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Factors affecting Big Data adoption in a government organisation in the Western Cape

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Background: Government organisations have realised the potential to derive value from Big Data (BD) and need to adopt BD. Currently, South African governmental organisations have not fully committed to adopting BD because they are unsure if they are adequately equipped, and additional empirical research is required to understand the salient factors that influence BD adoption.

Objectives: This research investigates the factors influencing the adoption of BD at a government organisation in the Western Cape, South Africa.

Method: This study adopted a qualitative research approach, using semi-structured interviews and snowball sampling to collect data from 11 participants at a government organisation in the Western Cape. Participants provided informed consent and it uses a thematic analysis approach to analyse the data.

Results: The technology-organisation-environment (TOE) framework was used to study the factors influencing BD adoption at government organisations. Seventeen factors were identified, the majority in the organisational context of TOE framework. The salient factors were identified as top management support, finance, and budget, skills and talent and organisational strategy.

Conclusion: The study found 17 factors that influence the adoption of BD at this government organisation and provides recommendations on how to address those factors to ensure that BD is adopted successfully.

Contribution: This study presents empirical evidence of the factors that influence BD adoption in government organisations. By considering these factors, government organisations can integrate and synergise IT and business to ensure that the core business of government, which is service delivery to the citizens, is achieved competently by harnessing the potential of BD.

Keywords: adoption; data; Big Data; government; information systems; information technology; service delivery; factors; technology-organisation-environment (TOE) framework.

Introduction

Data have become a critical asset for government agencies to enhance societal needs (Gutierrez 2017). Governments produce and accumulate huge amounts of data through everyday activities, such as managing pensions and allowance payments, tax collection, national health system records and recording traffic data (Cavanillas, Curry & Wahlster 2016). The knowledge hidden in large datasets is increasing, as is the pressure on governments to turn the data into actionable information (Gutierrez 2017).

The effective use of data could be the missing link between good governance and capacity building, where insights through data are used to improve service delivery (Gutierrez 2017). Government organisations have realised that accurate, up-to-date data are required to improve service delivery, accountability, transparency, efficiency and productivity (Hoti 2015). Big Data directly affects the economy because public sector income is collected through taxes and social contributions, and efficient services relate to direct cost savings (Cavanillas, Curry & Wahlster 2016). For example, the more efficient the public sector is, the better-off citizens are, as fewer resources (taxes) are needed to provide the same level of service (Cavanillas, Curry & Wahlster 2016).

However, despite the excitement and interest in BD and its high operational and strategic potential, little is known about the factors involved in adopting BD in government organisations (Bremser 2018).

Only 14% of organisations that start with BD implementation projects have done so successfully (Bremser 2018). While BD technology's potential is real, government adoption is lagging because of fundamental concerns about high expectations and excessive financial investment (Eynon 2013). Most discussions concerning BD have been technologically biased and industry-oriented, leaning towards the technical aspects of its design and not adoption (Boyd & Crawford 2012).

Government agencies are still lagging in adopting BD despite research and business reports showing how government can use BD to serve citizens and overcome national challenges such as rising healthcare costs, job creation, natural disaster prevention and terrorism (Kim et al. 2014). Additional empirical studies are required to assess BD's potential and the adoption process (Fosso Wamba et al. 2015). This study explores the factors influencing the adoption of BD in a government organisation. The conceptual framework developed in this research could serve as a guideline for government organisations that experience challenges in adopting BD or those interested in adopting such technology.

Objectives

It is crucial for organisations to understand the benefits and challenges of BD adoption because it leads to new data-driven services that improve processes and enable innovative products and services. Therefore, this research describes BD and the factors influencing adoption at a government organisation in the Western Cape. The following objectives guide the study:

- Assess the current literature relating to BD, the use of BD in government organisations and the factors that influence BD adoption.
- Explore the challenges and benefits of BD in government organisations.
- Explain how the identified factors through the technology-organisation-environment (TOE) framework influence BD adoption in government institutions.

The concept and characteristics of Big Data

Big Data encompasses collecting, managing and analysing massive volumes of different data types at the right speed within the right time frame while providing meaningful output to the end user (Runting et al. 2020). Because data constantly change, it is difficult to express how much data define BD in specific, measurable terms.

Big Data can be classified into four groups based on its: (1) attributes, (2) technological needs, (3) thresholds and (4) social impact (De Mauro, Greco & Grimaldi 2016). Data attributes provide one of BD's most popular definitions, underpinning the expected three-dimensional increase in data: volume, velocity and variety (Kitchin & McArdle 2016). Also, BD is not only about a matter of size, but also an opportunity to find insights in new and emerging types of data and content to make useful decisions (Taleb, Serhani &

Dssouli 2018). Big Data is not a single technology but a combination of technologies and processes that support organisational data analytical processes to gain insight while effectively handling data load and storage problems (Yakobi, Scholtz & Vom Berg 2020).

Big Data's concepts and technologies allow governments to achieve various objectives that enhance levels of sustainability and governance (Al-Sai & Abualigah 2017). Firstly, governmental organisations can increase service delivery and offer transparency, effectiveness, efficiency and certainty (Al-Sai & Abualigah 2017). Secondly, BD can transform government practices by generating added value for public services and the ability to motivate and support the digital innovations of governments (Al-Sai & Abualigah 2017). Thirdly, it improves the time required to process data and deliver high-quality services and products that meet citizens' demands while improving internal business decisions (Al-Sai & Abualigah 2017).

The characteristics of BD were previously defined through a 3V model as high volume, high velocity and high variety of information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision-making (Desai 2018). This definition has subsequently been extended to a 4V model by adding a new 'V', 'value', and even further to a 5V model by adding 'veracity' (Bello-Orgaz, Jung & Camacho 2016).

Big Data has five distinguishing characteristics that can be described in terms of the 5Vs, namely, (1) volume, using and combining multiple, large datasets from various sources, both external and internal to the organisation; (2) variety, using and combining structured (traditional) and less structured or unstructured (nontraditional) data in analysis activities; (3) velocity, using incoming data streams in real time or near real time; (4) value, development and use of advanced analytics and algorithms, distributed computing and advanced technologies to handle very large and complex computing tasks; and (5) veracity, through innovative use of existing datasets and data sources for new and radically different applications than the data were gathered for (Klievink et al. 2016).

Benefits of Big Data in government

Big Data's efficient use and understanding as an economic asset carry great potential for economies and society (Fosso Wamba & Mishra 2017). It is expected that BD can impact various sectors, including healthcare, media, energy and retail (eds. Cavanillas, Curry & Wahlster 2016).

Firstly, in healthcare, it can be used through medical applications, including comparative effectiveness research where the clinical and financial effectiveness of interventions is compared to the next generation of clinical decision support systems that make use of comprehensive heterogeneous health datasets and advanced analytics of clinical operations (eds. Cavanillas, Curry & Wahlster 2016). Healthcare systems collect vast data through, among others, electronic healthcare records, social media, patient summaries, genomic and

pharmaceutical data, and clinical trials. Healthcare professionals can benefit from the large amount of data because it reveals new approaches to improve health by providing insights into the causes and outcomes of disease, better drug targets for precision medicine, and enhanced disease prediction and prevention (Pastorino et al. 2019).

Secondly, benefits in the public sector include improved transparency via open government and open data, improved public procurement, enhanced funding allocation into programmes, higher quality services, increased public sector accountability and a well-informed citizenry (Van der Voort et al. 2019). Also, citizens can participate more freely in the public decision-making processes because they can express their opinions and requirements through social media, making it easier to participate in governmental activities (Fredriksson et al. 2017).

Thirdly, BD provides innovative ways to monitor transportation and logistics by using various new data sources. BD's potential in the transport sector is estimated at USD 500 billion worldwide in terms of time, fuel savings and the avoidance of 380 Mt of carbon dioxide (CO_2) emissions (eds. Cavanillas, Curry & Wahlster 2016). Also, BD enables government transport agencies to collect and analyse current and historical data that can predict traffic flow in real time for better public transportation service planning (Zhang et al. 2015).

Lastly, advancements are possible when energy systems are digitised to acquire real-time, high-resolution data via smart metres that can be leveraged within advanced analytics to improve the levels of efficiency within both the demand and supply sides of energy networks (eds. Cavanillas, Curry & Wahlster 2016). The use of BD analytics in energy systems promotes better planning, management and optimisation of energy systems (Kamarulzaman & Hassan 2019).

Challenges of Big Data in government

Despite the various benefits of using BD in government organisations, challenges exist that adversely affect adoption. The challenges have been grouped into three categories according to the TOE framework. Firstly, challenges like data reliability and suitability, IT infrastructure, security and privacy and system integration exist in the technological context. These challenges focus on how technology characteristics influence the adoption process, including current practices and equipment internal to the organisation and the pool of technologies external to the organisation (Ismail & Mokhtar 2013).

Secondly, in the organisational context, the challenges stem from, among others, data management, retaining capable employees that can manage BD systems and having a well-defined regulatory (legal) environment to facilitate BD, organisational strategy and organisational processes. These challenges relate to how BD can alter organisational processes, structures and culture.

Lastly, in the environmental context, challenges relating to customers, competition, vendors and society (social) in terms of service delivery. These challenges relate to the size and structure of the organisation's industry, partners and competitors and how these influence the services that the organisation delivers to citizens.

Technology-Organisation-Environment framework

The TOE framework is an organisation-level framework that explains three different elements of an organisation's context that influence adoption decisions (Baker 2012). Tornatzky and Fleischer (1990) developed the TOE framework to explain the decision to adopt a technological innovation by an organisation based on the technological, organisational and environmental contexts (Kalema & Mokgadi 2017). The TOE framework has been extensively used in technology adoption studies and provides a useful approach to understanding the factors influencing technology adoption in organisations (Pudjianto et al. 2011).

The TOE framework is suitable for studying the factors influencing BD adoption in government organisations because it allows us to evaluate the importance of different factors that affect the inclination to adopt IT (Ismail & Mokhtar 2013). Also, the TOE framework is suitable for these studies because it measures the success of information system adoption in terms of human, organisational and environmental factors (Almoqren & Altayar 2016). The TOE framework evaluates the concept of implementation that provides identification and contributions to adoption and the need to understand innovation to provide in-depth insights to researchers and practitioners (Defitri et al. 2020).

Methodology

This study used a qualitative approach to understand the factors that affect BD adoption in a government organisation in the Western Cape. This research required in-depth engagement with the participants to gain a comprehensive insight into the problem being addressed. Data were collected from 11 participants (see Table 1) from different departments within the organisation, and all participants were part of a single government organisation in the Western Cape. Data were collected through open-ended

TABLE 1: Participant organisational role and gender.

Participant ID	Role	Gender
P1	Project Manager	Male
P2	Professional Officer	Male
P3	Director	Female
P4	Manager	Male
P5	Professional Officer	Male
P6	Professional Officer	Male
P7	Professional Officer	Male
P8	Information Coordinator	Male
P9	Director	Male
P10	Manager	Male
P11	Technology Officer	Male

interviews. The 11 participants held various titles within the organisation and included 1 project manager, 4 professional officers, 2 directors, 2 managers, 1 information coordinator and 1 technology officer.

Nonprobability sampling is the method used for this research project. The researcher deliberately selected staff such as directors and senior managers because they could refer the researcher to other potential participants (Rahi 2017). Also, the research purposely selected its participants because these individuals are involved in deciding which technologies are put forward for review and adoption.

This study used the interpretivist paradigm to examine real-life phenomena in depth involving the participants, events or situations that occur within the organisations that contribute to the participants' sentiments and participants' assigned meanings on BD adoption based on their cultural and historical context (Guest, Namey & Mitchell 2013; Smit 2010).

This study collected qualitative data through one-on-one open-ended interviews with 11 participants scheduled through a remote conferencing system and saved (recorded) for later analysis. The qualitative data collected were analysed for the different themes identified in the research objectives and analysed through Atlas.ti, a qualitative data analysis tool.

The study followed a four-phase methodology to analyse the data. After collecting data, the first phase was to transcribe the recorded data in a word processing application. The responses from participants were saved in individual documents. The next phase was to import the data into an analysis tool. Atlas.ti was used to perform this function. The next phase involved querying the data and grouping related responses to create themes. In the last phase, the identified themes were linked to the research objectives and the results of the findings described. To summarise, the phases were transcribing the interviews, grouping the related data (themes), linking the data to the research objectives, and analysing and reporting on the findings (Mezmir 2020).

The following five were the ethical considerations for this study: (1) conducting the research in a manner that safeguards the identity of the participants, organisation, university and the researcher; (2) analysing the collected data with the highest integrity to ensure that it is accurate, concise and specific to the proposed research; (3) participants were requested to partake in the study voluntarily; (4) the researcher explained the nature of the research to which participants were being asked to contribute and avoided any unfair, prejudiced or discriminatory practice; and (5) a formal request asking for permission to conduct the research was sent to the organisation, accompanied by a letter of reference from the university.

Results and discussion

The findings are based on the participants' perceptions of the specific government organisation. The main themes identified from the data related to the concept of BD, adoption of technologies within the organisation, challenges and benefits of using BD in the organisation, and the factors that affect the adoption of BD.

The concept of Big Data

The study found that 9 out of the 11 participants understood the concept of BD and could elaborate on what BD is and how it can be used within the organisation. Participants referred to BD in terms of volume, variety and velocity and analysing the data in a central repository with tools such as NoSQL to produce dashboards, reports and other analytic results that will help predict or describe events that have happened. For example:

> '[L]ooking at the Organisation XYZ's data as a whole and then analysing that data with various new types of techniques that are available now like NoSQL, … then bringing all of this data together into one spot, like a data lake or data house … then analysing that data to produce dashboards, report some analytic results that will help either predicting events or describing events that has [*have*] happened.' (P1, Project Manager, Male)

Responses also indicated that BD datasets are so large that it cannot be processed, aggregated or transformed in a reasonable time frame using a single machine (computer/server).

Technology adoption

This study found that the organisation is actively reviewing technologies used within the organisation. This was a crucial aspect of the study because if the organisation is not actively adopting new technologies, the possibility of adopting BD would be minimal. Also, new technologies could lead to new data-driven services that improve processes and enable innovative products and services, which is important for governmental organisations, and BD can create these services. Responses included the following:

> 'We looked at our future business strategies and then based on a combination of our future business strategies and our current landscape, along with where technologies are moving to, we came out with insights on how we could build out a digital road map for technologies of the future.' (P3, Director, Female)

This study used the TOE framework to explain an organisation's decision to adopt a technological innovation based on the technological, organisational and environmental contexts (Sam & Chatwin 2018). This framework has been extensively used in technology adoption studies and provides a useful approach to understanding the factors influencing technology adoption in organisations.

Challenges of Big Data adoption

The participants in this study agree with Rajaraman (2016) and Tomar et al. (2016) that an important challenge for BD

adoption is related to a skill (talent) shortage. They suggest that BD analytical skills should be more widespread across the organisation and that data analytical teams must sometimes be established within departments. Participant 2 substantiated this with the following comment, 'I think sometimes we focus on the technology, but the people and process aspect of implementation is quite critical and that should be really factored in from the beginning' (P2, Professional Officer, Male).

Another important challenge mentioned by participants is removing the 'silo mentality' (a mindset present when certain departments or sectors do not wish to share information with others in the same company) from employees within the organisation to ensure that data are sufficiently integrated within systems and departments. It is also claimed that silos result in different perspectives or views when the same data are analysed.

Government organisation infrastructure was historically built as department-specific silos, which resulted in fragmented structures, costly duplication, unnecessary complexity, an inability to share and collaborate, and an increased vulnerability to security threats (Chatfield, Reddick & Al-Zubaidi 2015). Participant 2 suggested that the organisation should look at changing how infrastructure is used and provided the following comment, 'I would say it is more related to change … Changing the way and behaviour around how we do things' (P2, Professional Officer, Male).

Perceived benefits of adopting Big Data in the organisation

Participants envisioned BD providing better service delivery to citizens. Although they know data have no value if not properly analysed, it has an extraordinary value-adding potential to promote the extraction of meaningful, actionable information (Iftikhar et al. 2020).

The main remarks from the participants were centred around the following: (1) opportunities to discover new ways to answer age-old questions around societal issues regarding poverty and social economics; (2) informed decisions based on the information and initiating programmes or projects based on the information provided through BD; (3) considering service delivery from a spatial point of view, while building a framework around it; (4) better planning and rollout of services based on the needs of the citizens; (5) planning for the future, to improve existing programmes; (6) providing timely services, where citizens do not have to wait to be serviced (real-time servicing); (7) having the correct information on hand to make effective decisions for service delivery and to improve the performance of the organisation's staff and (8) basing decisions on data, specifically around housing projects and the services accompanying such developments. Participant 8 claims that BD will promote service delivery and provides the following comment:

> 'First of all, our organisation is there for service delivery, so I think it improves service delivery. Not only for our external customers, but also within the Organisation XYZ within different departments.' (P8, Information Coordinator, Male)

Factors of Big Data adoption in government

In the technological context of the TOE framework, the study found integration, data security and privacy, data reliability and suitability, and IT infrastructure as factors that affect the adoption of BD. The organisational context of the TOE provided the most factors in the study, including the organisation's structure, scope, size and managerial capabilities. These factors directly influence the adoption of BD and play a crucial role in capacity building by structuring and orchestrating resources within the organisation for the adoption of BD (Schüll & Maslan 2018). Factors such as competition, customers, vendors and social challenges were identified in the environmental context.

Technological context
Integration

The response from Participant 8 indicates that many of the organisations' systems are integrated. Therefore, reliable system integration should always be considered when adopting new technologies. 'Obviously I think one factor that you … that we always should keep in mind is … the systems integration within the Organisation XYZ' (P8, Information Coordinator, Male). Furthermore, a significant impediment to the adoption of BD relates to data not being pooled (integrated) for the entire organisation (Sivarajah et al. 2017). Integration should be considered from the start of BD adoption projects to ensure that current systems and daily operations are compatible with BD.

Data security and privacy

Participant 9 mentions that the organisation has been averse to adopting specific technologies because of security concerns:

> 'Our organisation is behind the curve when it comes to technology such as cloud adoption and the like … the Organisation XYZ has been cloud averse up until now, purely because of a security, let's say the assumptions and the perceptions around security in the cloud.' (P9, Director, Male)

Also, the total volume of data collected and created in a typical BD environment raises security issues (Salleh & Janczewski 2016). Consequently, new security tools and mechanisms are required to effectively protect BD environments (Salleh & Janczewski 2016). Therefore, government organisations need to put policies in place so as to enhance trust when processing citizen data, which should result in greater synchronisation between the government and the citizens.

Data reliability and suitability

Big Data involves collecting and integrating data from various sources (Walker & Brown 2019). Decision-making is affected by the data quality; hence, the more relevant, timely,

reliable and accurate the data, the more it positively affects decision-making (Walker & Brown 2019). Participant 1 mentions that there are some concerns regarding data quality and that getting the data into a reliable, suitable state will require organisational change (P1). The participants mention departments want data to make the next decision and are not concerned about data quality (P1). Participant 6 reiterates the importance of reliable, suitable data with the following statement, 'For a governmental organisation or a local government organisation, I don't know how we would get started without having a high degree of confidence that the data was robust' (P6, Professional Officer, Male).

The reliability and suitability of data reveal two issues that influence the adoption process (P2). For one, the data are inaccurate, and two, the data are not what you are seeking and therefore unrelated to the problem you are investigating (P2). Reliable, accurate data are essential because you would not get value from the data and build a good reputation or trust based on your data (P5, P6, P8, P9 and P10).

Big Data acquisition scenarios assume data are of high volume, high velocity, high variety, high value and high veracity. However, sometimes low-value data are also gathered, making it important to have an adaptable and time-efficient gathering, filtering and cleaning algorithms that ensure all data fragments are processed.

Information technology infrastructure

Information technology infrastructure significantly influences the adoption process and bears a significant cost sometimes (Defitri et al. 2020). This factor is important because it can provide long-term economic effects, especially because infrastructure is required for capturing, storing, organising and analysing BD (Defitri et al. 2020).

Without the availability of infrastructure, the adoption of BD will be considered an unrealistic programme (Defitri et al. 2020). This sentiment is shared by participants 5, 6, 7, 8 and 10:

> 'It's very important that you need to have all your hardware, software and infrastructure in place. Otherwise, you would not be able to disseminate the data or to serve the data towards your customers …' (P8, Information Coordinator, Male)

> 'I mean if our infrastructure is not adequate to accommodate such. Again, it does not make sense to adopt that.' (P10, Manager, Male)

Infrastructure is one of the most critical issues for adopting BD in government (Zulkarnain, Nizar Hidayanto & Prabowo 2019). They offer that government organisations need to integrate IT infrastructure resources, especially datasets, to enable BD (Zulkarnain et al. 2019). Participant 2 agrees with this statement and mentions:

> 'I think you need IT infrastructure that allows for integration, that allows for access to data. So, a scalable and agile infrastructure, flexible dynamic infrastructure is important as the business needs to grow.' (P2, Professional Officer, Male)

Therefore, BD infrastructure needs to support the entire BD lifecycle. Government organisations need to overcome challenges like investing in technologies such as cloud computing and data warehouses, large-scale heterogeneous dataset acquisition, efficient data storage, real-time data processing and data analysis, curation, retrieval, visualisation and interoperability.

Organisational context
Skill and talent

Participant 2 stated:

> 'I think there is always the people perspective when it comes to technology implementations. It's always important to ensure that you're resourcing and change management is catered for specifically with the technology implementations. I think sometimes we focus on the technology, but the people and process aspect of implementation is quite critical and that should be really factored in from the beginning.' (P2, Professional Officer, Male)

Participant 11 claims that having talented employees to address critical business issues is vital.

Technical IT skills are vital in analysing, designing and implementing changed business processes (Chauhan, Agarwal & Kar 2016). Technological competence stretches further than physical assets, as skilled individuals generate competitive advantages for innovators, as skills and know-how complement physical assets and are more difficult to imitate by competitors (Awa, Ukoha & Emecheta 2016). Proficient individuals understand the technology's usefulness and use their experience to turn the complexities of technology into mental effortlessness (Awa et al. 2016). Government organisations should therefore acquire and retain skilled individuals with the knowledge to implement, use and maintain BD. Technical experts need to be teamed up with data-savvy business experts with strong domain knowledge to effectively apply their data knowledge within the organisation.

Financial support (budget)

Sun et al. (2018) assert that the investment's initial and overall budget is affected by an organisation's intention to adopt BD and the cost of adopting BD. Participant 10 confirms this: 'Do we have the, you know the budget for that? And if we do, what will be the cost linked to the maintenance of that technology' (P10, Manager, Male). Therefore, adopting BD might be a severe challenge for many organisations with budgetary constraints.

Participants 1, 2, 3, 8 and 11 suggest that financial support is not a concern for BD adoption because if you have support from top management, the budget will be made available if it makes business sense to adopt BD depending on the organisational priorities (P1, P2, P3, P8 and P11). Organisations should ensure that BD projects are properly scoped and adequate budget is allocated for BD projects. When the budget is created, all the costs should be considered.

These costs include the organisation's ability to sustain BD, future scalability, hardware, and software, and the cost of hiring new employees and training the existing staff.

Organisational strategy

The availability of quality, accessibility data and well-defined rules for collecting, storing and analysing data is critical for creating a supportive organisational strategy for BD adoption (Kumar & Krishnamoorthy 2020). Organisational strategies entail setting clear objectives that organisations need to address through their resources.

Participant 3 mentions that strategic business needs must be considered. 'What are the future technologies in terms of offerings that exist out there and bringing together the strategies and those business needs' (P3, Director, Female). Participants 2, 4, 5, 8 and 10 mention that organisational strategy is important for BD adoption because it enables the technology (P2, P4, P5, P8 and P10). Kumar and Krishnamoorthy (2020) state that management's clear vision towards adopting BD is critical for aligning the BD adoption strategy with the business requirements. We recommend that BD be included in the strategy of government organisations, and it should be well defined and clearly outline how BD can promote the vision (strategy) of the organisation. The strategy should also be well communicated to ensure that all employees know their roles within the organisation.

Organisational process

Organisations are less likely to use technology if they find it problematic to comprehend and integrate it with their organisational processes (Kumar & Krishnamoorthy 2020). They refer to this as a 'complexity' factor. Participant 1 perceives the organisational process directed explicitly at BD as immature even though the organisation has other data processes (P1). However, they are addressing the lack of BD processes (P1). The participant mentions that data management happens in silos, not at an enterprise level, and that the organisation is dealing with security, privacy and infrastructure matters to put organisational processes in place that deal with BD (P1).

Organisational processes are described in terms of assimilation as the extent to which technology diffuses across organisational work processes and becomes routinised in the activities associated with those processes (Nam, Kang & Kim 2015). Participants 2, 4, 5, 8 and 10 agree and indicate that the organisational process should stem from organisational strategy to influence BD adoption (P2, P4, P5, P8 and P10). Therefore, organisational processes should incorporate the adoption and use of BD in day-to-day tasks. Government organisations should introduce strong access and governance controls into their organisational processes.

Organisational size

Organisational size affects the adoption of new technologies and has, therefore, gained significant consideration as a main factor in the success of adopting technological innovations (Malak 2017). In the responses from the participants, it was discovered that various participants consider the organisation 'big' because the organisation has around 30 000 employees.

One reason for the relationship between IT adoption and organisational size is that larger organisations have more resources (e.g. technical, financial and personnel) and can assign more resources to the adoption of new technologies and absorb more risk (Malak 2017). Participants 2, 7 and 10 support this argument by claiming that organisational size influences the resources available for BD adoption projects (P2, P7 and P10).

Participants 5, 6, 9 and 11 describe the organisation's size in terms of its complexity. They provide evidence to this in terms of the number of systems the organisation uses (P5, P6, P9 and P11). If the same critical business systems are used throughout the organisation, it reduces the organisation's complexity required to integrate BD with many systems. Further, these four participants mentioned that the organisational structure is complex because of the various levels of reporting within the organisation. Dooley (2002) provides a supporting narrative for both the first and second annotations by stating that the ability of organisational entities to connect depends on the number of entities and their diversity because it is easier to make connections between similar entities as opposed to larger dissimilar ones. Therefore, irrespective of the size of the organisation, data sharing and the reuse of data between departments should be encouraged. The reuse of data eliminates the time required to process data.

Top management

Top management support refers to top management's role in influencing the adoption decision in organisations (Al Mudawi, Beloff & White 2019). Hence, top management support refers to the role of top managers in supporting decision-making that goes into the adoption and implementation of information technology to develop the organisation with technological investments (Al Mudawi et al. 2019). Therefore, top management is crucial for any adoption project because they determine its approval (Çaldağ, Gökalp & Alkış 2019). When top management views technological investments as positive, it encourages employees to adopt the new technology to improve organisational effectiveness (Al Mudawi et al. 2019). Participant 9 mentions 'they [*top management*] do have the authority to push it down and actually understanding and influencing outcomes and adoptions' (P9, Director, Male).

Participant 1 believes that top management is critical to supporting and driving adoption, which goes hand in hand with financial support (P1). Participant 6 mentions that 'top management is absolutely critical in getting going. You need to have strong top management support because BD is a new way of doing things' (P6, Professional Officer, Male). In addition, participants 5 and 11 claim that if top management is not on board, the BD adoption project would be doomed from the start (P5 and P11). Support from top management

must be obtained for the BD adoption project. The commitment from top management promotes the data strategy of organisations and, in turn, reveals the benefits of using BD within the organisation.

Policy and legal

Participant 4 identified policies as a factor that needs to be considered for the adoption of new technologies. The following is a quotation from Participant 4:

'First, we need to comply with MFMA rules. In other words, your Municipal Finance Management Act, were you not allowed to where they allow you only a certain amount of time period and to use certain service providers.' (P4, Manager, Male)

Tomar et al. (2016) state that creating a data-driven society in the public sector requires a balance between protection against data misuse and data sharing regulation. Relevant open data policies and intergovernment data exchange policies are key objectives for exploring BD regulations (Tomar et al. 2016). We recommend that policies clearly define data ownership, usage, protection, privacy, security, liability, cybercrime, intellectual property rights and the implications of data misuse.

Service delivery

One aspect of the data obtained relates to being service-orientated and understanding the needs of citizens. Participant 5 explains that the organisation is customer-facing, and technology should not be adopted to stay abreast of technological advancements (P5). In contrast, Participant 10 explains that services for citizens should always be the highest priority irrespective of the technology the organisation adopts (P10). The organisation should rather try to understand how the technology will benefit society and the organisation. Participant 10 observes:

'Basically, to understand the needs of our customers … we need to understand who we serve and do our customers have access to that … Do they have even the ability to transact and talk to us … remotely or electronically.' (P5, Professional Officer, Male)

Service delivery is critical for government organisations. Government organisations need to explain and illustrate the benefits of adopting BD, which will increase civic participation and acceptance of the technology.

Supporting systems and procedures

The findings suggest participants indicated that supporting systems and procedures would influence the adoption of BD. Participants mention that supporting systems and procedures will be developed during the adoption of BD to ensure that the technology can be sufficiently supported.

Therefore, organisations must have sufficient procedures in place to support BD systems. Supporting systems and procedures need to be built around BD during the adoption process. Organisations should ensure that the employees who support the technology are well trained on these systems.

Environmental context
Competition

Empirical studies recognise that competition can pressure organisations to adopt an innovation (Ismail & Mokhtar 2013). Kumar and Krishnamoorthy (2020) describe competitive pressure as the influence that an organisation experiences in the environment that it is trading to use technology to maintain or increase competitiveness. They claim that organisations with higher competition for market share, revenue, market growth and product development are more steered towards adopting technologies for business analytics.

Participants 1, 2, 5 and 11 believe that the organisation has no competition: 'The organisation does not have competition because of the nature of the services it provides' (P2, Professional Officer, Male); 'I don't believe there is competition within the organisation, more collaboration and cooperation and working together with these departments' (P5, Professional Officer, Male) and 'There is no competition in the public sector. You are a captive client. The only thing that you can do as a citizen or business is [to] leave and go to [the] city' (P11, Technology Officer, Male)

To address this factor, government organisations should ensure that no competition exists within the organisation that would prevent the adoption of BD. There should also be intentional efforts to guard against the development or growth of silos within the organisation, as this could culminate in competition between departments.

Customers

Customer orientation pressure has been found to drive BD adoption in some adopter organisations (Kumar & Krishnamoorthy 2020). Agrawal (2015) suggests that customer orientation might significantly impact BD adoption, as BD can assist in shorter production cycles and radically improve customer services.

The data collected by the researcher indicate that all the participants believe that BD adoption will benefit their organisation's customers. The general sentiment from participants is that the organisation's main goal is to provide services to its customers and that through BD, these services will be improved. Participant 1 mentions that BD will enable the organisation to manage tariffs better, alleviate some of the citizens' social stresses and provide a means to better forecast based on population statistics (P1, Project Manager, Male).

Therefore, to address this factor, government organisations should ensure that the services and responses to service delivery queries are of the highest quality. Because BD also

influences the way services are delivered, government organisations should be transparent in how these services are created and delivered.

Vendors

There is an inherent security and privacy risk when BD initiatives are outsourced to vendors (Salleh, Janczewski & Beltran 2015). As BD is relatively new, most organisations still cannot build and maintain an in-house BD environment, which makes organisations resort to outsourcing practices for their BD environment or part of it (Salleh et al. 2015).

Some participants indicated that vendors either do not impact the adoption of BD within the organisation or they will negatively affect the adoption thereof. The most relevant support for this claim is provided by Participant 11, who claims that 'vendors do influence the public sector, but in a bad way. They are excellent at hyping up old technologies and trying to convince top management to buy from them' (P11, Technology Officer, Male).

Therefore, careful consideration should be given to any vendors who are involved in the adoption or maintenance of BD. Vendors should be well informed of the organisation's strategy and, if possible, be aligned with it.

Social challenges

Some participants claim that BD provides a means to ease social stresses through better forecasting based on population statistics. Transforming societal beliefs to be more data-centric is a major challenge which requires that citizens observe how data are used and discover and realise the benefits of transparency and public service delivery.

It is, therefore, critical to increasing the awareness of BD's benefits for businesses, public sector organisations and citizens. Government organisations need to transform societal beliefs to be more data-centric. These changes require that citizens observe how the data are used and realise and discover the benefits of transparency and public service delivery.

Conclusion

This study explored the benefits, challenges and factors associated with adopting BD at a government organisation in the Western Cape. Big Data is manifested internally and externally in the organisation. Internally, the benefits were identified as data integration, better decision-making, operational efficiency and improved productivity. This finding emphasises how BD can be used for data-driven decision-making in response to the organisation fulfilling its mandate to deliver services to citizens.

The findings also indicate that BD would provide a means for better root cause analysis, allowing the organisation to create more efficient operational response plans.

Data management and the accessibility of integrated data have also been identified as a benefit because it provides a holistic view to inform decisions. Other benefits are indicated as better, quicker decision-making, which reduces inefficiencies and improves productivity, service delivery and transparency. The ability of BD to increase service delivery is a common aspect in the results due to the nature of the organisation. It is believed that BD would positively affect public service delivery, improving the organisation's efficiency and effectiveness, ultimately resulting in savings and increased productivity.

None of the participants thought or said that BD would negatively affect the constituents of the Western Cape; instead, the participants believe(d) that BD will positively contribute to service delivery, decision-making, poverty alleviation, new project rollouts, planning and housing.

The TOE framework and participant responses discovered 17 factors influencing BD. Descriptive evidence was provided on how these factors influence the adoption of BD within the organisation and recommendations for addressing these factors.

Most of the factors were identified in the organisational context of the TOE framework. These factors are as follows: top management, organisational size, finance and budget, organisational processes, strategy, service delivery, supporting systems and procedures, policy and legal, and skill and talent. These factors relate to the organisation's structure, scope, size and managerial capabilities. It was discovered that these factors can drastically deter the adoption of BD and that if they are not adequately addressed, they could cause the failure of BD adoption.

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Data availability

The data that support the findings of this study are available from the corresponding author, A.N.B., upon reasonable request. The data are not publicly available due to it containing information that could compromise the privacy of research participants.

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