

Tension in the Data Environment: How Organisations Can Meet the Challenge

Maureen Meadows^a, Alessandro Merendino^b, Sally Dibb^c, Alexeis Garcia-Perez^d, Matthew Hinton^e, Savvas Papagiannidis^f, Ilias Pappas^g, Huamao Wang^h

^aProfessor of Strategic Management, Centre for Business in Society, Coventry University, Priory Street, Coventry CV1 5FB, UK

^bAssistant Professor, Centre for Business in Society, Coventry University, UK

^cProfessor of Marketing and Society, Centre for Business in Society, Coventry University, UK

^dProfessor of Management Information Systems, Centre for Business in Society, Coventry University, UK

^eSenior Lecturer in Information Management, Department for Public Leadership & Social Enterprise, Open University Business School, Walton Hall, Milton Keynes MK7 6BB, UK

^fProfessor of Innovation and Enterprise, Newcastle University, Newcastle upon Tyne NE1 7RU, UK

^gProfessor of Information Systems, University of Agder, (also NTNU), Postboks 422, 4604 Kristiansand, Norway

^hAssociate Professor in Finance, Risk and Banking, University of Nottingham, Wollaton Road, Lenton, Nottingham NG81BB, UK

Abstract

Big Data is becoming ubiquitous - widely applied across organisations, industry sectors and society. However, the opportunities and risks it presents are not yet fully understood. In this paper we identify and explore the tensions that Big Data can create at multiple levels, focusing on the need for organisations to meet the challenges that can arise. We draw on insights from twelve papers published in the Special Issue of *Technological Forecasting & Social Change* entitled “*Tension in the Data Environment: Can Organisations Meet the Challenge?*” in order to build a ‘Multi-Layer Tensions Model’ that highlights key pressures and challenges in the BD environment. We find evidence of tensions of three types, which we summarise as “*Organisational Learning*”, “*Organisational Leadership*” and “*Societal*” tensions. We contribute, first, by identifying and developing a nuanced understanding of the tensions faced in the Big Data environment; and second, by elaborating on the capabilities that can be developed and the actions taken to maximise the benefits of Big Data. We end with a “*Learning, Leading, Linking*” framework, which points to implications for practice and a future research agenda.

Keywords (max 6 words): big data, digital, tensions, organisations, society, challenges

Highlights

- BD creates opportunities and tensions at the organisational and societal level
- Organisational Learning, Organisational Leadership and Societal tensions are analysed
- The “Learning, Leading, Linking” framework identifies actions to address the tensions

1. Introduction: Big Data in Organisations and Society

Big Data (BD) is becoming ubiquitous; its applications can be found in organisations of all kinds – both private and public, across industry sectors and areas of society. The recent coronavirus pandemic has increased reliance on digital technologies, enhancing the opportunities presented by BD while further entrenching its widespread use. Today, BD is at the heart of a range of diverse applications, from fraud identification to the monitoring of servicing requirements in critical infrastructures, from the exploration of network relationships on social media to the analysis of text-based health documents and other unstructured clinical healthcare data (e.g. McAfee and Brynjolfsson, 2012; Wang et al., 2018). We know that BD can offer organisations a range of potential opportunities and benefits. It can assist an organisation in achieving its goals of growth, improving its products and services, enhancing efficiency or productivity, aligning IT and business strategies, responding rapidly to changes in the external environment, expanding its capabilities and seizing new business opportunities, and improving data accuracy and data management (e.g. Raguseo, 2018).

However, it has long been argued that BD requires organisations to behave in different ways, if its benefits are to be realised. For example, managers have been advised that BD analytics should no longer sit solely within IT departments; organisations should embed analytics within and across core business functions (Davenport et al., 2012). Organisations should adopt and implement policies and procedures for effective management of BD, in the form of BD governance frameworks tailored to the context where they operate (Singh, 2020). Studies frequently point to the risks and challenges of BD, as well as the benefits it can offer (e.g. Dubey et al., 2019; Raguseo, 2018; Rialti et al., 2019; Sivarajah et al., 2017).

The existing literature offers little synthesis of the challenges that BD could present for individuals, organisations and society, and how they might be addressed. In this paper, we explore evidence that BD can create a range of tensions, i.e. pressures that can either hinder or incentivise the use of BD and the effective operation of the organisation. Such tensions and challenges, created by BD and requiring solutions from individuals, organisations and society, can prevent the optimum benefits of BD from being realised, and they are often difficult to resolve. Through a critical analysis of the papers appearing in this Special Issue of the journal *Technological Forecasting & Social Change*, we build a ‘Multi-Layer Tensions Model’, which describes the three main areas of tension occurring in the data environment, which can both hinder or incentivise the use of BD. ‘Organisational Learning’ tensions refer to the pressures experienced at both an individual and organisational level to enhance skills and capabilities.

‘Organisational Leadership’ tensions refer to pressures to develop the organisation’s vision, strategy, dynamic capabilities and oversight. Finally, ‘Societal’ tensions refer to pressures stemming from the external environment, including the need for the organisation to engage with a wider digital ecosystem, share data and knowledge, and respond to demands around personal data and privacy.

These three main areas of tension provide challenges and opportunities for organisations, as well as scope for action, as summarised in the 3Ls framework: Learning, Leading, Linking. This framework identifies: the key aspects of BD that sit within the organisation (Learning: developing new skills and capabilities); those aspects that connect the internal environment of the organisation with its external environment (Leading: the need for a data vision, strategy, oversight and dynamic responses); and finally, those aspects that are driven from the external environment (Linking: embedding the organisation within a wider data ecosystem). Using the 3Ls framework, we examine the tensions faced by organisations in relation to their internal and external environments and draw out implications for practice and opportunities for further research.

Based on our analysis of the papers in the Special Issue, three main theoretical contributions are made. First, with regard to organisational learning, we provide a more nuanced understanding of the different capabilities and learning processes (e.g. Fosso Wamba et al., 2017) that individuals and organisations should develop to maximise the benefits of BD and to overcome the challenges that it presents. Second, in relation to organisational leadership, we contribute to the debate on the implications of using BD at the strategic level of organisational decision-making (Merendino et al., 2018) by analysing the challenges and pressures that organisations have to address when formulating their strategies. Third, regarding societal tensions, we contribute to the debate on the importance of developing data ecosystems where data actors operate in an integrated manner to promote open and flexible collaborations (Pappas et al., 2018). We further expand this debate by clarying the tensions and opportunities occurring amongst organisations, and between organisations and individuals within a context of digital ecosystems.

Section 2 of this paper draws on articles published in the Special Issue, providing an overview of recent research to identify, understand and clarify the main tensions that BD can cause. In Section 3, we undertake a critical analysis, resulting in three sets of tensions at different levels, summarised under the headings ‘Organisational Learning’, ‘Organisational Leadership’ and ‘Societal’ tensions. We explore the implications of the main tensions created by BD, and the risks associated with such tensions, if they are not effectively addressed. In

Section 4 we develop the 3Ls framework, and draw out implications for practice and a future research agenda.

2. Big Data in Action in Organisations and Society

Big data (BD) has a wide range of applications in different contexts. It has been described as versatile, ubiquitous and crucial for the success of organisations and society (e.g. Choi et al., 2018; George et al., 2014). This section explores diverse applications of BD, as illustrated by the Special Issue manuscripts. These applications lead to tensions at the organisational and societal levels, which are discussed in Section 3. The main areas of application featured in the manuscripts were:

- **data in action in diverse industry sectors**, where research demonstrates BD applications in automotive cybersecurity (Morris et al., 2020), telemedicine (Cegarra-Sánchez et al., 2020), service system analytics (Akter et al., 2020) and machine learning in financial services (Gan et al., 2020);
- **data crossing boundaries between the private and public sectors**, where research shows BD applications in corporate political activity (Liedong et al., 2020), smart city ecosystems (Gupta et al., 2020) and anti-money laundering/counter-terrorist finance (Ball et al., 2020);
- **the adoption of data-driven changes within organisations**, where the papers presented here discuss organisational digital culture (Martínez-Caro et al., 2020), big data analytics and related skills/capabilities (Hughes and Ball, 2020), and privacy issues relating to the personal data of customers (Cloarec, 2020);
- **social media in society**, where studies show how new sources of data can drive machine learning (Wang et al., 2020) and corporate investment efficiency (Yang et al., 2020).

2.1. Data in action in organisations in key sectors of industry

In this section we introduce papers that offer insights into digital technologies in use in four key sectors of industry: cybersecurity in the automotive industry; telemedicine; service systems analytics; and financial services.

Morris et al. (2020) analyse cybersecurity threats in the automotive sector, an industry that has been experiencing continuous and radical technological change. Organisations in this sector have been striving to respond to increasing complexity, the embodiment of unfamiliar

technologies, development of new software-based applications, the need to analyse and gain insight from large and fast-changing datasets, and greater reliance on suppliers for design, engineering and production. As a result, the potential risks associated with cybersecurity threats are heightened. Morris et al. (2020) emphasise the need for shared cybersecurity knowledge and integrated or coordinated strategies for the interpretation of BD applications for cybersecurity, in order to both protect the organisation and gain competitive advantage. In a study based on a survey and interviews with four global automotive organisations (manufacturers and suppliers), the authors find that the strategies of manufacturers and suppliers do not take into account ubiquitous cybersecurity threats and their implications for business. Therefore, they argue that the introduction of new technologies should be contextually accompanied by knowledge-sharing, trust and integrated strategies between manufacturers and suppliers as a crucial driver to address cyberthreats.

Cegarra-Sánchez et al. (2020) explore the learning process, and the exploration and exploitation of knowledge in telemedicine technologies, which connect patients and medical staff by integrating health data and information. Although these technologies are highly effective (Sims, 2018), they are rarely used, because the resulting data are difficult to analyse and interpret due to their velocity, variety and volume. The authors survey healthcare professionals and patients in Spain, to explore how learning processes can support effective exploitation of telemedicine technologies. They find that the exploration and exploitation of the knowledge of both patients and medical staff are key components in ensuring that telemedicine technologies are more widely used, and their data mined and analysed. Knowledge exploitation (e.g. when users learn from formal interactions with staff) facilitates the usage of telemedicine technologies. The engagement and responsiveness of patients when confronted with such technologies could be improved by promoting partnerships and knowledge sharing. Knowledge exploration (i.e. when users learn through informal interactions or e-learning) accelerates the utilisation of telemedicine technologies because, through social networks and meetings, medical staff and patients are more inclined to interact and exchange ideas and perspectives. In sum, for users to effectively employ telemedicine technologies, a balance between explorative and exploitive learning processes is likely to foster the wider use of such technologies.

Akter et al. (2020) develop and validate a service system analytics capability (SSAC) model, by adopting resource-based view and dynamic capabilities lenses. They define service system analytics as the process of capturing and analysing data generated from the execution of a service system, in order to improve service and create value for both providers and

customers. Service system management capability represents the ability to manage big data analytics across functional areas. By conducting an online survey with service analytics professionals, they find that SSAC affects competitive advantage through sensing, seizing and reconfiguring the market. Interestingly, the positive effect of SSAC on competitive advantage is mediated by the dynamic capabilities that should be developed in the big data environment. Akter et al.'s model highlights the importance of personnel capability, management capability and technology capability in enhancing dynamic capabilities.

Gan et al. (2020) propose deep learning methods to accurately and quickly estimate the prices of particular financial products, known as Asian arithmetic average options, which are widely traded in many financial markets around the world, especially the US. Options are derivatives based on the value of underlying securities such as corporate stocks. Arithmetic average options are preferred by institutional and individual investors, who use them for risk management and investment. The challenge the study addresses is that the pricing of arithmetic average options requires expensive calculations or simplified models with assumptions that may not be realistic. Gan et al. (2020) seek to overcome these long-standing problems by applying deep learning technologies to their pricing. This novel pricing method achieves more effective, accurate, and timely results than the traditional methods for estimating arithmetic average options.

2.2 Data crossing societal boundaries between the private and public sectors

Next, we introduce three papers that raise issues around data crossing the boundaries between private and public sector organisations, in three important contexts: corporate political activity, smart cities, and anti-money laundering / counter terrorist finance.

Liedong et al. (2020) conceptualise the relationship between BD and corporate political activities, where the latter refers to an organisation's actions to influence or lobby its political environment. They theorise that BD provides resources for developing political capabilities that allow organisations to learn about their political environment and political issues. For instance, data from social media enable organisations to understand individuals' political preferences, monitor and influence trends and political opinions. Therefore, BD can be employed to develop political capabilities, i.e. the ability to assess policy risk and manage the policy-making process (Holburn and Zelner, 2010). Organisations can collect, share or sell BD from individuals, other businesses, policy-makers and politicians in exchange for political favours (data politicisation). As a result, the development of such data-driven political

capabilities reinforces corporate political activities where organisations can mobilise the public for political actions or manipulate individuals' political preferences.

Gupta et al. (2020) illustrate the importance of using BD in smart cities, where different actors need to have an integrated view to maximise the benefits of a smart city environment. By applying a qualitative case study approach to the topic of London's city data initiatives, this paper highlights the need to create a data ecosystem where all the actors develop an integrated and shared data agenda. The authors suggest that actors involved in a smart city data ecosystem need to achieve consistency in their data initiatives, for instance in sharing good practice to ensure that different projects meet the needs of multiple actors through openness, diffusion and a shared vision. Openness allows some actors to show a sense of leadership, and other actors to leverage successful initiatives to avoid duplication of effort. Diffusion refers to practices of shared learning amongst actors, and practices to build legitimacy and trust within a digital ecosystem. Finally, city governments and the other businesses involved in the smart city or data ecosystems should take joint responsibility for their long term vision and a shared strategy to implement smart city initiatives, which every actor can benefit from.

Ball et al. (2020) investigate issues arising from mandatory data exchange between private and public organisations in the context of Anti-Money Laundering and Counter-Terrorist Finance (AML/CTF) in the UK. Their in-depth qualitative study reveals that larger organisations re-arrange their existing structures to meet the requirements of anti-money laundering regulations to capture and transfer AML/CTF data to regulators. Such data exchange creates organisational issues concerning organisations' commercial priorities, customer relationships and working patterns. They also find that, while information flows between organisations and the public sector are crucial for national security, such information flows can create new issues between organisations and the regulators. Meeting the AML/CTF requirements may include both the organisation's fiduciary duty towards its customers and its ability to meet day-to-day business goals. On the other hand, failure to meet such legal requirements could potentially threaten an organisation's survival, as well as challenging national security interests.

2.3 The adoption of data-driven changes within organisations

In this section we introduce three papers that explore the challenges that organisations face as they seek to adopt new practices around BD and digital technologies. These challenges include the need to change skills, capabilities and culture, and to address the tensions that arise when an organisation faces privacy issues relating to its use of personal data.

Hughes and Ball (2020) analyse how organisations address issues concerning the application of Big Data Analytics (BDA) to gain competitive advantage. By applying a qualitative multiple case study approach, this paper explores how non-technical staff members are persuaded to engage in BDA projects that can create added value and competitive advantage. The authors find that soft skills in BD are vital if non-technical staff are to engage with technical staff during BDA implementation. They point to the need to close the capabilities gap between technical and non-technical staff members within an organisation, in order to maximise the opportunities BDA yields. Finally, they identify a series of persuasive practices to encourage non-technical staff to employ BDA. These practices include involving data scientists in marketing or business projects, translating the language of data into organisational language, involving non-technical staff in BDA projects, visualising BDA findings to make analytics more accessible and promoting knowledge exchange sessions within the organisation.

Martínez-Caro et al. (2020) analyse how a digital organisational culture facilitates the adoption of new technologies and business digitisation to improve organisational performance. Via a case study of a multinational company designing, producing and manufacturing materials, they survey managers and other staff members in some of the firm's manufacturing centres. Their study confirms that digital organisational culture is crucial for an organisation to adopt new technologies such as BD and BD analytics, which can, in turn, leverage the development of other activities of significant value. They find that new technologies are likely to be adopted and exploited if their adoption is accompanied by a process of acceptance and understanding across the different functional areas of an organisation. Overall, investments in new technologies adopted in a digital organisational culture improve firm performance by increasing revenues through the development of new services and ways of working.

Cloarec (2020) investigates the relationship between an organisation's need to access and use an individual's information (e.g., to personalise the individual's experience when dealing with the organisation), and their need for privacy: the so-called personalisation-privacy paradox. This theoretical study highlights the role of attention within the personalisation-privacy paradox. Individuals' attention capacity decreases as the volume of information and competing signals they receive increases. Although individuals value personalisation, attention competition can lead to privacy concerns, making individuals reluctant to share their personal information in exchange for personalised experiences. This leads organisations to compete for the attention of individuals. Because the personalisation level exceeds individuals' attention level, organisations tend to increase personalisation, resulting in a strenuous battle for attention.

However, if this competition becomes blatant and excessive, individuals can feel manipulated, increasing their privacy concerns. Zuboff (2019) defines data surveillance capitalism as the unilateral appropriation of private individuals' experience as free raw material for translation into behavioural data. We return to this discussion in Section 4.

2.4 Social media data in society

Finally, we introduce two papers that explore social media data in use. First, Wang et al. (2020) explore the effectiveness of machine learning techniques which employ data from large-scale datasets, enabling the generation of information, insights and patterns for effective decision-making (Provost and Fawcett, 2013). As machine learning is a sophisticated method, it can cause issues related to the sensitivity of prediction accuracy due to the type of data collected, collated, mined, the size of the dataset, the methods applied, sampling, and algorithm parameters. Wang et al. (2020) address the problem of prediction accuracy by testing data from social media, such as Twitter and Facebook, blogs on Mashable, news on Google and Yahoo, and other datasets, including the US house survey and Bitcoin prices. They find that using around 20% of the full sample can provide a better prediction accuracy than opting for the full sample. Full samples can yield inaccurate results because of misleading information and data noise embedded in the machine learning method.

Yang et al. (2020) investigate whether online social networks and media have any positive impact on investment efficiency in a sample of Chinese listed companies. Previous research points out that social media or networks, such as Weibo, WeChat, Twitter and Facebook, provide a pivotal advantage regarding the efficient disclosure of information to the wider public (Babutsidze, 2018). Yang et al. (2020) confirm existing studies suggesting that traditional media, such as TV and newspapers, have a negative impact on investment efficiency, while social media have positive effects on firms' investment efficiency. Relevant investors can interact directly with firms by using social media options, such as 'post', 'forward' and 'repost'. As a result, senior managers are more likely to communicate directly with investors, monitor their responses and engage with them.

Having introduced the BD applications highlighted by the twelve papers in the Special Issue, we turn our attention to the identification of the key tensions that can arise from such BD applications. We focus on the challenges that the tensions present, their implications for organisations and society, and the responses that leading organisations are making in order to rise to the challenges presented.

3. The Multi-Layer Tensions Model

BD is a multi-faceted and ubiquitous phenomenon. Therefore, tensions in the BD environment occur at different levels. This section is based on a critical analysis of the twelve Special Issue papers that informed the previous section, to provide a more nuanced understanding of where and with what implications these tensions occur. As noted earlier, by tensions, we refer to pressures that could both hinder and incentivise the use of BD. We also draw on the relevant literature on BD in relation to the Special Issue papers, to enhance our understanding of the tensions to be understood in order to unlock the potential of BD.

We find evidence of three types of tensions. The first, organisational learning, refers to the pressures to enhance skills and capabilities, which can be experienced both at an individual and organisational level when confronting BD. The organisational leadership tensions are a group of pressures to develop the organisation's vision, strategy, dynamic capabilities and partnerships in response to BD. Finally, the societal tensions refer to the pressures stemming from the environment external to an organisation, including the need to engage with a wider digital ecosystem and respond to challenging issues such as demands around personal data and privacy.

Figure 1, the Multi-Layer Tensions Model (below), provides a summary of the key areas covered by the Special Issue papers (inner circle, as identified in Section 2), and connects these areas with the tensions identified (outer circle of the Model), via the three types of tension (middle circle). Next, we elaborate further on the three types of tension identified in our analysis (3.1 – 3.3).

[Insert Figure 1: The Multi-Layer Tensions Model]

3.1 Organisational Learning Tensions

At the organisational learning level, three types of tension occur, namely “*hard*” or technical BD skills and capabilities; “*soft*” or managerial BD skills and capabilities, and learning processes.

In using the term hard BD skills and capabilities, we refer to those technical skills and capabilities that data scientists need to acquire in order to analyse and visualise BD effectively. The literature indicates that there is a wide range of hard or technical BD capabilities that individuals need to acquire, depending on their role or how their organisation intends to make use of BD.

One area of technical BD capability that can be acquired relates to the usage of machine learning to solve business challenges (e.g. Chaoji et al., 2016). For instance, Gan et al. (2020) apply machine learning in finance as a reliable tool to predict with great accuracy the pricing of financial products such as options. This technical or hard BD capability can contribute to more efficient investment decisions where traditional methods are not entirely capable of fulfilling this task. Wang et al. (2020) also apply machine learning; their study highlights the need for skilled handling of large datasets, demonstrating that more data is not necessarily better, and that inferior solutions can arise without adequate BD capabilities.

An additional technical capability that could be acquired to exploit BD benefits is related to Information and Communication Technologies (ICT), often referred to in the literature as information technology-knowledge. Gaimon (1997) described this capability as both knowledge about the technology and knowledge acquired through technologies. In this Special Issue, Martinez-Caro et al. (2020) claim that ICTs are crucial tools for innovation, and can increase revenues by enabling new ways of working. These new opportunities require the acquisition of new capabilities and an appropriate digital organisational culture. The latter is considered to be a vital factor in the effective use of new technologies and the development of hard capabilities to effectively employ ICT.

A further area of technical capability relating to BD is in service system analytics (Akter et al., 2020), which aims to improve, extend, and personalise service to create value for both providers and customers (Cardoso et al., 2015). Akter et al. (2020) put forward their service systems analytics capability (SSAC) model, which combines three key dimensions: service system analytics management capability, technology capability, and personnel capability. By mastering SSAC hard capabilities, organisations will be able to acquire competitive advantage through market sensing, seizing and reconfiguring (Akter et al., 2020; Teece, 2007).

Soft BD capabilities are as important to organisations of all kinds as hard capabilities. They can be acquired by both data specialists and non-specialists, such as managers and directors. BD specialists and non-specialists need to develop a mutual understanding through a common language of what BD means and its implications for an organisation (Martinez-Caro et al., 2020; Hughes and Ball, 2020). Hughes and Ball (2020) stress the importance of closing the gap between data specialists and non-specialists through persuasive practices. In other words, data scientists and directors should work together by employing organisational resources to enhance mutual understanding, such as translating data language into business language, or demonstrating the value of BD to directors.

Liedong et al. (2020) explore the importance of using BD to develop political capabilities - defined as the ability to assess policy risk and manage the policy-making process (Holburn and Zelner, 2010). BD can leverage political capabilities to gain policy influence and competitive advantage. However, the use of BD to develop political capabilities can lead to illegal conduct. This is the case – as reported by Liedong et al. (2020) – for Cambridge Analytica. The latter was a British consulting company that illegally mined Facebook data to manipulate people’s behaviour (Wylie, 2019). In addition, the ethics of political capabilities that leverage BD, even if the data usage is legal, have been up for debate. For instance, some local councils in the UK have monetised data by legally selling individuals’ information to political parties, estate agents and other organisations (Dutta, 2013; Liedong et al., 2020).

A third tension concerns a learning process that must be ingrained in an organisation, to maximise the benefits of BD. A learning process in the realm of BD refers to the transformation of data into knowledge, by using technologies and soft and hard capabilities to ultimately support the decision-making process. The learning process within an organisation is identified as a crucial yet complex process through which organisations can maximise the use of BD and technology in general. For instance, Cegarra-Sanchez et al. (2020), in their analysis of updates to telemedicine, uncover the need for explorative learning processes. Explorative learning processes concern all those activities that bring people close together to promote mutual benefits and build trust amongst actors (Lin and Lee, 2005). Ensuring that explorative learning processes are in place within an organisation will collectively build e-knowledge to make progress in using technology and BD. In the same vein, Hughes and Ball (2020) stress the importance of establishing a learning environment within an organisation. This should be engrained in the organisation’s practices. Shared and collective learning across an organisation is crucial for successful use of technology and data; however, actors within an organisation often struggle to create a shared learning process due to the lack of a supportive culture. Therefore, in order to address this tension, organisations need to revisit their organisational structures, infrastructures and access to datasets (Hughes and Ball, 2020). Gupta et al. (2020) discuss learning and knowledge mobility in the context of smart city data ecosystems, highlighting the importance of the ‘orchestration of learning practices’ (p. 7), and noting that both outsourcing and a lack of technical skills can be barriers to sustained learning processes within and across organisations.

3.2 Organisational Leadership Tensions

At the organisational leadership level, three types of tensions occur: creating a shared strategy and vision, the development of dynamic capabilities, and an oversight/monitoring role for senior leaders.

An important tension occurring at the organisational level concerns the creation of a shared vision and strategy. A lack of a comprehensive data strategy can lead to conflicting agendas within an organisation, as well as difficulties in achieving organisational goals and exploiting digital technology fully (Martinez-Caro et al., 2020). It is becoming apparent that regardless of their size and the industry they operate in, organisations need to develop a digital strategy that will help them to benefit from what BD can offer while managing it as a critical resource, in a timely manner and considering issues such as its consistency, reliability and trustworthiness. An effective data strategy can help the organisation to address issues around cyber-security threats (Morris et al., 2020), data collaboration (Gupta et al., 2020), investments in digital technologies (Martinez-Caro et al., 2020) and online social networks (Yang et al., 2020). Liedong et al. (2020) show that corporate political activities, e.g. efforts by an organisation to influence government policy, can be antecedents of a data strategy. Politically active organisations collect and manage high volumes of data on disparate issues in their political environments, interpret data from various interest groups in political markets, and cope with political and social issues in a dynamic market. As a result, organisations that are politically active need to put forward a data strategy that reflects the complexity of the market and helps the organisation to exploit the benefits of BD. This points to the need for a comprehensive data vision. A shared data vision, both for a focal organisation and across an ecosystem of businesses, enables the organisations concerned to identify and exploit opportunities, and prioritise and agree on strategic agendas (Gupta et al., 2020). In order to reach a shared data vision, organisations need to collaboratively work towards a digital organisational culture (Martinez-Caro et al., 2020) and collective and integrated ecosystems (Gupta et al., 2020).

A second tension occurring at the organisational leadership level concerns dynamic capabilities. Dynamic capabilities are generally defined as an organisation's ability to integrate, build, and reconfigure internal competences to address changes in the business environment (Teece, 2007). They have gained momentum in BD research (Braganza et al., 2017; Fosso Wamba et al., 2017; Mikalef et al., 2019) because they can help to identify a path towards competitive advantage in innovative environments. This is different from the hard and soft capabilities at the individual level, i.e. the capabilities that individuals within an organisation need to develop if the organisation is to benefit from BD. Dynamic capabilities at the organisational level refer to a more deeply ingrained concept, i.e. BD capabilities should be

part of the organisational culture. Dynamic capabilities represent a suitable standpoint from which to study the effect of information systems on organisations (Contractor et al., 2016). These include processes and routines that may be used to solve different data-related problems in the organisation (Fosso Wamba et al., 2017). Hughes and Ball (2020) describe a range of “*persuasive practices*” which help to identify valuable moments of engagement between technical and non-technical colleagues on BD projects. For example, their study found that the practice of involving data scientists throughout marketing projects was valuable in raising awareness of analytics capabilities amongst marketers in the organisation, addressing gaps in the mindset.

Akter et al. (2020) point out the importance of a business acquiring BD dynamic capabilities, noting that according to Davenport and Harris (2017, p. 107), “*the overwhelming majority of organizations, however, have neither a finely-honed analytical capability nor a detailed plan to develop one*”. Akter et al. (2020) show that dynamic capabilities crucially mediate the relationship between competitive advantage and service systems analytics capability (SSAC). This means that investing in BD dynamic capabilities will make it possible for organisations to reconfigure competitive advantage by reshaping, sensing and seizing market opportunities. In the same vein, Liedong et al. (2020) argue that political capability must also be dynamic, because it can enable organisations to respond to external changes. Their new concept of political agility refers to the ability of an organisation to manage BD, reconfigure resources and shape timely political strategies in response to changes in the political environment (Liedong et al., 2020).

A third tension identified at this level highlights a novel role that key individuals, such as directors, can develop: a BD oversight role. For instance, Gupta et al. (2020) stress the importance of directors maintaining an oversight role over the use of BD within an organisation or an ecosystem. Their study highlights how oversight is essential to good governance across an integrated, collective ecosystem in order to orchestrate activities effectively. Interestingly, technology can support some monitoring functions. For example, Cegarra-Sanchez et al. (2020) point out that telemedicine and e-health technologies offer new opportunities for monitoring access to data and information in order to save money, time and eventually lives. In addition, Yang et al. (2020) find that online social networks can increase the investment efficiency of an organisation; therefore, senior executives should monitor investors’ responses by engaging with online social media communications.

3.3 Societal Tensions

At the societal level, there are a number of tensions that occur amongst organisations (Ball et al., 2020) or between organisations and individuals (Cloarec, 2020) within a context of digital ecosystems (Gupta et al., 2020).

The first tension relates to digital or data ecosystems. This term refers to a collaborative environment made up of a number of actors, including organisations, public or private, small, medium or large, belonging to any sector, where they dialogue, integrate and cooperate to share data, information and knowledge (Pappas et al., 2018). Digital or data ecosystems are an integrated system and provide an opportunity to transcend traditional industry boundaries to promote open and flexible collaborations and to leverage resources and specialised services across different industries to respond to stakeholders' needs (Senyo et al., 2019). In this regard, Gupta et al. (2020) explore the challenges for digital ecosystems by analysing the case of London's data ecosystem. They identify what they describe as “*multi-layer tensions*” (p. 2), which can affect reporting and open data sharing between different levels of government.

This leads to the identification of a second tension regarding the need for data and knowledge exchange amongst data actors. Gupta et al. (2020) argue that being part of a data ecosystem can foster effective collaborations; for example, projects can be scaled up by collaborative working between a range of actors. However, tensions around the exchange of data and knowledge can also arise amongst such actors (Gupta et al., 2020; Morris et al., 2020). Although the exchange of data and information is paramount in particular instances, e.g. to avoid money laundering, Ball et al. (2020) find that the data flow between organisations involved in anti-money laundering operations can be viscous and is not automatic. Several factors contribute to hindering or fostering this flow and exchange of knowledge between organisations. The organisational structure and processes, the availability of resources, capabilities of staff (Ball et al., 2020), political ties (Liedong et al., 2020) and the degree of collaborations amongst organisations (Gupta et al., 2020) or between organisations and individuals (Cegarra-Sánchez et al., 2020), are examples that reveal the potential to improve data and knowledge exchange for society's benefit. Therefore, in order to maximise the benefits of data and knowledge exchange, there is a need to establish and operationalise a shared and agreed data agenda between different parties (Ball et al., 2020; Cegarra-Sánchez et al., 2020) working within the same ecosystem (Gupta et al., 2020; Morris et al., 2020).

A third tension can occur between organisations and individuals. Cloarec (2020) unveils the paradox between consumers' appreciation of personalised advertising and the risk of marketers exploiting their privacy. Thus, organisations can exploit their appreciation by using data illegally, or in a way that lacks transparency, for individuals. When individuals decide to

share their personal data with third parties, they may not have a full understanding or awareness of the related conditions and consequences. Therefore, individuals have to be legally equipped (e.g. GDPR) and have sufficient knowledge (e.g. data literacy) to select those third party data and information exchanges in which to engage, and to what extent they should exert privacy control (Cloarec, 2020). Without sufficient understanding or awareness of data sharing, individuals cannot evaluate the trustworthiness¹ (Cloarec, 2020) and legitimacy² (Gupta et al., 2020) of these third party organisations. Trustworthiness and legitimacy are key drivers in the BD debate at the societal level. The presence of organisational legitimacy, and trusting relationships between organisations and individuals, can prompt individuals to engage with an organisation, and to use its services or technologies (Cegarra-Sánchez et al., 2020). Societal level tensions widen the scope of trustworthiness and legitimacy: organisations need to be perceived as trustworthy and legitimate in the eyes of individuals but also by other organisations. Trustworthiness between an organisation and policy-makers is crucial, because both parties should be convinced that the other has the key trustworthiness characteristics of benevolence, ability and integrity (Mayer et al., 1995), if they are to build a (data) exchange relationship (Liedong et al., 2020).

4. Conclusions: how can organisations respond to the tensions in the data environment?

To conclude, we highlight how organisations should proceed, in order to respond effectively to the challenges and tensions in the data environment identified in our analysis. We present the tensions identified in the previous section under three headings – Learning, Leading and Linking – in order to highlight the opportunities that organisations can seize in order to make the most of BD, i.e. moving towards areas of recommendation for organisational action. Our 3Ls framework is shown in Figure 2. As well as indicating areas of action that organisations can pursue to address the tensions identified in this paper, the framework highlights: those aspects that sit principally within the boundary of the organisation (such as Learning, i.e. the development of skills and capabilities); those aspects that potentially connect the internal and external environments (Leading: the need for vision, strategy, oversight and

¹ Trustworthiness is a set of beliefs about a third party (e.g. an organisation) that facilitates a willingness to depend on that party in a situation of risk. Trustworthiness involves three key dimensions: *ability*, *benevolence* and *integrity* of -for instance- an organisation (Colquitt et al., 2007; Mayer et al., 1995).

² Legitimacy is a generalised judgement or perception that an organisation's activities are desirable, proper or appropriate within some socially constructed system of norms, values and beliefs (Suchman, 1995).

dynamic responses); and those aspects that are mainly driven from outside the organisation (Linking: the need to embed the firm in a wider ecosystem and respond to societal issues).

[Insert Figure 2: The Learning, Leading, Linking Framework]

4.1. Learning

The tensions around organisational learning require the organisation to develop its hard and soft BD capabilities, and its learning processes. The exact nature of how an organisation can go about addressing this tension is debated in the literature, but the chosen activities are often largely internally focused, i.e. they may involve training and upskilling existing staff as well as recruiting new talent. However, organisations may also decide to involve outside partners in order to learn and build their capabilities, by outsourcing their data analysis, partnering with a data service provider or even crowdsourcing their data science (e.g. Marr, 2017). The balance between outsourcing BD capabilities and enhancing the skills of existing staff is a challenging one. In addition, the breadth of papers in the Special Issue indicates a wide range of BD capabilities that can be acquired at the individual level, depending for example, on the role of that individual in the organisation, and their positioning with regard to the organisation's intended use of BD. Merendino et al. (2018) point to the importance of enhanced cognitive capabilities at the board level, including a need to overcome cognitive biases and cognitive overload due to BD. While it may be unlikely that a director is required to acquire hands-on technical skills to make use of BD, the organisation will benefit if directors develop their understanding of how BD can help the organisation to gain competitive advantage (Akter et al., 2020; Morris et al., 2020; Hughes and Ball, 2020;) or increase performance (Akter et al., 2016; Fosso Wamba et al., 2017; Martínez-Caro et al., 2020). Such benefits will only be achieved if the organisation can look beyond the specific capabilities at the level of the individual, and consider the broader learning processes of the organisation (e.g. Hughes and Ball, 2020; Gupta et al., 2020), enhanced by an environment and culture that supports digital development and learning.

4.2 Leading

As we consider the tensions relating to organisational leadership and their associated responses, our focus moves further across the boundary of the organisation, from the internal to the external environment. We have noted that organisations need to develop a shared strategy and vision, develop their dynamic capabilities, and put in place an oversight role for BD. Marr

(2017) highlights the need for organisations to identify their “*strategic data needs*” (p.21), pointing to a range of potential benefits including better decision-making, enhanced understanding of customers and markets, improved operations and efficiency gains. Yet there is no universal agreement on the management capabilities required to achieve these benefits. In the area of BD and analytics, these capabilities have been conceptualised as involving planning investment, coordination and control (Akter et al., 2016). However, Merendino et al. (2018) show that BD can present challenges for board cohesion, potentially disrupting decision-making, raising temporal issues (e.g. around the speed of innovation), and impacting negatively on the cohesion of the board. This paper indicates the need to support a shared vision and strategy with dynamic capabilities relating to BD. Moreover, we point to a key oversight role, as the data held by a particular organisation may be an indicator of important connections with other organisations and wider society. This points to new capabilities at a senior organisational level, including for board directors. For example, organisations need to develop and periodically update a protocol to ensure good governance of BD, including appropriate data sharing and data protection.

4.3 Linking

Finally, the societal tensions and their associated activities require the organisation to adopt a largely external focus as it makes connections with other entities. Organisations must consider their position in a wider digital ecosystem, develop their strategies around data and knowledge sharing, and pay attention to personal data and privacy issues. Concerns around data sharing and privacy are of course not entirely new. Almost a decade ago, Rubinstein (2013) pointed to the challenges that BD presented for new forms of regulation, and George et al. (2014) drew attention to practices around data sharing, privacy and ethics. Today, we can view the “*Linking*” tension, with its societal focus regarding digital ecosystems, data and knowledge exchange and privacy, through a data surveillance capitalism lens (Zuboff, 2019). Data surveillance capitalism is defined as the unilateral appropriation of private individuals' experience as free raw material for translation into behavioural data (Zuboff, 2019). Data are then computed and packaged as prediction products and sold into behavioural futures markets, i.e. organisations can – often unbeknownst to individuals - predict, manipulate and influence individuals' behaviour (Zuboff, 2019). Such observations lead other authors such as Véliz (2020) to call upon individuals to “*take back control*” of their data, “*think twice before sharing*” and “*choose privacy*” (p. 182). Hence, we summarise the insights of a number of studies in this Special Issue (Ball et al., 2020; Cloarec, 2020; Gupta et al., 2020) into a call for renovating

transparency about how, why, where, when and which data is exploited by organisations - whether they are private or public - for the benefit of society as a whole. The coronavirus pandemic has brought data sharing issues to the fore, for example in the context of smart cities (Allam and Jones, 2020). Future research could seek to increase public awareness of the power of data in everyday life.

4.4. Contributions and Future Research Agenda

In this paper, we contribute, first, by identifying and developing a nuanced understanding of the tensions that organisations face in the new BD environment. We highlight and analyse three areas of tension, and hence contribute to the theoretical debate on the implications of BD for society (Pappas et al., 2018), organisations and senior management teams (Merendino et al., 2018; Davenport et al., 2012). The three areas of tension relating to BD identified are organisational learning, organisational leadership and societal tensions. Under organisational learning, the tensions relate to the development of (1) hard skills and capabilities, (2) soft skills and capabilities, and (3) learning processes. In relation to organisational leadership, we identify tensions concerning (1) shared strategy and vision, (2) the development of dynamic capabilities, and (3) an oversight/monitoring role around BD. Finally, under the heading of societal tensions, we point to the following areas of tension: (1) digital ecosystems, (2) the sharing/exchange of data and information, and (3) a so-called privacy paradox around personal data. These nine tensions, as presented in the Multi-Layer Tensions Model (Figure 1), are listed in Table 1 as we develop implications for practice and a future research agenda (below).

Second, we make theoretical contributions in relation to the three areas of Learning, Leading and Linking. With regard to organisational learning, we provide a more nuanced understanding of the different capabilities (hard and soft) and learning processes that individuals and organisations should develop to maximise the benefits of BD and overcome the tensions and challenges that BD present. In particular, we enrich the existing literature on dynamic capabilities (Teece, 2007) and learning processes (March, 1991) in a BD environment (Fosso Wamba et al., 2017) by revealing the BD tensions and opportunities that individuals, organisations and society face. In relation to organisational leadership, we contribute to the debate on the implications of using BD at the level of strategic decision-making in the organisation (Merendino et al., 2018). We provide an analysis of the challenges and pressures that organisations should address when formulating their strategies – relating to shared vision and strategy, the development of dynamic capabilities and an oversight role in relation to BD.

Finally, turning to the societal tensions identified, we contribute to the debate on the importance of developing data ecosystems where data actors operate in a connected fashion, promoting open and flexible collaborations (Pappas et al., 2018). We further expand this debate by clarifying the tensions and opportunities occurring amongst organisations, and between organisations and individuals within a context of digital ecosystems – including the sharing and exchange of data and information, and privacy tensions around personal data.

Our paper also has important implications for practice. We elaborate on the capabilities that could be developed and the actions taken to respond to the above tensions, and maximise the benefits of BD for the organisation. We note that the papers informing our analysis draw on many different contexts and areas of application (as summarised in Section 2), and hence a nuanced approach to what constitutes ‘good practice’ around BD (based on industry sector, organisational size and resourcing, etc.) is required. We therefore strongly recommend that organisations should undertake a careful mapping of the tensions that can occur, to understand the impact in their own particular context. Our “*Learning, Leading, Linking*” framework (Figure 2) develops areas of action in relation to each area of tension. Table 1, below, offers some potential solutions to overcome the tensions identified, as outlined below.

First, organisations - from the senior team to the shopfloor - can benefit from regular training and upskilling on BD and BD analytics. Investing in data training can help organisations build awareness and understanding of how to sense, seize, and transform (using dynamic capabilities) opportunities leveraged by BD. To upskill staff, the senior team should create a learning process and culture within the organisation to promote the acquisition of BD capabilities at all levels. By doing so, organisations will be able to both explore and exploit opportunities provided by the BD environment. Second, the senior team should develop a comprehensive digital strategy that involves not only the IT department, but all functional areas of the organisation. Digital strategies will help organisations to identify opportunities to work with and leverage data by, for instance, optimising investments in technology infrastructure and reducing costs. Third, we encourage organisations to consider building and improving their data ecosystems to strengthen the exchange of data and knowledge. The initial focus of such an initiative is likely to be on a small number of partners, and datasets of limited size and scope. As a data ecosystem develops, an organisation can include additional partners and extended datasets. As a result, the organisations within the ecosystem may spot opportunities to improve their growth, productivity and risk management. Fourth, as pointed out by consultants (Evans and Forth, 2015) and confirmed here, in such a data environment, organisations risk a fierce backlash if they overlook important issues of legitimacy and trustworthiness. Organisations

need to manage their perceived legitimacy and trustworthiness in the eyes of key stakeholders. An organisation's use of data and technology can change whether individuals perceive it to be legitimate and trustworthy, and the consequences of negative judgements can be severe. As a result, legitimacy and trustworthiness in a BD environment should represent one of the foundations of an organisation's strategy.

We conclude by identifying areas for further study. For each of the tensions identified, we suggest a future research agenda (Table 1, below) to inspire further research to continue to address key evolving issues in relation to BD and its impacts on individuals, organisations and society. Our analysis points to the need for further research regarding which capabilities organisations and individuals should acquire in order to maximise BD's benefits, hence improving performance and building competitive advantage. Dynamic capabilities are considered the cornerstones of BD capabilities (Fosso Wamba et al., 2017; Teece, 2007). However, future research could further analyse dynamic capabilities relating to BD, and uncover other capabilities that organisations can acquire to maximise their competitive advantage through the use of BD.

This paper confirms that new learning processes around BD capabilities often present organisations with complex challenges (March, 1991). Future research could further explore how organisations can develop an ambidextrous approach to the exploration and exploitation of new technologies. Future studies could analyse how to create and support a learning culture within an organisation, addressing the complexity of the development of new BD capabilities.

This research paves the way for further studies on digital strategies and BD at the senior level in organisations. We find that organisations often pay insufficient attention to issues pertaining to data or digital strategy, despite their potential to minimise cyber-security threats, maximise data collaborations, and improve investment decisions relating to digital technologies. Further research could study the critical elements of a comprehensive and successful digital strategy. Future studies at the senior level of organisations could further explore the elements of the BD oversight role that should be acquired to maximise BD opportunities.

A data ecosystem is a key construct in our understanding of the digital economy, requiring further exploration. In line with previous research (Pappas et al., 2018), our analysis suggests that future studies are needed to analyse how digital ecosystems can best be characterised, given the issues they present for the focal organisation. Future research could also explore the factors that help or hinder the effective exchange of data within such ecosystems.

Finally, notions of legitimacy and trustworthiness are central to our understanding of how stakeholder acceptance of BD organisations is gained or lost. Future research could investigate how individuals evaluate an organisation's legitimacy and trustworthiness in the context of new and disruptive business models. Judgments of legitimacy and trustworthiness change over time; future studies could examine whether and how organisations recover from negative judgments of their legitimacy and trustworthiness.

Table 1: Contributions to Practice and Future Research Agenda

Tension	Contribution to practice / recommended actions	Future research agenda
Hard skills/capabilities	Need for regular training/upskilling of staff, and recruiting new talent. Appropriate involvement of external partners to fill gaps in skills/capabilities	What are the most valuable capabilities (changing over time) and how can they be acquired effectively?
Soft skills/capabilities	In addition to the above, need to build awareness and understanding of individual characteristics (such as personality traits and competencies, motivation, social skills, etc.) and their possible mediating effect on the effective use of BD within organisations	Do individual capabilities and competencies have a mediating role in the relationships between BD investments and organisational performance?
Learning processes	Need to create a learning culture and environment within the organisation	How to create and support a learning culture effectively?
Shared strategy/vision	Need for a comprehensive digital vision and strategy that reflects the opportunities and threats of BD; the strategy should embrace the ecosystem in which the organisation operates	What are the elements of a comprehensive digital strategy? How does organisational level strategy connect with the digital ecosystem?
Develop dynamic capabilities	Need to acquire dynamic capabilities relating to BD	What are the most valuable dynamic capabilities relating to BD and how can they be acquired effectively?

Oversight/monitoring	Need to develop a BD oversight role at senior level	What are the elements of the BD oversight role, and how can they be acquired effectively at senior level?
Digital ecosystems	Need to clearly design and specify the digital ecosystem of the organisation, and the opportunities and challenges it presents	How can an organisation's digital ecosystem best be characterised, and what issues does it raise for the focal organisation?
Data/knowledge sharing and exchange	Need for a shared data agenda between parties, addressing the factors that help or hinder the effective flow of data and knowledge	How can the factors that help/hinder the effective exchange of data/knowledge be maximised/minimised in the future?
Privacy paradox	Need to manage the perceived legitimacy and trustworthiness of the organisation in the eyes of key stakeholders	What are the factors that impact upon the legitimacy / trustworthiness of the organisation, and how can they be managed effectively in the future?

References

***Note: the papers indicated with an asterisk “*” are the twelve papers that form the Special Issue, and the basis of the analysis in this article.**

- Akter, S., Fosso Wamba, S., Gunasekaran, A., Dubey, R., Childe, S.J., 2016. How to improve firm performance using big data analytics capability and business strategy alignment? *Int. J. Prod. Econ.* 182, 113–131. <https://doi.org/10.1016/j.ijpe.2016.08.018>
- *Akter, S., Gunasekaran, A., Wamba, S.F., Babu, M.M., Hani, U., 2020. Reshaping competitive advantages with analytics capabilities in service systems. *Technol. Forecast. Soc. Change* 159, 120180. <https://doi.org/10.1016/j.techfore.2020.120180>
- Allam, Z., Jones, D.S., 2020. On the coronavirus (Covid-19) outbreak and the smart city network: Universal data sharing standards coupled with artificial intelligence (AI) to benefit urban health monitoring and management. *Healthc.* 8. <https://doi.org/10.3390/healthcare8010046>
- Babutsidze, Z., 2018. The rise of electronic social networks and implications for advertisers. *Technol. Forecast. Soc. Change* 137, 27–39. <https://doi.org/10.1016/j.techfore.2018.06.010>
- *Ball, K., Canhoto, A., Daniel, E., Dibb, S., Meadows, M., Spiller, K., 2020. Organizational tensions arising from mandatory data exchange between the private and public sector: The case of financial services. *Technol. Forecast. Soc. Change* 155, 119996. <https://doi.org/10.1016/j.techfore.2020.119996>
- Braganza, A., Brooks, L., Nepelski, D., Ali, M., Moro, R., 2017. Resource management in big data initiatives: Processes and dynamic capabilities. *J. Bus. Res.* 70, 328–337. <https://doi.org/10.1016/j.jbusres.2016.08.006>
- Cardoso, Jorge, Hoxha, J., Fromm, H., 2015. Service Analytics, in: Cardoso, J., Fromm H., Nickel S., Satzger G., Studer R., Weinhardt C. (Eds.), *Fundamentals of Service Systems. Service Science: Research and Innovations in the Service Economy*. Springer, Cham. https://doi.org/10.1007/978-3-319-23195-2_6
- *Cegarra-Sánchez, J., Cegarra-Navarro, J.-G., Chinnaswamy, A.K., Wensley, A., 2020. Exploitation and exploration of knowledge: An ambidextrous context for the successful adoption of telemedicine technologies. *Technol. Forecast. Soc. Change* 157, 120089. <https://doi.org/10.1016/j.techfore.2020.120089>
- Chaoji, V., Rastogi, R., Roy, G., Learning, M., 2016. Machine Learning in the Real World. *Proc. VLDB Endow.* 9, 1597–1600.
- Choi, T.M., Wallace, S.W., Wang, Y., 2018. Big Data Analytics in Operations Management. *Prod. Oper. Manag.* 27. <https://doi.org/10.1111/poms.12838>
- *Cloarec, J., 2020. The personalization – privacy paradox in the attention economy. *Technol. Forecast. Soc. Chang.* 161. <https://doi.org/10.1016/j.techfore.2020.120299>
- Colquitt, J.A., Scott, B.A., LePine, J.A., 2007. Trust, Trustworthiness, and Trust Propensity: A Meta-Analytic Test of Their Unique Relationships With Risk Taking and Job Performance. *J. Appl. Psychol.* 92, 909–927. <https://doi.org/10.1037/0021-9010.92.4.909>

- Contractor, F., Yang, Y., Gaur, A.S., 2016. Firm-specific intangible assets and subsidiary profitability: The moderating role of distance, ownership strategy and subsidiary experience. *J. World Bus.* 51. <https://doi.org/10.1016/j.jwb.2016.09.002>
- Davenport, T., Harris, J., 2017. *Competing on Analytics. The New Science of Winning.* Harvard Business Review, Boston.
- Davenport, T.H., Barth, P., Bean, R., 2012. How “big data” is different. *MIT Sloan Manag. Rev.* 54.
- Dubey, R., Gunasekaran, A., Childe, S.J., Papadopoulos, T., Luo, Z., Wamba, S.F., Roubaud, D., 2019. Can big data and predictive analytics improve social and environmental sustainability? *Technol. Forecast. Soc. Change* 144. <https://doi.org/10.1016/j.techfore.2017.06.020>
- Dutta, K., 2013. Councils sold electoral register data for £250k. *Indep.*
- Evans, P., Forth, P., 2015. *Borges’ map: navigating a world of digital disruption.* Boston Consulting Group.
- Fosso Wamba, S., Gunasekaran, A., Akter, S., Ren, S.J., Dubey, R., Childe, S.J., 2017. Big data analytics and firm performance: Effects of dynamic capabilities. *J. Bus. Res.* 70, 356–365. <https://doi.org/10.1016/j.jbusres.2016.08.009>
- Gaimon, C., 1997. Planning information technology-knowledge worker systems. *Manage. Sci.* 43. <https://doi.org/10.1287/mnsc.43.9.1308>
- *Gan, L., Wang, H., Yang, Z., 2020. Machine learning solutions to challenges in finance: An application to the pricing of financial products. *Technol. Forecast. Soc. Change* 153, 119928. <https://doi.org/10.1016/j.techfore.2020.119928>
- George, G., Haas, M.R., Pentland, A., 2014. Big Data and Management. *Acad. Manag. J.* 57, 321–326. <https://doi.org/10.5465/amj.2014.4002>
- *Gupta, A., Panagiotopoulos, P., Bowen, F., 2020. An orchestration approach to smart city data ecosystems. *Technol. Forecast. Soc. Change* 153, 119929. <https://doi.org/10.1016/j.techfore.2020.119929>
- Holburn, G.L.F., Zelner, B.A., 2010. Political capabilities, policy risk, and international investment strategy: evidence from the global electric power generation industry. *Strateg. Manag. J.* 31, 1290–1315. <https://doi.org/10.1002/smj.860>
- *Hughes, J., Ball, K., 2020. Sowing the seeds of value? Persuasive practices and the embedding of big data analytics. *Technol. Forecast. Soc. Chang.* 161, 120300. <https://doi.org/10.1016/j.techfore.2020.120300>
- *Liedong, T.A., Rajwani, T., Lawton, T.C., 2020. Information and nonmarket strategy: Conceptualizing the interrelationship between big data and corporate political activity. *Technol. Forecast. Soc. Change* 157, 120039. <https://doi.org/10.1016/j.techfore.2020.120039>
- Lin, H.F., Lee, G.G., 2005. Impact of organizational learning and knowledge management factors on e-business adoption. *Manag. Decis.* 43. <https://doi.org/10.1108/00251740510581902>
- March, J.G., 1991. Exploration and Exploitation in Organizational Learning. *Organ. Sci.* 2.
- Marr, B., 2017. *Data Strategy: How to Profit from a World of Big Data, Analytics and the Internet of Things.* Kogan Page Ltd, London.

- *Martínez-Caro, E., Cegarra-Navarro, J.G., Alfonso-Ruiz, F.J., 2020. Digital technologies and firm performance: The role of digital organisational culture. *Technol. Forecast. Soc. Change* 154, 119962. <https://doi.org/10.1016/j.techfore.2020.119962>
- Mayer, R.C., Davis, J.H., Schoorman, D.F., 1995. An Integrative Model of Organizational Trust. *Acad. Manag. Rev.* 20, 709–734.
- McAfee, A., Brynjolfsson, E., 2012. Big Data: The Management Revolution. *Harv. Bus. Rev.* 61–68.
- Merendino, A., Dibb, S., Meadows, M., Quinn, L., Wilson, D., Simkin, L., Canhoto, A., 2018. Big data, big decisions: The impact of big data on board level decision-making. *J. Bus. Res.* 93, 67–78. <https://doi.org/10.1016/j.jbusres.2018.08.029>
- Mikalef, P., Boura, M., Lekakos, G., Krogstie, J., 2019. Big data analytics and firm performance: Findings from a mixed-method approach. *J. Bus. Res.* 98, 261–276. <https://doi.org/10.1016/j.jbusres.2019.01.044>
- *Morris, D., Madzudzo, G., Garcia-Perez, A., 2020. Cybersecurity threats in the auto industry: Tensions in the knowledge environment. *Technol. Forecast. Soc. Change* 157, 120102. <https://doi.org/10.1016/j.techfore.2020.120102>
- Pappas, I.O., Mikalef, P., Giannakos, M.N., Krogstie, J., Lekakos, G., 2018. Big data and business analytics ecosystems: paving the way towards digital transformation and sustainable societies. *Inf. Syst. E-bus. Manag.* 16, 479–491. <https://doi.org/10.1007/s10257-018-0377-z>
- Provost, F., Fawcett, T., 2013. *Data Science for Business. What You Need to Know About Data Mining and Data-Analytic Thinking.* O'Reilly Media, Sebastopol, CA.
- Raguseo, E., 2018. Big data technologies: An empirical investigation on their adoption, benefits and risks for companies. *Int. J. Inf. Manage.* 38. <https://doi.org/10.1016/j.ijinfomgt.2017.07.008>
- Rialti, R., Zollo, L., Ferraris, A., Alon, I., 2019. Big data analytics capabilities and performance: Evidence from a moderated multi-mediation model. *Technol. Forecast. Soc. Change* 149. <https://doi.org/10.1016/j.techfore.2019.119781>
- Rubinstein, I.S., 2013. Big data: The end of privacy or a new beginning? *Int. Data Priv. Law* 3. <https://doi.org/10.1093/idpl/ips036>
- Senyo, P.K., Liu, K., Effah, J., 2019. Digital business ecosystem: Literature review and a framework for future research. *Int. J. Inf. Manage.* 47, 52–64. <https://doi.org/10.1016/j.ijinfomgt.2019.01.002>
- Sims, J.M., 2018. Communities of practice: Telemedicine and online medical communities. *Technol. Forecast. Soc. Change* 126, 53–63. <https://doi.org/10.1016/j.techfore.2016.08.030>
- Singh, D., 2020. Towards Data Privacy and Security Framework in Big Data Governance. *Int. J. Softw. Eng. Comput. Syst.* 6, 41–51. <https://doi.org/10.15282/ijsecs.6.1.2020.5.0068>
- Sivarajah, U., Kamal, M.M., Irani, Z., Weerakkody, V., 2017. Critical analysis of Big Data challenges and analytical methods. *J. Bus. Res.* 70, 263–286. <https://doi.org/10.1016/j.jbusres.2016.08.001>
- Suchman, M.C., 1995. Managing Legitimacy: Strategic and Institutional Approaches. *Acad. Manag. Rev.* 20, 571. <https://doi.org/10.2307/258788>

- Teece, D.J., 2007. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strateg. Manag. J.* 28.
<https://doi.org/10.1002/smj.640>
- Véliz, C., 2020. *Privacy is Power: Why and How You Should Take Back Control of Your Data*. Penguin Random House, London.
- *Wang, H., Yao, Y., Salhi, S., 2020. Tension in big data using machine learning: Analysis and applications. *Technol. Forecast. Soc. Change* 158, 120175.
<https://doi.org/10.1016/j.techfore.2020.120175>
- Wang, Y., Kung, L.A., Byrd, T.A., 2018. Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. *Technol. Forecast. Soc. Change* 126, 3–13. <https://doi.org/10.1016/j.techfore.2015.12.019>
- Wylie, C., 2019. *Mindf*ck: inside Cambridge Analytica's plot to break the world*. Profile Book, London.
- *Yang, X., Cao, D., Andrikopoulos, P., Yang, Z., Bass, T., 2020. Online social networks, media supervision and investment efficiency: An empirical examination of Chinese listed firms. *Technol. Forecast. Soc. Change* 154, 119969.
<https://doi.org/10.1016/j.techfore.2020.119969>
- Zuboff, S., 2019. *The Age of Surveillance Capitalism: The Fight For a Human Future At the New Frontier of Power*. PublicAffairs, New York.

Biographical details of authors

Maureen Meadows (PhD) is Professor of Strategic Management at the Centre for Business in Society (CBiS) at Coventry University. She is co-leader of a research cluster on ‘Data, Organisations and Society’, with a particular interest in strategic decision-making relating to ‘big data’. With a background in mathematics and statistics, Maureen has many years’ experience of working with customer data and analytics, both as a practitioner in the financial services sector and an academic. Her research interests include the use of strategy tools (e.g. scenario planning and visioning) and the implementation of projects such as relationship marketing and customer relationship management.

Sally Dibb is Professor of Marketing and Society at Coventry University. She has visiting posts at The Open University, Warwick Business School and University of St Andrews. Her research focuses on the role of data in addressing societal challenges and supporting strategic decision making. Sally has received funding from the ESRC, InnovateUK, European FP7 and EU KIC programmes, The Leverhulme Trust, Academic of Marketing, amongst others. She has served twice as a panel member for the UK Research Excellence Framework and as international panel member for the Norwegian Research Council.

Alessandro Merendino (PhD) is an Assistant Professor at the Centre for Business in Society at Coventry University. His research interests lie in the area of corporate governance, the board of directors, the top management team and big data in a wide range of industries. He is also a qualified chartered accountant and a member of a number of professional and academic bodies, including The Institute of Chartered Accountants in England and Wales, the British Academy of Management and the International Corporate Governance Society. He has extensive experience in different projects funded by national and international organisations.

Alexeis Garcia-Perez is Professor of Management Information Systems at Coventry University and Visiting Research Scholar at Georgetown University. A PhD in Information Systems and Knowledge Management from Cranfield University complemented his original background in Computer Science, enabling an interdisciplinary perspective of Management Information Systems research and practice. Alexeis has published widely on the subject of Knowledge Management, including three Emerald books co-authored with international scholars. He serves as an advisor on a number of national and international bodies focused on cybersecurity and digital resilience in the public and private sectors.

Matthew Hinton is Senior Lecturer in Information and Knowledge Management at the Open University Business School, UK, where he has also been lead academic consultant working with the BBC. He is interested in how organisations innovate with their internal business processes and how technology mediates performance improvement. He is on the editorial board of several journals and has been author/co-author of more than 50 publications, spanning technology assessment, e-business and performance management. He earned his PhD in innovation and technology assessment from Cranfield University, UK.

Savvas Papagiannidis is the David Goldman Professor of Innovation and Enterprise in the Newcastle University Business School, UK. His work has been published in several academic journals and presented at international conferences. His research interests mainly revolve around electronic business and its various sub-domains. More specifically, his research aims to inform our understanding of how e-business technologies affect the social and business environment, organisational strategies and business models, and how these are implemented

in terms of functional innovations. His work puts strong emphasis on innovation, new value creation and the exploitation of entrepreneurial opportunities, within the context of different industries.

Ilias Pappas is a Full Professor of Information Systems at the Department of Information Systems, University of Agder, Norway. His research activities include data science and digital transformation, social innovation and social change, user experience in different contexts, as well as digital marketing and e-service adoption.

He has published over 100 articles in peer reviewed journals and conferences including *Journal of Business Research*, *European Journal of Marketing*, *Computers in Human Behavior*, *Information & Management*, *Psychology & Marketing*, *International Journal of Information Management*, and the *Journal of Systems and Software*.

Huamao Wang is Associate Professor in Finance, Risk and Banking at Nottingham University Business School, University of Nottingham. Before that, he was Lecturer in Finance at the University of Kent. He obtained his Ph.D. degree at the University of Leeds, winning the Tom Lupton prize, sponsored by the Society for the Advancement of Management Studies and the *Journal of Management*. He has published papers in *Technological Forecasting and Social Change* and the *European Journal of Operational Research*, amongst others. His research interests include theoretical and empirical studies into big data, machine learning, entrepreneurship, corporate finance, asset pricing, and portfolio choice.

Figure 1: The Multi-Layer Tensions Model

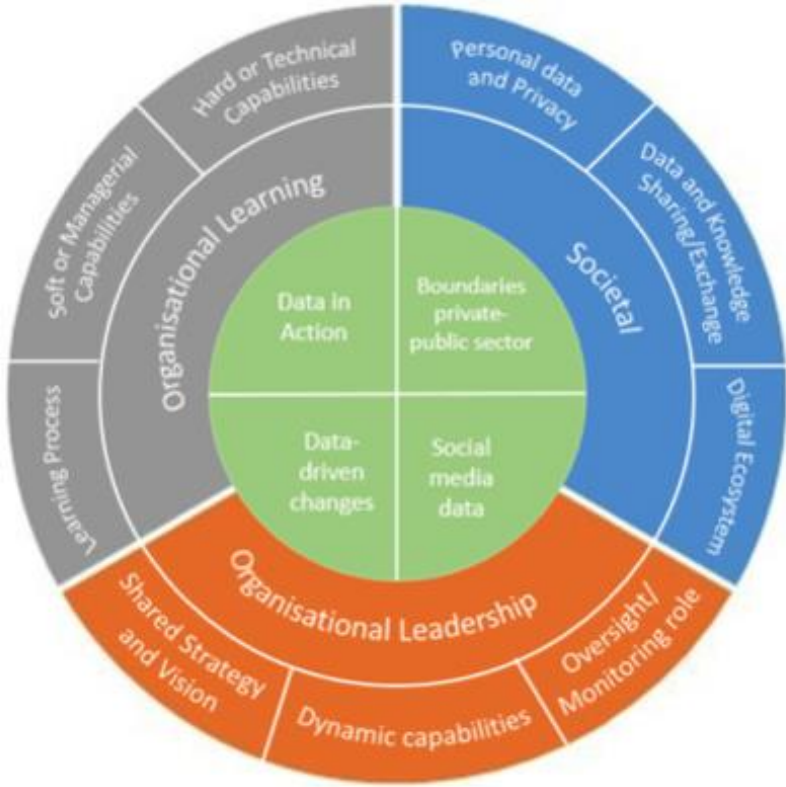


Figure 2: The Learning, Leading, Linking Framework

