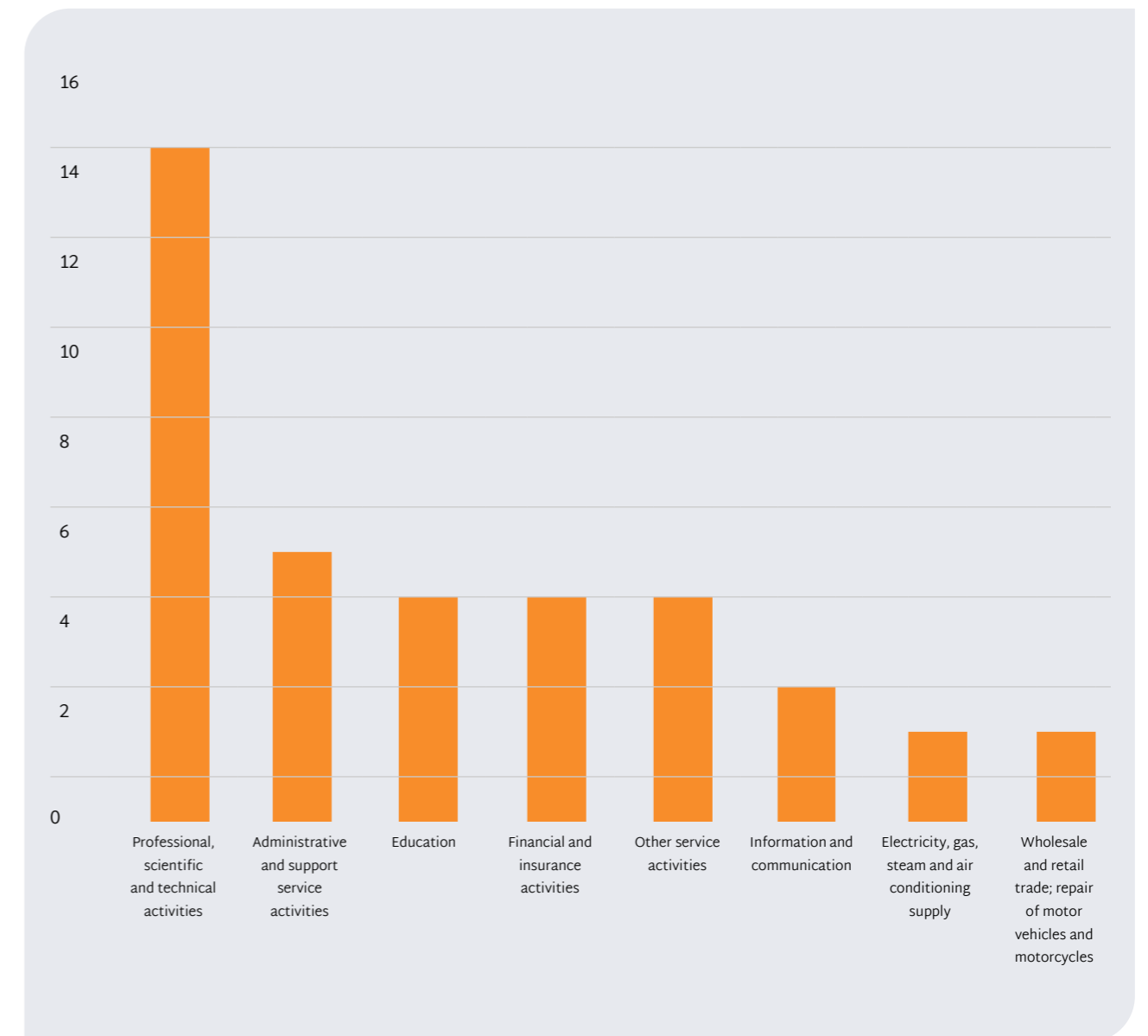


Industry

The 35 participants in the study were from a range of industries, mapped against the Standard Industrial Classification (SIC) codes in Figure 2 below. Fourteen participants worked in the “professional, scientific and technical activities” industry, which includes management consultancy, financial management, accounting and auditing activities. Five participants worked in the “administrative and support service activities” industry, which mainly includes business support services such as business and accounting consultancy and financial advisory. The participants working in the education industry had a senior managerial or financial role (i.e. they were not primarily in teaching roles).

It is important to note that the majority of the participants worked in the tertiary sector (e.g. accounting and business consultancy), with a lower level of representation from the secondary sector (e.g. fashion and packaging). However, the findings of the study are based on a rich and deep qualitative analysis of the inputs of 35 participants across the sample, and the validity and reliability of the findings were promoted by a series of strategies adopted by the research team in line with previous studies (please refer to the section on Data Analysis for further information). The limitations of the study are more fully discussed later in the report (please refer to the section on Limitations).

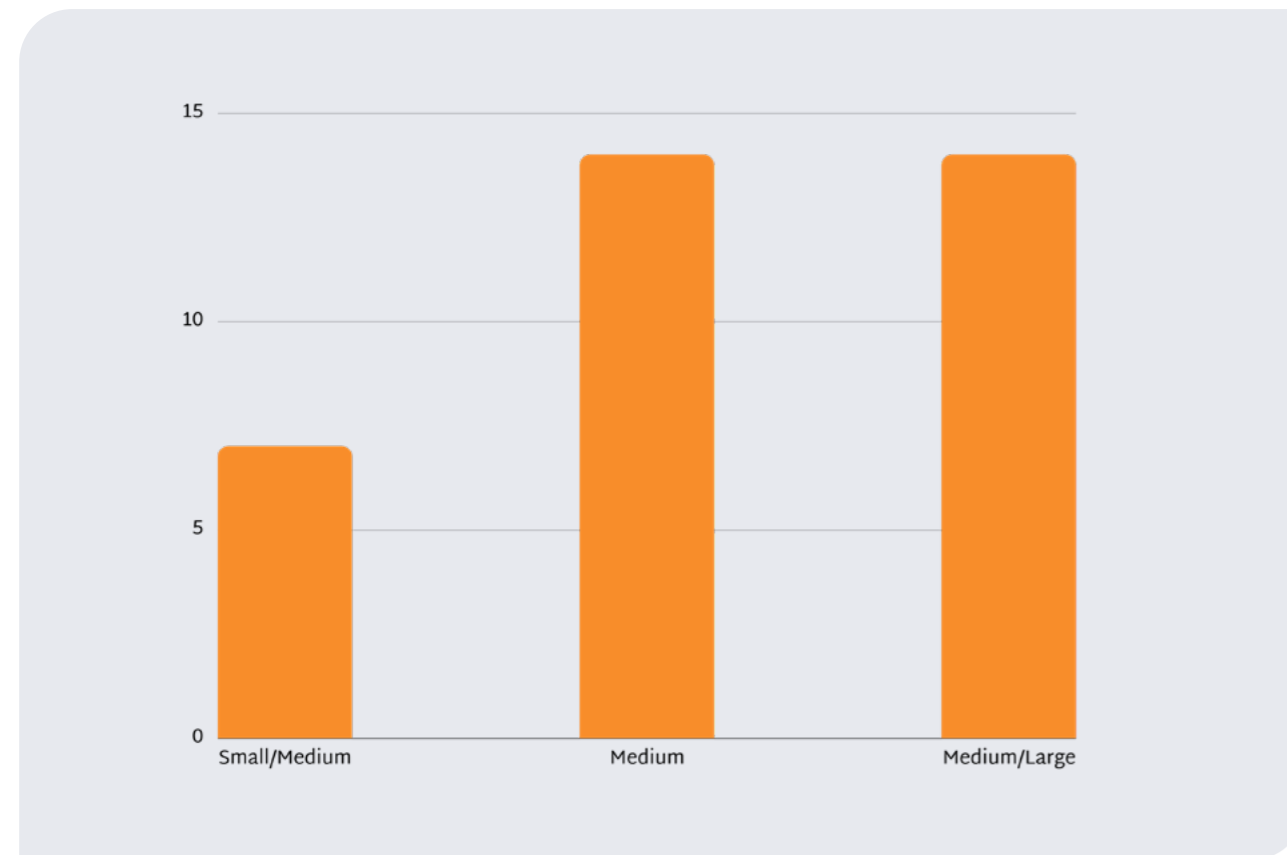
Figure 2 – Industry (SIC code)



Firm size

The majority of participants (28 out of 35) worked for medium and medium/large organisations (Figure 3). A small number of participants (seven) worked for small/medium organisations, which were mainly business and accounting consulting companies working with medium and medium/large-size clients.

Figure 3 – Firm size



Level of Big Data knowledge

In order to place the findings of the study in context, the research team made a broad assessment of the levels of knowledge and understanding of BD for each participant.

A series of questions were posed to each participant, responses were analysed and an assessment made, following a discussion of the following points:

- Current job role, and previous work experience with BD
- Educational background, where appropriate/relevant
- Experience of applying BD, particularly in an accounting /finance context
- Awareness and experience of data strategies, and management practices relating to data
- Any relevant 'hard' skills, such as coding/programming.

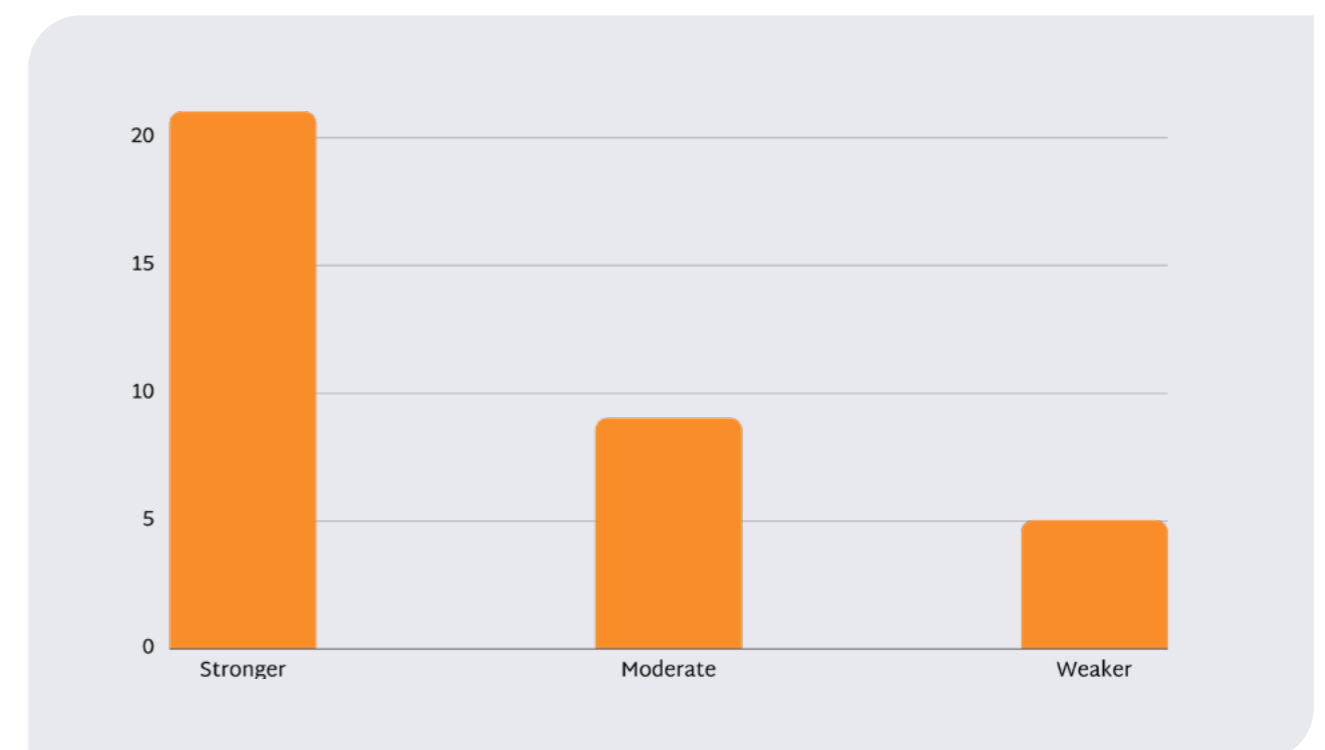
It is important to note that the majority of senior professionals who participated in the project and were judged to have prominent levels of BD knowledge did not necessarily have high levels of 'hard' capabilities in BD, such as coding/programming skills. The findings of this project reinforce the argument that these 'hard' capabilities are not essential at a senior level, where a range of 'soft' BD capabilities come to the fore.

The below provides an illustration of three broad levels of Big Data knowledge/ understanding:

- **Senior professionals at a stronger level** of BD knowledge and understanding typically discussed well-defined strategies or 'roadmaps' for BD which supported the future strategic development of their organisations; they had often already committed to invest resources in BD, or to persuade the board / C-suite about the benefits of BD.
- **Senior professionals at a moderate level** of BD knowledge were typically aware of BD concepts and benefits; however, they had not yet fully committed to BD in their organisations, or been able to invest significant resources to explore BD further.
- **Senior professionals at a weaker level** of BD knowledge were judged to be behind other participants in terms of their discussion of data maturity levels and data management practices, for example. They typically had a more basic awareness of BD, its benefits and its usage.

The majority of the participants (21 out of 35) were judged to have a stronger level of BD knowledge and understanding; a smaller number had a moderate (9) or weaker (5) level (Figure 4). It was to be expected that the majority of participants would have a stronger level of knowledge/ understanding of the topic, as it was the experience of the research team that many potential participants who felt they had little knowledge of BD chose not to participate in the project.

Figure 4 – Level of BD knowledge and understanding



Data analysis

The data analysis began with careful scrutiny of the transcripts of the interviews and workshops, before drawing out common themes such as any capabilities that the participants considered senior finance and accounting professionals should possess for BD application, and challenges that they may face in adopting BD. Common themes were extrapolated across the dataset. The software package NVivo was used to code the transcripts, and extract key fragments relevant to the aims and objectives of the project. The research team held brainstorming sessions to discuss and interpret the findings, returning to the transcripts and re-analysing the data as necessary.

In order to promote the validity and reliability of the findings, the research team adopted the following strategies, in line with previous protocols (Bell, Bryman and Harley, 2019):

- Acknowledging possible biases in sampling and ongoing reflection on methods, to guarantee depth and relevance of data collection and analysis
- Creating comparison cases to seek out similarities and differences across the datasets, to guarantee that different perspectives are taken into account
- Including 'rich' and 'thick' descriptions of participants' accounts to support findings
- Data triangulation, e.g. different sources (such as reports and corporate documents) were used to develop a comprehensive understanding of BD capabilities for senior finance professionals and to corroborate the findings.

Research findings

We begin the presentation of our research findings by describing three BD use cases. These were selected from the dataset to illustrate the different BD journeys that managers and organisations are pursuing as they acquire new BD capabilities, and to explore the impact of low, medium and high levels of BD use by different organisations. We summarise the use cases using the four dimensions of Technology, Individual, Organisation and Environment (introduced earlier). We go on to identify enablers and barriers to the acquisition of BD capabilities, summarised under the same four dimensions.

Use cases

CASE 1 – Low level of Big Data use

The participant worked as a CFO in a medium-sized clothing business, with shops in the UK and other countries worldwide.

Technology

The CFO felt that the first challenge of BD is the overwhelming volume of data points; senior accountants and finance professionals do not necessarily know how to address the issue of data volume:

...the biggest challenge, not just here, but I think in previous businesses as well, is just, a) the sheer volume of information that's collected within a business and b) the consistency of that information across the business.

An additional drawback which can prevent the finance team from fully adopting BD is the lack of data consistency across the different functional areas or teams. In the CFO's experience, different datasets were not brought together, i.e. there was no centralised repository to collect, store and process data in the organisation. As a result, he was sceptical about the real value of BD:

One of the biggest challenges everywhere is to make sure the data is consistent across, not just different departments, but different databases, etc....

Because of a sense of BD 'overload' and a lack of consistency and coordination across the organisation, the finance team may not necessarily know how BD can be of use, or how to work effectively with the IT team to draw out information that is of greatest value to the business:

...it's almost an IT function... let's all begin with a database, and the right platform on top of it ... ninety per cent of that work is, I would classify as an IT role. It's the ten per cent at the end with, 'how do you want this report? What information do you need out of it? What do you need to make sure it's correct?' etc., that's where the finance input would come... finance should be the conduit between the information that's in the business and the distribution of it in a sensible way to people.

Individual

The CFO reported that his CEO was sceptical about using BD to inform strategic decisions:

...[the CEO has] no interest in the information, and little interest actually in the data that was produced ... it was ... 'are we making money?', 'is that customer profitable?' etc. Just did not have the appetite...

The CFO challenged his CEO's position, feeling that decision-making based on BD could bring benefits:

...we should at least have a respect for that, and know that it's going to be right ninety percent of the time, as opposed to just going with a gut feel... it's senior management that drive that.

The CFO reported that the CEO was concerned that BD are too expensive; investments in BD require time and energy which may not be proportionate to the ROI. While the CFO recognised the need for consistent data across functional areas such as finance and marketing, the CEO questioned which version of the data holds 'the truth', and expressed a lack of trust in BD, preferring to rely at times on 'gut feelings':

Certainly, at times ... gut feeling and experience will maybe override the information, but most other places I've worked we've ended up making, whether it's the right or wrong decision, it's based on some sort of interpretation of the data or forecast... you can have data ... that says, "We don't need to buy any more winter coats because the warehouse is full of them," and you can have the chief exec going, "No, no, no, I know better. It's going to be cold in February, we'd better buy more. It was cold last February. So, I'm going to buy more winter coats", which is okay some of the time, and some of the times you've got to work with your gut, but ... it's certainly not the right way to manage information.

Organisation

BD were not widely used by the finance team or the rest of the organisation, because of scepticism about its validity and usefulness. As a result, the CFO advised that to make progress with BD, an organisation should 'start small', i.e. making gradual investments in datasets, training, and even new staff members:

... the best option is, introduce it somewhere in a small way ... I think there's power to sitting in a meeting with a bit of paper that has got factual, clear, precise information that's understandable to people in that area, and if the person beside you doesn't have a similar bit of paper, they're going to feel pretty silly and will quickly want to get up to the same level of clarity.

'Starting small' also means that the finance team should meet periodically with the IT team, and other teams across the organisation, to discuss the data that the organisation already holds, which information can be extrapolated from existing datasets, and how to solve common business challenges using BD:

There was a lot of time and pain and energy in setting things up, but the time that was saved and the analysis and interpretation of the information ... was very useful, and you actually felt ... that you [the finance team] were actually talking in the same language, whether it be to your commercial colleagues or your operational colleagues ...

Environment

The CFO felt that the collection of data from external sources represented a challenge that senior accountants and finance professionals may not currently have the capacity to fully address:

I would think of Big Data as being information on the customers and how we gather, collect that and maximise the benefit of having that information. So, there's that aspect of it, which is an ongoing struggle...

Summary of case 1

- Address concerns about data overload, quality and consistency across the organisation
- Persuade key individuals of the validity and potential usefulness of BD
- 'Start small' with BD investments, and work across functional silos
- Address the challenges of external/unstructured data and 'reliance on gut feelings'

CASE 2 – Medium level of Big Data use

The participant worked as a CFO in a large organisation providing materials to businesses.

Technology

The CFO explained that his company used ‘traditional’ software (mainly spreadsheets) to analyse data; despite having an appetite for data, the finance team had limited capacity in terms of complex data analysis:

We use very much Excel as a business, so in that sense we probably are a wee bit limited in terms of some of the analysis we do. We do have a small team of business analysts within the business and they use a combination of Excel and [name of software] to do that analysis. But I would say it's still very embryonic ... One of the issues we do have by using the tools that we've got is getting good quality information out to our teams quicker, faster.

The IT team is an enabler of BD usage in the finance team; the latter cannot work in isolation. Giving the example of a particular project with a marketing/sales focus, the CFO felt that the finance team should work with the IT team and also with the sales manager to develop the relevant software:

If you look at [name of project], that is sponsored by the sales director, because it's fundamentally a customer-driven project and the IT is an enabler to get to the end result, but there's a heavy bias within that project towards sales, and we have champions within the business that are part of the team... So, it's led by the business, but IT clearly provide a huge amount of the support to get it to a stage where it's ready to use.

Individual

The CFO had a curious and inquisitive approach to BD, i.e. trying to understand how BD can improve the performance of the finance and accounting team. For BD to be used effectively in decision-making, the finance team need to be able to communicate effectively and work well with other functional areas. Although the CFO was curious about the benefits of BD, he acknowledged that the finance team did not currently have sufficient involvement with other teams:

...it's down to the finance people to demonstrate their value to the business and, by doing that, they get involved more. If you stay in your box and just do what you're doing, then frankly people won't get you involved because they don't see you as a 'value add', they just see you as an overhead.

The participant pointed to the need for a CFO to be able to persuade their top management team about the usefulness of BD. As a result, CFOs need to have good communication skills, and be resilient to overcome data challenges:

You do need to be a good communicator. You do need to be pretty resilient as well, because when you're leading change, you're going to come up against obstacles, so you need to be quite determined and resilient and you need to be able to bring people together. That requires some patience as well. So, you've got to be able to communicate with people what you're trying to achieve.

Organisation

The CFO pointed out that investments in BD in the finance and accounting functional area are rarely considered to be essential to the running of the business:

... finance is probably the bit that's the least thought of when it comes to these investments ... when we make the business case for these investments, there's not any great thought to whether finance benefits or not, but if there's a knock-on benefit to finance, then that's great, they get an extra benefit from that, but it's not really the main thrust of the business case.

The CFO felt that other senior colleagues do not perceive the finance team to have a prominent role in BD and data analytics:

They very much just see finance people as the number crunchers, and don't really necessarily see them as any great value for the business. I think leadership from the top does start to decide the extent to which finance is involved in the business, or not involved, but the extent to which they're involved in the commercial aspects of the business.

Environment

A key issue raised was the need for trust in the data source, hence the quality of the data:

... one of the issues I see with data is the quality of the inputs, and how you're collecting the data. For example, in our business, we rely on people collecting data about customers at the point they start to deal with customers or doing research on customers. If they don't believe there's value in that for them, or value in that for the business, the quality of the data you get in is tainted, and to some extent then your trust ... the lack of the outputs become tainted as well.

The CFO was curious about exploring new analysis, trends and opportunities with data specialists. However, he also recognised the importance of leadership from the C-suite regarding BD, noting in particular that the CEO should be a driver of organisational change regarding BD. He pointed out that the finance and accounting community is able to provide unbiased interpretation of findings from data analysis; the finance team can meet the need for someone who can interpret and analyse the data in an unbiased way, while looking at the business internally and externally:

... I certainly see the finance community as being key to putting a kind of almost unbiased interpretation to the information, taking on board different viewpoints from within the business and outside the business.

Summary of case 2

- Seek opportunities for the finance team to move beyond the use of ‘traditional’ software such as spreadsheets; the finance team can grow its role as a driver of BD across the organisation, alongside the IT team and other functions
- Strengthen the role of the CFO and finance team in promoting the use of BD across the organisation
- Promote the role of the finance team in offering skilled and unbiased data analysis and interpretation, e.g. in relation to the quality of new sources of external/unstructured data.

CASE 3 – High level of Big Data use

The participant was the CFO of a medium-sized organisation producing sustainable energy across the UK.

Technology

The company had chosen to do very little outsourcing of tasks such as data collection or analysis; they had built BD capabilities in-house, across the whole organisation:

...we're building that capability ourselves. So, from a finance perspective, we have capability on the team for things like [name of software] and data analytics, but it's not just a finance function, it's a business function. We use [name of software] to pull in all of our data ... it allows one source of truth...

The CFO was constantly driven by curiosity about what new BD can offer to the finance team. The value of BD comes from looking forward, as opposed to the month-end accounts that analyse historical data:

...I think also, just having the team and the systems, it's crucial. Getting the choice of the right systems, that's having the proper IT personnel to guide you, because it's difficult as a finance person to understand which is the right software for you. We've done very well with [software package name], but that might not be right for everybody. But you need something that is able to capture everything you do and present it in that succinct way, otherwise it's a bunch of numbers and it becomes like boring accounts again. You need something that is actually going to give you value.

Individual

The CFO argued that senior finance and accounting professionals need to be curious about BD, and not afraid of its potential power and benefits for their organisations. They should be able to help the senior management team and the finance team to become more comfortable with the use of BD. They need to put together the right team, which includes IT experts, for BD to thrive in their organisations and to enable the creation of value via BD:

I think first and foremost is: be curious, don't be scared of the data, be curious and actually find out what it can do for you, and I think that's really important. Some of the senior guys in my team, I had to get them comfortable with my push for automation and data, because they were quite nervous about it, but now they've embraced it, they get it.

The senior management team has to become inquisitive, has to be challenged to 'dig deep' into the data and ask questions about why some numbers are the way they are, and how improvements can be made:

...maybe people on the board are not challenging enough, digging deep enough to understand what makes up the numbers, and I think you have to have that curiosity ... to really want to dig down ... why is that number like that? Okay, it's gone up and it's gone down for various reasons, but understanding why it's like that, how can it be better, what's causing that, whether it's good or bad, because quite often with board reports, we'll say, we're up by 20% this month and everyone goes 'hooray' and then you move on. Nobody questions it. If you actually find out and dig into it, maybe it should have been 25 or 30%, you don't know that until you scratch behind it.

Organisation

An organisation should develop a data culture based on value creation; reports can be used to generate greater insight via BD. Data can be valuable in predicting what is about to happen; accountants should be challenged to be curious about what BD can bring to the creation of valuable reports:

.. as accountants, how many reports have we produced that people never look at, and it has to add value. So, the culture within the business to ... be curious and scratch at the surface of the data and ... challenge the accountants in particular, but across the business, to come up with reports that actually create value and ... give you good insights. And often it's the smallest thing that piques interest, and in the board reports that we do, six pages of our board report is purely data. We're driven by data ... data's crucial to us to start predicting what's coming around the corner.

Experimentation and flexible approaches with new data and technologies can open up innovative and thought-provoking pathways for the business:

There's a lot of trial-and-error within this as well, to get rid of the dead wood, if you like, the stuff that is not going to be of value to you, but sometimes you go down a path, you think actually that's quite interesting and open it up to the whole business, it's really created that for us, to give us that kind of 'oh wow' moment.

The senior team used BD to inform strategic decisions on cost-cutting, and where best to invest. The CFO used BD to offer real-time accounting information, for example to help with management accounting:

Where should we be looking at reducing costs, or maybe increasing costs to generate more revenue? So, it gives us a real insight that I have never had in a business before that I've worked in, to be honest, of real time data ... from that, it can really help us drive the business decisions ... at any minute of any given day, we can tell you what the revenue cost, EBITDA across our network ... it gives you a lot of on-hand information that historically, you would never have had in finance.

Environment

The CFO was passionate about the potential value of a strong capability in BD, for example to help the company to understand its environment and its customers' needs. This can lead to opportunities to build the business and increase customer satisfaction and loyalty:

It [BD] allows us to know what the customers want. So, it's a builder of revenue. It allows us to target customers in a way that we know their habits ... we will offer new things, we will give them new technologies ...

The CFO argues that some senior finance and accounting professionals have not experienced what BD can offer - which is why they are sceptical or not sufficiently curious about BD:

Perhaps they [some senior finance professionals] have never seen it work, they've never seen what it can give you ... there is a tendency in accounting just to do what went before, and things are working and the board are happy with your reports, it's easy just to keep churning out the same old reports and no one says anything...

Summary of case 3

- Focus on building skills in-house, with limited use of outsourcing where appropriate
- The senior team can learn to work together on BD, and demonstrate curiosity in exploring what BD can offer
- Adopt a mindset of an organisational 'data culture' where BD creates value for the organisation
- Promote opportunities for (senior) colleagues to gain first-hand experience of BD.

Summary of use cases

The use cases illustrate three different BD journeys that companies and senior finance and accounting professionals in medium-sized UK-based organisations are currently exploring. Each use case also elucidates the 'Technology, Individual, Organisation and Environment' dimensions that can influence BD adoption.

Our data shows that the various 'BD journeys' taken by individuals are influenced by their personal career paths, their particular organisational settings, and the external context, such as career support from accountancy bodies. Yet the participants in the study were keen that every manager and organisation should consider the BD 'trajectory' that is right for them at this particular point in time – regardless of organisational size, for example. As one finance director pointed out:

The little guys that think: 'Oh, Big Data is for the big guys!'. Smaller companies can benefit too, it's just a question of getting, depending on what it is that's useful for them. Finance Director/ Company G

The following table provides a summary of some key concepts arising from the three use cases (Table 2).

Table 2 – Summary of the use cases

	1st case	2nd case	3rd case
Level of Big Data use	Low	Medium	High
Big data are	A challenge and a cost	An area for further exploration and potential investment	A key priority area for significant strategic investments
Technology	Concerns include 'data overload' and a lack of data consistency across the organisation.	The IT team is viewed as the driver of BD; the finance team has a modest role, but cross-functional working is necessary. Software use is mainly 'traditional' e.g. spreadsheets.	Use of BD is driven by a strategic and forward-looking approach. Significant collection and analysis of data is undertaken in-house.
Individual	Scepticism is expressed about BD. Reliance on 'gut feelings' rather than data, on many occasions.	Curious/inquisitive approach to BD. Good skills required in order to address difficulties in persuading senior colleagues.	C-suite works together on BD, demonstrates curiosity in exploring what it can offer, and is convinced of its potential value.
Organisation	Questioning whether BD are useful. Recognition of need to 'start small' to overcome concerns.	Preliminary collaborations between the finance team, the IT team and across the organisation. Need for finance team to demonstrate its value/ role with regard to BD.	Strong 'Big Data culture' across the organisation, e.g. valuable real-time reporting to support decision-making. Willingness to accept a 'trial-and-error' approach to new BD initiatives.
Environment	Concern that collecting external data is challenging. Little explicit acknowledgement of the role of BD in exploring the firm's external environment.	Lack of trust in external data. Identifying the role of the finance / accounting community in providing unbiased interpretation of Big Data analytics.	Extensive use of BD to provide strategic understanding of customers, competitors, etc.

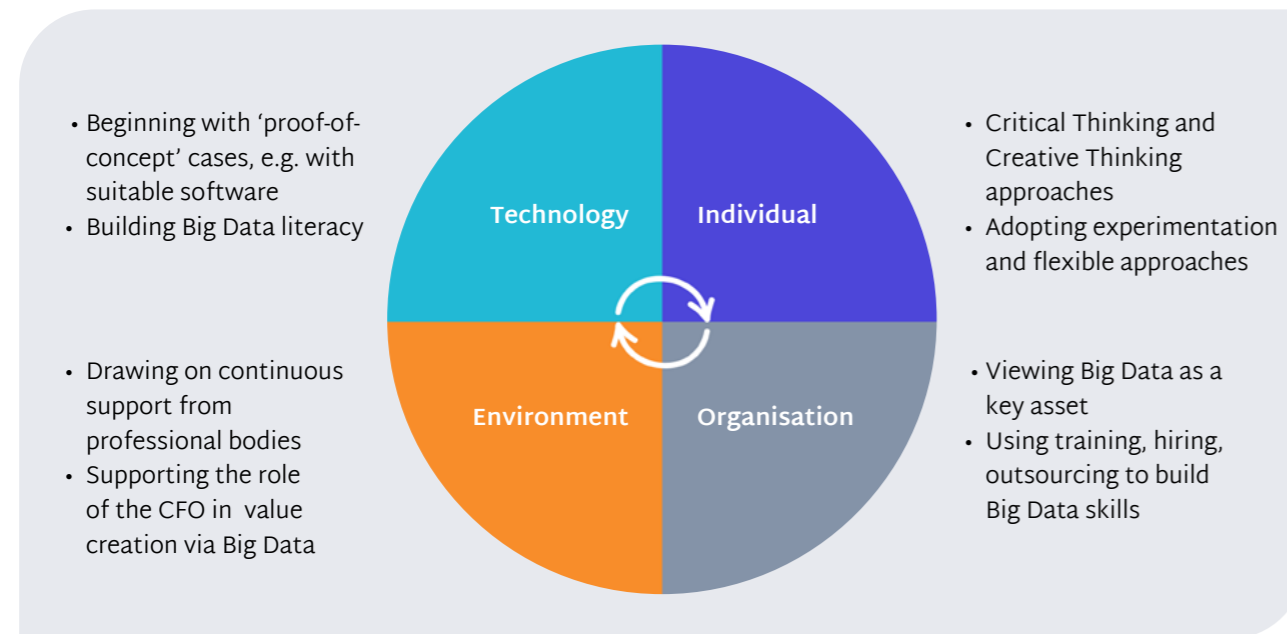
Next, based on an analysis of the whole dataset, we explore the enablers and barriers to acquiring BD capabilities, from the same four perspectives: Technology, Individual, Organisation and Environment.

Enablers and barriers to acquiring BD capabilities

Enablers of the acquisition of Big Data capabilities

Figure 5 summarises the enablers that senior accountants and senior finance professionals highlighted as the most common and prominent in their experience, based on their various BD journeys.

Figure 5 – Enablers of acquisition of BD capabilities



Technology

Beginning with “proof-of-concept” cases: starting with small steps involving modest BD investment. Specific ‘proof-of-concept’ cases can be used to establish BD viability and value, before scaling up into wider applications as appropriate. Those senior accountants and finance professionals with little experience or knowledge of BD preferred to initiate a change by making modest investments in infrastructure, such as appropriate software. By designing and implementing a proof-of-concept case, senior professionals can address the challenges related to the overwhelming volume of data; small steps can be taken to gauge the potential value of the new initiative, guarantee data consistency across the organisation, and initiate greater cross-functional working, e.g. improving connections with the IT function, or establishing a digital ‘committee’. This approach indicates that these companies feel that they are at the beginning of a journey with regard to the acquisition of BD capabilities. In some cases, they ‘start small’ due to fear of a cognitive overload of data and information:

...get the right resource in place. Start with it on a small scale in an area where there's well defined information, such as finance, and start to produce information. CFO/Company P

“Building Big Data literacy”: promoting a good level of awareness of the potential of BD, across the organisation. As senior accountants and finance professionals are typically involved in finance or management accounting using ‘traditional’ financial data, they are in a good position to identify new

opportunities to leverage BD. The participants felt that the opportunities and benefits arising from BD are currently not discussed to a satisfactory degree in their organisations. Building BD literacy means bringing the core functions of the finance team, such as reporting, data analysis, planning and forecasting, to a new level by leveraging innovative types of data and analysis. Senior accountants and finance professionals can use their digital literacy to inform the organisational strategy and to support the finance team in employing non-traditional methods of accounting such as real-time access, data analytics and data visualisation:

I was drawing the link between digital literacy and identity, and that actually learning this stuff quite often involves a change in how you see yourself. Head of Digital/Company U

Individual

“Adopting Critical Thinking and Creative Thinking approaches”: enabling the use of BD within the top finance and accounting team. The participants argued that using a combination of critical and creative thinking is the most appropriate way to understand patterns and gain insights from BD. Critical thinking involves questioning data and information to make better decisions. Moreover, the adoption of creative thinking can make BD more impactful, e.g. matching data with other sources of information to gain new insights. Creative thinking evolves by actively engaging with colleagues to bring together existing ideas into a new configuration, hence developing new insights:

You have to be much more agile and willing to experiment and help people, and be seen as a kind of partner in all of that. So, it's quite a big shift and it's quite a challenge to really well accepted models. CEO/Company F

“Adopting experimentation and flexible approaches”: seen as key to unleashing the potential of BD and to confirming ‘proof-of-concept’ cases. This can represent a big shift for senior professionals, requiring them to leave behind well-accepted models and adopt new ways of working. A trial-and-error approach can initially appear costly for the organisation; during an experimentation phase, mistakes and adjustments will inevitably be made. Participants argued that organisations, or board members, should not measure the success of a BD investment in the short term, as costs, time and effort are likely to outweigh the immediate benefits; there is a need to focus on the potential long-term benefits of new initiatives:

...so, let's try, if it doesn't work, I've made a mistake and then I will improve from it, really good learning and listening to their team and the other teams. Finance Director/Company C

Organisation

“Viewing BD as a key asset” can lead to transformational change in the organisation. BD are not recognised as an asset in current reporting; the accounting standard IAS-38 on intangible assets (IFRS, 2022) does not currently allow BD to be capitalised. However, some participants argued that BD should be viewed as an intangible asset. This suggests that even medium-sized organisations should be exploring the use of a wider set of key performance indicators and measures, to assist accountants, senior finance professionals and the wider management team in shifting their perspective regarding the potential value of BD. Larger organisations should consider adopting alternative forms of reporting (integrated

reporting³, for instance) where the CFO and CIO calculate a true and fair view of BD, and the extent to which it can generate probable future economic benefits:

It's an intangible asset. But it's probably the most valuable asset that the organisation now has. So, unless you understand that every further step is going to be wrong. CFO/Company V

“Using training, hiring, and outsourcing to build BD skills” and facilitate the acquisition of BD capabilities. The participants felt that traditional training, such as workshops and master classes, may not work well for all senior accountants and finance professionals, because they are at different stages of the BD journey. The participants argued that if BD collection, analysis and interpretation are left to (traditional) accountants, the potential benefits of BD may not be maximised. As a result, the finance team needs experts in data; this can be achieved through training existing staff members, hiring accountants with a background in or knowledge of data analytics, or outsourcing data collection and analysis:

There is a whole department set up for training, so management meets to discuss what needs to be done... if Big Data is identified as something that awareness has to be created on, training has to be delivered on, and it's handed over to the training department, that could be carried out and fed back to the finance officer. Head of Finance/Company AC

Other participants pointed to the need to outsource elements of data collection and analysis:

...outsourcing to Big Data specialists. The whole workplace is going very specialist at the moment... specialists in that field will create companies, they'll come together.... And then maybe outsource that entire function. Corporate Finance Manager/Company L

There is the appetite to assemble stakeholders and sponsors who will then support the acquisition of BD capabilities for finance professionals by allowing the time and resource within the organisation rather than simply reverting to traditional methods and information sources.

Environment

“Drawing on continuous support from professional bodies”.

Some participants argued that training in BD for senior accountants and finance professionals should be mandatory because opportunities to upskill or reskill may otherwise be missed. The participants also identified a need for bespoke learning and development activities, based on an ‘ecosystem approach’ where they can learn from each other and from external parties with relevant expertise. An ecosystem approach provides tools and mechanisms for learning, exchanging practices, mutual development, sharing diagnostics and supporting each other.

Many participants agreed that it would be beneficial if accountancy bodies collaborated to accelerate the pace of education on BD. They believed that the enabler is when accountancy bodies share their learning and experience, encouraging collaboration across the whole sector or profession. Although the accountancy bodies were acknowledged to be not-for-profit organisations with limited resources, it

³ Integrated Reporting is a more holistic form of reporting that addresses limitations of current reports and develops long-term business strategies. (ICAS, 2015)

was felt that collaborations and sharing of BD knowledge could be powerful enablers to unlocking the acquisition of BD capabilities for senior finance professionals and accountants:

...the professional bodies, accountancy institutes have a role to play ...the role of the professional bodies is very important in terms of advancing the profession and advancing the understanding of what accountants do and should be doing. So, I think the advocacy and support that professional bodies do has to increase in this space. Finance Director/Company R

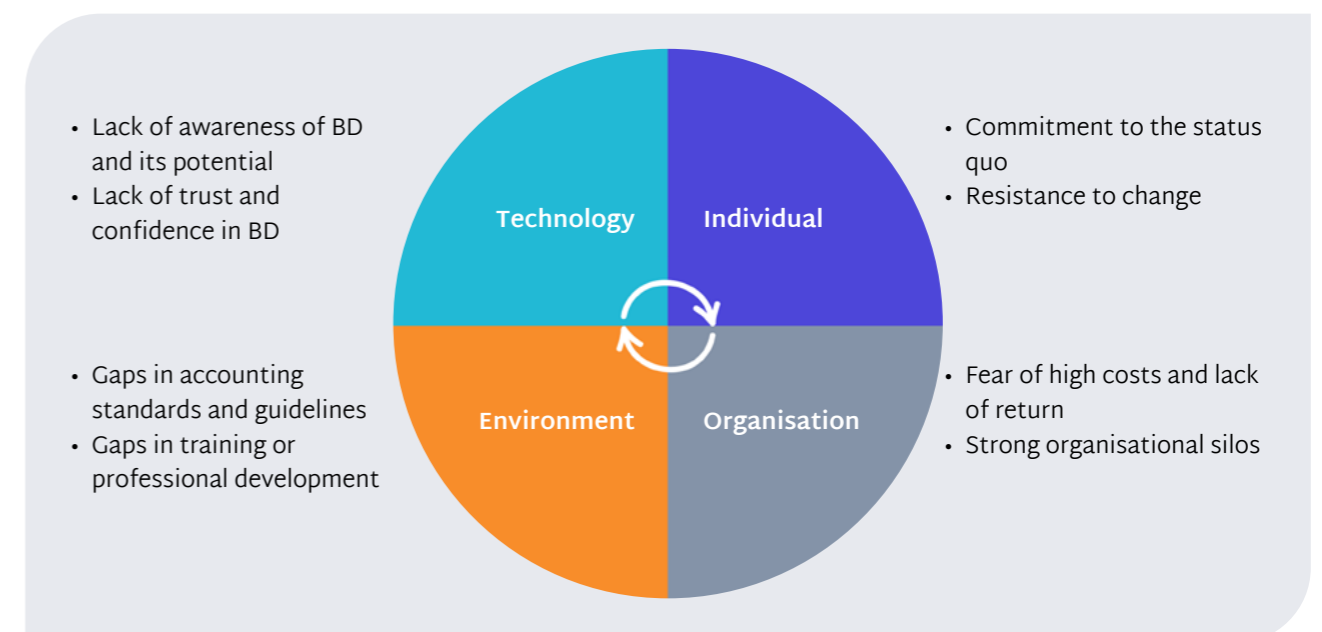
“Supporting the role of the CFO in value creation via Big Data”: Participants felt that many senior accountants and finance professionals are still operating under an ‘old paradigm’ where financial ratios and financial reports to shareholders are the key basis of performance improvement and success. To acquire BD capabilities, senior accountants and finance professionals should be supported in adopting more comprehensive and collaborative approaches. External institutions, such as accountancy and independent bodies, can support the role of the CFO in value creation via BD by enabling collaborations between organisations. The use of BD should encourage senior professionals to create and strengthen channels for information sharing and insights. Having a value creation agenda via BD can help senior professionals to identify opportunities and recognise challenges relating to organisational strategy:

I've been challenging the education directors ... to collaborate. You need to work together; otherwise, we're going to lose the battle. Head of Finance/Company AC

Barriers to the acquisition of Big Data capabilities

The participants identified a range of barriers to the acquisition of BD capabilities that are again related to the four dimensions of Technology, Individual, Organisation and Environment. By understanding and overcoming such obstacles, senior finance professionals and accountants can develop strategies to address gaps in BD capabilities (Figure 6).

Figure 6 – Barriers to the acquisition of Big Data capabilities



Technology

“Lack of awareness of BD and its potential”: plays a big part in whether and how senior professionals want to invest in BD learning, infrastructure and upskilling. Senior finance professionals and accountants are not always aware of the benefits of BD, or are not sufficiently interested in how BD can help improve the profession:

When people are planning to make investments in capability to use Big Data or whatever, they need to start with why, what am I doing it for? Is it better decision making? Is it better understanding? Is it better...what is it? Because otherwise I'm going to invest five million pounds in some Big Data warehouse, and then no one's ever going to use it, and so it's a classic 'start with why' type thing, isn't it, of being clear what the purpose is for the development of the capability. Finance Director/Company K

“Lack of trust and confidence in BD”: a fear of a lack of reliability and trustworthiness of BD.

Specifically, a lack of trust and confidence can take a number of different forms:

- lack of trust in the types of data, due to past confidence in more traditional forms of financial data (such as equity, income and expenses) rather than 'newer' forms of data from external sources, or unstructured data such as CCTV, images, social media, etc.
- lack of trust in 'new' forms of data analysis, either because it is conducted by a team outside the finance team, or because it differs from more traditional forms of financial data analysis, for example requiring new or more sophisticated software and/or types of analysis.
- lack of trust in the findings. The findings may differ from those obtained with more traditional methods, or may challenge 'gut feelings'.

As one participant commented:

...Monte Carlo simulation ... sensitivity analysis, goal seeking, all of these are techniques that the board probably doesn't need to necessarily know the underpinnings, but they need to have enough confidence to invest in these kinds of resources, because they believe that it will give them a leg up on the foresight and insight in a very uncertain disruptive world. CEO/Company T

Individual

“Commitment to the status quo”: some senior financial professionals and accountants found it challenging to contemplate changes to the current structure of the finance team, to their roles or to the set of skills acquired through their careers. Some felt that finance is a “back-office function” that prepares reports, and that no change to this was really required:

In certain organisations ... things are not going to change, the status quo won't change unless there's a driver from outside. Finance Director/Company R

“Resistance to change”: some senior finance professionals and accountants are not ready to commit to new approaches to decision-making. Their knowledge and consolidated experiences prompt them to follow what they already know:

...where I'm not seeing that willingness to commit is, they've not used it before, it's not the done thing, it's very much a change from the status quo. Finance Director/Company G

Organisation

“Fear of high costs and lack of returns”: BD are viewed as expensive and requiring significant investment. Some senior finance professionals/accountants indicated a fear of investing considerable sums of money in BD infrastructure, which may not yield the forecasted return on investment. They argued that high costs are associated with storing, managing and processing BD. If the organisation is not willing to adopt a 'trial-and-error' approach (as discussed above) to demonstrate the benefits of BD, such fears can prevent senior finance professionals and accountants from investing in BD and the associated capabilities:

The reason people ignore Big Data is because [name of a senior colleague] gives me a spec to write something, and I fall off my chair, and the board says we're not spending that, it's not a case of no value, it takes a lot to run Big Data, it's an expensive business. Finance Director/Company A

“Strong organisational silos”: the finance function sometimes works in isolation, or without sufficient liaison with other departments such as operations, marketing and IT. If data are not shared across the organisation, the finance team may not even have access to any centralised data repository where data are stored, processed and managed for the organisation. The finance team may not collaborate sufficiently with the IT team, or with data analysts who have the technical skills to process the BD the finance team needs:

...you have to be working as part of the business with other functions in order to play in the Big Data space. This is not something you can do in isolation, in a silo as a finance and accounting team. Finance Director/Company N

Environment

“Gaps in accounting standards and guidelines”: accounting standards and guidelines do not necessarily fully accommodate the fast-changing BD phenomenon. Some participants argued that accounting standards and procedures were outdated, or no longer adequately reflected current practice, especially in supporting the development of BD capabilities:

...we have created so many accounting standards .. that actually don't keep track with how the world really works. The data was created with different definitions, it's like there is nobody setting the standard for this. CFO/Company V

“Gaps in training or professional development”: some senior accountants and finance professionals suggested that the current training and development offerings from accountancy bodies are of great value and importance to the profession. However, they pointed out that professionals may attend training only when it is mandatory, and not necessarily to acquire new BD capabilities. It was felt that there is room for a bespoke approach to improving the acquisition of BD capabilities:

...the accountancy training is just ...it's very mechanical, and you're not training those capabilities around forward looking, uncertainty, judgement, communication, team, all of the sort of things ... is the training too narrow? Finance Director/Company K

Recommendations and policy implications

The recommendations below build on the main findings identified during the project; in particular, they seek to strengthen the enablers and overcome the barriers to acquiring BD capabilities. The recommendations are discussed at different levels of BD use (low, medium and high), as the project has identified that individuals and organisations are taking **different journeys** with regard to BD. Our findings indicate that the BD capabilities required by senior accountants and finance professionals are more complex, including in their acquisition, than the BD capabilities that their more junior colleagues require. Whilst training programmes on ‘hard skills’ such as data cleansing, data ethics, data analytics and data visualisation are essential for the profession, senior accountants and finance professionals need to acquire other capabilities that will encourage the adoption of BD in their organisations. The BD capabilities required of senior financial professionals are those that are defined as ‘soft’. They should have an awareness and understanding of BD benefits and applications in accounting, as well as the ability to adopt business systems thinking, i.e. a holistic and integrated mindset as specified in the Background section under “What are Big Data Capabilities?”. The project has illustrated that BD capabilities for senior professionals are a **multi-faceted and complex phenomenon** - intertwined with business and leadership skills, communication skills and BD understanding. The acquisition of BD capabilities by senior accountants and finance professionals can be enhanced by a good **understanding of the barriers and enablers** identified, which can be summarised under the four dimensions of Technology, Individual, Organisation and Environment.

The recommendations and policy implications below are shaped on the basis of a **‘spectrum’ of BD use**, and **a range of BD journeys**, barriers and enablers that the study participants have identified. Their message was that “one size does not fit all”, i.e. there is a need to create **bespoke sets of L&D** (Learning and Development) activities depending on where the individual is in his/her BD journey.

Recommendations and policy implications, drawing upon the data collected and analysed during this project, are summarised below, under three levels of BD use (low, medium and high).

Technology: Low level of BD use

- *“Adopt proof-of-concept cases”*. If the senior professional is at an early stage of their BD journey, and perhaps has a sceptical mindset with regard to the benefits of BD, it may first be appropriate to take ‘small steps’ in the acquisition of BD capabilities. ‘Proof-of-concept’ examples for BD should be used to demonstrate their viability and utility before expanding to more widespread applications. For instance, an initial step may be a modest investment to acquire BD software, or a similar investment in BD infrastructure. Once the benefits of an initial ‘small start’ can be demonstrated, further steps can be planned and taken.
- *“Ensure data are consistent and reports are valuable”*. It is vital to keep a sharp focus on the benefits of BD for the business. Hence:
 - Identify the range of data that is currently available to the finance team (before broadening out to the rest of the organisation, as appropriate)
 - Assess data quality, and consistency with other areas of the business as necessary
 - Identify how key elements of the data can help to address key business challenges
 - Compare the above with current data reporting, suggesting improvements where necessary.

Technology: Medium level of BD use

- *“Build BD literacy”*. BD literacy is the ability to think creatively and critically about data in different contexts, and gain new insights by taking into consideration the needs of the whole organisation. Bespoke BD literacy training for senior finance professionals is one way to help make a shift towards a data-driven culture. Training in BD literacy for senior professionals is unlikely to include technicalities such as coding and programming. However, bespoke training can be developed by combining theories, (good) practices and experiences of senior professionals inside and outside the organisation. Examples may include the training of the senior finance/accounting team in how to interrogate and interpret BD and BD analysis, and how to lead and manage BD projects.
- *“Build awareness of BD and its potential to support the organisation’s strategy”*. BD are often considered a specialist theme for data analysts rather than an asset for the whole organisation including the finance team. When BD are treated as a cross-cutting topic (rather than a specialist field for a single organisational function), an improvement in the finance team’s performance becomes possible. Bespoke training can promote understanding of how data can become an asset for the organisation, and how senior professionals can continue the journey towards the inclusion of BD in the organisational strategy to support value creation.

Technology: High level of BD use

- *“Focus on insights and benefits, such as opportunities for revenue generation.”* The senior finance team can use tools such as scenario planning and gamification to gain insights into future opportunities relating to BD. Scenario planning explores the future environment based on driving forces and critical uncertainties facing an organisation; gamification is a technique to engage and motivate senior professionals in finding creative solutions to business problems.
- *“Establish suitable metrics and KPIs showing the value of BD to the organisation.”* As experience with BD develops, it can become a key element within a set of measures of success for the finance team and the whole organisation; i.e. BD analytics can be represented within the organisation’s KPIs. BD can provide insights into steps towards the creation of value for the finance team and the organisation.

Individual: Low level of BD use

- *“Recognition of a ‘trial-and-error’ approach”*. When a senior professional is at the beginning of the data journey, they can improve their understanding of BD by recognising the value of a ‘trial-and-error’ approach to experimentation with BD. A trial-and-error approach can be self-taught or learned in a team supervised by an expert.

Individual: Medium level of BD use

- *“Demonstrate the benefits of new approaches based on BD”*. Case studies from successful BD projects (ideally in a finance/accounting context) can be employed as evidence to educate and persuade senior professionals who are curious about the benefits of BD and want to learn more.
- *“Encourage greater critical thinking and creativity.”* Critical thinking and creative thinking skills are essential tools as organisations adopt new approaches based on BD. However, professionals in the accounting and finance sector have traditionally been trained with a focus on complying with rules, and limited scope for creativity. Critical thinking and creative thinking skills can enable accountants and finance professionals to focus on data-driven decision-making, and strategic advice based on both critical and creative perspectives.

Individual: High level of BD use

- *“Build a forward-looking approach, with BD adding value to the organisation”*. Financial data is typically backward-looking and historical. In order to encourage the finance team to capitalise on newly available data and technology, senior finance and accounting professionals can learn to adopt a more forward-looking approach. While a future-facing approach may be more common in forecasting and financial planning teams, the opportunities offered by BD indicate that such skills can be developed across the finance team. For instance, the finance team can ensure that reporting is forward-looking and predictive.

Organisation: Low level of BD use

- *“Establish a clear commitment to suitable budgets for BD”*. A clear step towards a greater BD commitment can be achieved by establishing a budget line for investments in BD infrastructure. Treating BD as an asset rather than a liability can help organisations to move forward.
- *“Build strong connections across functional silos”*. In some organisations, other functional areas (beyond the finance team) may already employ BD to answer business questions and make data-driven strategic decisions. A ‘silo effect’ can hinder the acquisition of BD capabilities; therefore, setting up a ‘data working group’ involving senior staff across the organisations can be a starting point for the finance team to learn and share ideas with other teams.

Organisation: Medium level of BD use

- *“Audit BD skills in-house and identify gaps”*. The BD skills that the organisation already has can be mapped, and potential gaps identified. This ‘audit’ exercise can be done at the level of the finance team and across the organisation. Identifying the gaps in capabilities at the senior level (the board of directors and the C-suite) is also essential, as it can lead to a plan to upskill the senior team.
- *“Consider training, hiring, outsourcing to build skills”*. An upskilling plan can be written, identifying a series of actions to fill the BD skill gaps. This can include training existing staff, hiring new staff with BD skills or outsourcing certain roles such as data collection, data cleaning or data analysis.

Organisation: High level of BD use

- *“Communicate the costs and benefits of BD”*. A communication plan should explain the costs, the return on investment and the benefits of BD for the finance team and the whole organisation.
- *“Build an approach based on BD as a key asset in organisational strategy and decision-making”*. Data strategy and data governance should be part of the organisational strategy. Any positive impacts of BD initiatives can be linked to KPIs, to incentive the C-Suite to pursue BD investments.

Environment: Low level of BD use

- *“Off-site workshops and networking events”*. Senior professionals who are sceptical about the value of BD can benefit from learning from finance teams in other organisations. They can be persuaded by studying practical examples of beneficial BD initiatives.
- *“On-site cross-team meetings”*. The C-suite can meet to share their data needs, capabilities, etc. The objective of such meetings is to create a comprehensive BD plan to build awareness at a senior level of the role that BD can play in creating value and improving performance.

Environment: Medium level of BD use

- *“Executive coaching programmes”*. These are designed for senior-level leaders, and should include sessions on the different BD journeys of other organisations, covering topics such as how to create an environment that supports BD, and providing opportunities to share BD challenges and aspirations.
- *“Executive mentoring programmes”*. As for coaching programmes (above), these should include specific sessions on BD use, exploring applications of BD in accounting and finance and how finance/accounting leaders take steps to benefit from BD. Where coaching is likely to be short-term and performance-driven, a mentoring programme is likely to be more long-term and development-focused.

Environment: High level of BD use

- *“Learning from use cases”*. To bring senior finance and accounting professionals to the next level of BD understanding, they can be introduced to BD business cases in order to learn about new applications and development of BD, and successful and unsuccessful practices in the community.

Summary of implications

Our findings indicate that senior accounting and finance professionals will typically require **bespoke training activities**, that are tailored to their current position on their BD journey. For instance, those who are currently experiencing low levels of BD use may first require evidence of the value of BD, via suitable use cases. Senior professionals typically prefer to learn at their own pace, and in a collegial way. A “community of practice” can be established, i.e. a network of senior professionals who share common interests regarding BD, and are willing to create and share joint opportunities for learning, acquiring capabilities and establishing good practice around BD. Another possible technique is the adoption of explorative learning process (Lin and Lee, 2005) where senior professionals meet to develop new knowledge relating to BD in accounting and finance, on a collaborative basis.

Traditional training programmes, such as courses on BD and business analytics, data ethics, programming and coding, are typically designed for junior/middle accountants. Whilst existing BD training programmes, such as seminars, webinars, courses and workshops, are valuable for early/mid-career colleagues who are seeking to acquire new skills and BD capabilities, they can be transformed or integrated with other types of programmes to make them more suitable for senior colleagues. For instance, multi-day offsite training may not be applicable for certain senior finance professionals and accountants; equally, some online activities may not be the best option for senior leaders who can benefit most from networking in person with external colleagues and experts on BD use cases.

Given the key message that ‘one size does not fit all’, the greatest range of benefits for the finance and accounting community is likely to be achieved via the creation of a digital learning ‘ecosystem’, where senior colleagues can gain insights from the accounting and finance community and other experts. Bespoke learning offerings based on interactive digital tools can be aggregated to support a wide range of BD learning journeys (Table 3). Table 3 specifies a set of recommendations for organisations aspiring to reach the next level of use of BD. For instance, organisations at the beginning of their BD journey, with very little or no current BD use, can begin with ‘proof-of-concept’ cases; while those who already have a low level of BD use can build BD literacy and awareness to reach a medium level; and so on.

Table 3 - Summary of the recommendations

	Achieving a low level of BD use	Achieving a medium level of BD use	Achieving a high level of BD use
Technology	Begin with 'proof-of-concept' cases. Ensure data is consistent, and reports are valuable.	Build BD literacy. Build awareness of BD and its potential to support the organisation's strategy.	Focus on insights, and benefits such as revenue generation. Establish suitable metrics and KPIs showing the value of BD to the organisation.
Individual	Recognition of experimentation and flexible approaches.	Demonstrate benefits of change / a new approach based on BD. Encourage greater critical thinking and creativity.	Build a forward-looking approach, with BD adding value to the organisation.
Organisation	Establish a clear commitment to suitable budgets for BD. Build strong connections across functional silos.	Audit BD skills in-house and identify gaps. Consider training, hiring, outsourcing to build skills.	Communicate the costs and benefits of BD. Build an approach based on BD as a key asset in organizational strategy and decision-making.
Environment	Off-site workshops and networking events. On-site cross-team meetings.	Executive coaching programmes. Executive mentoring programmes.	Learning from use cases, alongside further coaching and mentoring.

Limitations

- The project's findings are subject to a number of caveats, associated with the sample of participants:
- Most participants worked in service industries, including business support and consulting (see Figure 2); a small number of participants worked in industries such as retail, construction and manufacturing. Other findings may have been identified if the sample had included more organisations in the secondary sector.
 - The project targeted medium-sized organisations; other findings may be identified if the sample included more small or large organisations.
 - Most participants were judged to have a 'moderate' to 'stronger' level of BD knowledge and understanding; it was the experience of the research team, when recruiting senior accountants and finance professionals to participate in the study, that potential participants who felt they had little knowledge of BD were more likely to decline to participate.
 - This project targeted senior accounting and finance professionals as defined by their current role, and not by their years of experience in a senior position.
 - The project was UK-based. If the sample included companies based in other countries, such as the US or Europe, other findings might be identified based on different institutional settings.

Next steps

- The following represent recommendations for future steps:
- Conduct interviews with 6-10 large organisations to provide additional insights into good practices and examples/ detailed use cases of BD applications. A set of use cases and examples of good practice can be of great value for ICAS members, and assist further in setting the future BD agenda for professional education.
 - Design a questionnaire to gather panel data which can be analysed to understand the degree to which an additional set of factors, such as personal career paths, organisational settings and external context (e.g. career support from the accountancy bodies) can impact on the BD journeys taken over time by accountants and senior finance professionals.
 - Build a diagnostic tool that can be used to assess where senior professionals sit on their BD journey, and which L&D activities are likely to be the most suitable in a particular instance. This can be of great value to members who want to understand the most appropriate next steps on their BD journey.
 - Establish a project to consider the re-shaping of L&D programmes for the profession, with a focus on the needs of senior professionals, including both in-person and online activities. In particular, consider the design of a platform-based digital learning 'ecosystem' for senior accountants and finance professionals to build BD capabilities.

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