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Big data analytics capabilities and value creation at the work-practice level: A South African case study

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Abstract

While much effort has been expended on understanding the adoption and implementation of big data analytics in organisations, less effort, comparatively speaking, has been put into investigating the business value that can be derived from such investments. Recent research on the resources and capabilities required to leverage big data analytics value offers promise in this regard. The purpose of this research study is to describe big data analytics capabilities required to create business value that arises from the work practice level. This study was a single case qualitative semi-structured interview research study. The study found that the functions using big data analytics at the work-practice level included marketing, customer relationship management, and product development. Capabilities identified include strategic alignment, human expertise, technology, culture, investment and time, and governance. The work practices enacted included inductive, deductive and abductive approaches, as well as algorithmic and human-based intelligence. Product innovation, market penetration, customer satisfaction and revenue growth represented the business value accrued to the organisation.

1 Introduction

The application of big data (characterised by large volumes, high velocity and wide variety) and analytics to drive organisational decision-making has garnered much interest over the past two decades (Mikalef, Pappas, Krogstie, Giannakos and Michail, 2018). While there has been much research on big data analytics adoption, there has been less attention given to investigating how organisations might generate business value from big data analytics investments (Walker and Brown, 2019). Big data analytics capabilities of an organisation have been demonstrated as playing a key role in unlocking business value (Mikalef, Krogstie, Pappas and Pavlou, 2020). Such capability is described as an organisation's ability to provide innovative insights through big data analytics management, infrastructure, and expertise (Mikalef et al., 2018). However, organisations face various tensions when

attempting to realise business value from their big data analytics investments (Günther, Mehrizi, Huysman and Feldberg, 2017). These tensions manifest at the work-practice level, organisational level and supra-organisational level (Günther et al., 2017). The work-practice level refers to the day-to-day work with big data analytics, and arguably has the most direct bearing on business value creation since it focuses on the operational level (Gunther et al., 2017; Klee, Janson and Leimeister, 2021). The goal of this research is therefore to better understand big data analytics capabilities required to create business value that arises from the work-practice level. The primary question the study seeks to answer is as follows:

- What are the big data analytics capabilities required to create business value that arises from the work-practice level?

Secondary research questions the study seeks to answer are as follows:

- What are the functions that use big data analytics at the work-practice level?
- What are the big data analytics capabilities that create business value?
- What are characteristics of big data analytics at the work-practice level?
- What is the business value accrued from leveraging big data analytics at the work-practice level?

Following this section, the conceptual background of the study is presented. Next, the study's research methodology is described, and the research findings are presented. Thereafter the research findings are discussed, and conclusions are drawn.

2 Conceptual Background

The key concepts of big data analytics value, capabilities, and the work practice level are presented in this section, which leads to the development of the conceptual model.

2.0 Big Data Analytics Value

Big data analytics value refers to how big data analytics is utilised to improve an organisation's performance (Walls and Barnard, 2020). Dremel, Herterich, Wulf and vom Brock (2020) state that the overall value of big data analytics is heavily influenced by the socio-technical context and therefore is deeply embedded in an organisation's strategic goals. Big data analytics can be utilised too in daily organisational operational working practices (Klee et al., 2021). A key aspect of big data analytics is measuring business value and realizing and advancing benefits (Günther et al., 2017). Elia, Polimeno, Solazzo and Passiante (2020) infer hence that 'value' represents the primary goal of applying technological innovations to big data to explore complex insights that can be used constructively for strategic and operational reasons. Olszak and Zurada (2020) argue that organisations that use big data to inform core organisational strategy and daily operations are more likely to outperform those that don't.

Raguseo and Vitari (2018) and Akter and Wamba (2016) define business value in terms of the "transactional, strategic, transformational and informational value of the big data analytics solution." Grover, Chiang, Liang and Zhang (2018) on the other hand define big data analytics value by providing two classifications, namely functional value and symbolic value, whereas Günther et al. (2017) define value in terms of economic value and social value. Functional value is defined as direct performance enhancement as a result of big data analytics adoption (Grover, Chiang, Liang and Zhang, 2018), whereas symbolic value is generated primarily from the outcomes of big data analytics investment (Grover et al., 2018) . Economic value could be measured by an increment in revenue or market growth in an organisation (Günther et al., 2017) and typically consists of monetary gains seized by an

organisation that is leveraging big data analytics (Olszak and Zurada, 2020). In contrast, the social value could be measured by organisational success or customer surplus (Günther et al., 2017). Social value includes incentives for individuals, and more significant benefits to society, such as increased employment (Olszak and Zurada, 2020). In considering how value is generated from big data analytics, scholars have turned to the concept of big data analytics capabilities (Mikalef et al., 2018; Walls and Barnard, 2020).

2.1 Big Data Analytics Capabilities

Akter, Wamba, Gunasekaran, Bubey and Childe (2016) define big data analytics capabilities as an organisation's ability to provide insights that yield competitive advantage. These capabilities may relate to information management, infrastructural facilities, and expertise (Akter et al., 2016). Big data analytics capabilities focus on the procedures to be implemented to leverage big data (Mikalef et al., 2018). Synthesis of literature suggests six major categories of capabilities, namely (1) Strategic Alignment; (2) Governance; (3) Human Expertise; (4) Culture; (5) Investment and Time and (6) Technology.

2.1.1. Strategic Alignment

According to Gerow, Grover, Thatcher and Roth (2014) aligning business and IT strategies could boost sales and profits. When key resources are aligned with organisational strategy competitive advantage can be achieved (Coltman, Tallon, Sharma and Queiroz, 2015). It is critical that big data analytics initiatives assist in achieving the organisational strategy (Watson, 2014). When big data analytics projects and big data analytics resources are in alignment with organisational strategy, the yield is actionable insights that allow key activities to be completed in a timely manner to fulfil the organisation’s objectives (Sheng, Amankwah-Amoah and Wang, 2017). Pedro, Brown and Hart (2019) hence note strategic alignment as a key capability, as do Walls and Barnard (2020).

2.1.2. Human Expertise

Numerous studies have found that a lack of necessary skills is a major obstacle to realizing the full potential of big data analytics technologies (Gupta and George, 2016; Mikalef et al., 2018). Human resource skill level influences data understanding and awareness as to how to apply insights (Su, Zeng, Zheng, Lin and Xu, 2021). Leveraging big data analytics necessitates a variety of employees with both technical and management skills (Su, Zeng, Zheng, Lin and Xu, 2021; Mcafee and Brynjolfsson, 2012; Davenport and Dyché, 2013). Organisations in essence require human resources with managerial skills, technical skills, business knowledge, relational knowledge, and business analytics knowledge and skills (Jeble, Dubey, Childe, Papadopoulos, Roubaud and Prakash, 2018; Mikalef et al., 2018; Walls and Barnard, 2020).

Management skills are often hard to find and are highly organisation-specific (Gupta and George, 2016). Management skills are vital for analytics initiatives because managers are responsible for leading and building analytics teams (Jeble et al., 2018; Su et al., 2021). The success of analytics initiatives is determined by how well managers can build a team with the necessary skills and align members towards shared goals (Jeble et al., 2018). Four required management capabilities are noted as planning, investment, coordination, and control (Wamba, Gunasekaran, Akter, Ren, Bubey and Childe, 2017). In addition, strong, committed executive leadership and support is important (Pedro et al., 2019).

Technical skills refer to the knowledge and abilities needed to use the new advanced technology to acquire necessary insights from big data (Gupta and George, 2016; Mikalef, Framnes, Danielsen, Krogstie, and Olsen, 2017). These skills include knowledge and ability in machine learning, data extraction, cleansing, analysis, and knowledge in software programming (Gupta and George, 2016;

Mikalef et al., 2017). Technical skills can be acquired in an organisation through recruitment and skills development training (Jeble et al., 2018). Training for big data analytics personnel, development of organisation wide data-driven decision making and information sharing culture are hence recommended (Wang, Kung and Byrd., 2018, Walls and Barnard, 2020).

2.1.3. Technology

One of the core resources in the context of big data analytics is data (Mikalef et al, 2020). Previously, organisations focused solely on internal structured data when making business decisions (Gupta and George, 2016). However, organisations currently strive to capture almost any bit of structured or unstructured data, regardless of the volume, format, or speed at which the data is created (Gupta and George, 2016). For organisations to leverage the data captured, quality is highly critical (Mikalef et al., 2018). Data resources with these qualities have been required for the organisation to create business value (Ghasemaghaei et al., 2018).

Big data necessitates the development of technological advances capable of handling large volumes of diverse and rapidly changing data (Gupta and George, 2016). Organisations need to have the infrastructure to be able to store, share and analyse the data it collects from various sources (Mikalef et al., 2020). Often data collected from various sources comes in an unstructured format which requires sophisticated technology to yield valuable and useful insights (Mikalef et al., 2020) .

There are numerous software tools available that can facilitate requirements from a wide range of data sources (Gupta and George, 2016). Many executives have noted that infrastructure is not a major issue for most businesses because technology has advanced beyond the needs of analytics (Gupta and George, 2016). New software and information technology have emerged that enable distributed storage on traditional relational databases such as Hadoop and NoSQL (Gupta and George, 2016). Technologies used for big data analytics adhere to the same principles as business intelligence (Gupta and George, 2016). Value can be generated from big data analytics and visualisation tools when unstructured data is transformed into insights used by managers and analysts to make informed decisions (Gupta and George, 2016).

2.1.4. Culture

A data-driven culture is critical in influencing the overall success and sustainability of big data initiatives in organisations (Mikalef et al., 2018; Pedro et al., 2019; Walls and Barnard, 2020). The notion of a data-driven culture is derived from organisational culture (Gupta and George, 2016). With such a culture, workers in the organisation see value and benefit in data-driven decisions (Mikalef et al., 2018). The importance of data-driven decision-making is fostered throughout the organisation, as well as in specific procedures (Mikalef, Framnes, Danielsen, Krogstie, and Olsen, 2017). This can help organisations succeed in leveraging big data analytics and generating business value.

The intensity of organisational learning entails employees continuing to leverage existing knowledge whilst also consistently exploring new knowledge in order to detect or predict uncertain market changes (Su et al., 2021). Even though many organisations are pursuing big data initiatives, a significant proportion of these organisations continue to rely on management expertise, which is frequently guided by gut feelings and intuition rather than insights derived from data analytics (Su et al., 2021). Organisations that successfully adopt big data analytics capabilities are proficient at communicating the benefits of data-driven insights to various internal departments (Mikalef et al., 2018). This alleviates the burden on a single department to find new innovative solutions (Mikalef et al., 2018). Furthermore, these can motivate employees to collaborate in different departments to generate insights from big data analytics (Mikalef et al., 2018). Using big data analytics technology aids in the storage and sharing of knowledge, enabling the advancement of organisational knowledge

through encouraging efficiency within an organisation, notably through data integration and the application of analytical tools (Côrte-Real et al., 2020).

2.1.5. Investment and Time

According to Gupta and George (2016), organisations must invest adequately in their big data projects. Organisations must be consistent and allocate sufficient time to their big data analytics projects in order to attain their analytical goals (Gupta and George, 2016). Mikalef et al. (2020), and Walls and Barnard (2020) too note these as under the banner of basic resources.

2.1.6. Governance

According to Grover et al. (2018), data governance refers to the overall management of data accessibility, user-friendliness, integrity and security. Wang et al. (2018) define data governance as an extension of IT governance that is centred on generating business value by harnessing organisation-wide digital assets. Üyesi and Abubakar (2019) define big data governance as an organisation's ability to gain, store, process, assess, and perceive big data-rich diversity and integrate it with real-time data to anticipate upcoming events such as supply and demand, volatility and price adjustments, within legal boundaries. Wang et al. (2018) recommend the implementation of governance in big data initiatives, to leverage cloud technology and innovation to garner big data insights. Another aspect of data governance is ensuring legal compliance for data protection in accordance with data privacy policy, legal prescripts, third party agreements and user access policy (Pedro et al., 2019). Walls and Barnard (2020) as well as Mikalef et al. (2020) include governance in discussions of big data analytics capabilities.

2.2 Work-Practice Level

Debates on realising value from big data analytics arise at the work-practice level, organisational level and supra-organisational level (Günther et al., 2017). The work-practice level is where the operational practice of big data analytics occurs and is therefore especially pertinent in understanding how big data analytics capabilities translate into business value (Klee et al., 2021). Günther et al., (2017) outline two debates at the work-practice level – (1) the debate concerning inductive versus deductive approaches to big data analytics and (2) the debate concerning algorithmic versus human-based intelligence approaches in big data analytics. In addition to inductive versus deductive, we assert there is potential also for an abductive approach in big data analytics, which fits with attempts at utilising both inductive and deductive approaches (Günther et al., 2017). The goal in all cases is to use big data analytics to acquire new insights which have the potential to create business value (Klee et al., 2021).

2.3 Conceptual Framework

The big data analytics capabilities previously discussed are posited as being necessary for organisations to generate business value that arises from the work-practice level. Big data analytics is employed within and between various functions within organisations, e.g. Marketing and Sales; Product Development; and Business Process Management (Walls and Barnard, 2020; Dhlamini, Brown and Oosterwyk, 2021) and so the big data analytics work practices may be prevalent to varying degrees across functions. Figure 1 depicts the conceptual model. Whilst Klee et al., (2021) generated a similar model to understand how big data analytics competencies create business value by improving practices at the operational work level, we are interested in big data analytics capabilities required to create business value that arises from the work-practice level for various functions.

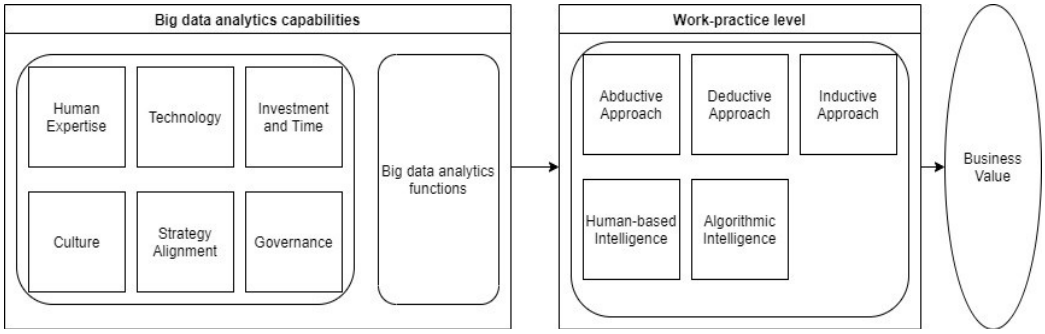

Figure 1: Conceptual Model (adapted from Klee et al, 2021)

3 Research Methodology

The study philosophy was interpretivist (Saunders et al., 2016) in order to understand and make sense of how organisations leveraging big data analytics capabilities at the work-practice level create business value. The study adopted an approach that combined both deductive and inductive elements in theory development (Saunders et al., 2016 pp.148). While there was an initial conceptual framework to guide data collection, any additional insight to emerge from empirical data was also noted and included in the findings.

A single case study research strategy was employed. Such an approach seeks to understand a "contemporary concept in a real-life setting" (Dubé and Paré, 2003; p. 600). Data may be gathered from a variety of sources and using a variety of data collection techniques such as observations, surveys, interviews, and documentation (Saunders et al., 2016). The chosen single case for this study is a media organisation in South Africa with big data analytics being employed at the work practice level. The organisation has a presence in several African countries. The case was chosen for its ability to investigate the research problem in a workplace context with professionals who conduct big data analytics tasks daily. The primary source of data was qualitative interviews with the professionals.

3.0 Sample

The research target population was professionals in an organisation that had adopted big data analytics work. The professionals included specialist data engineers/analysts, managers, and machine learning specialists working with big data or in big data analytics initiatives. A snowball sampling strategy was used to determine interview participants. Snowball sampling is a sampling method in which participants are selected from recommendations given by the first participants (Saunders et al., 2016). This ensured that individuals with relevant access and expertise in big data analytics initiatives were selected. Due to time constraints and the nature of the study being cross-sectional only nine professionals (see Table 1) with different positions in the field of BDA were interviewed for this study. To check for saturation, emerging themes were documented in the interview session sequence. The number of new themes generated decreased as the interview process progressed. By the 9th interview session, no new theme was generated, there for saturation was reached. Due to POPIA compliance, participants did not share any details of potential interviews.

Participants	Alias	Position	Years of work experience
Participant 1	PT001	Specialist Customer Quality	13
Participant 2	PT002	Senior Data Engineer	13
Participant 3	PT003	Senior Data Engineer	11
Participant 4	PT004	Machine Learning Specialist	4
Participant 5	PT005	Customer Quality Manager	8
Participant 6	PT006	Senior Manager Analytics & Insights	11
Participant 7	PT007	Manager Machine Learning	4
Participant 8	PT008	BA AI & Robotics Specialist	7
Participant 9	PT009	Machine Learning Specialist	5

Table 1: Participant demographics

3.1 Data Collection Procedure

Data was collected through semi-structured interviews, which were held virtually using Microsoft Teams. This is due to the Covid-19 pandemic and the associated restrictions. Therefore, the choice of an online interview protocol for this study was to not compromise the health and well-being of participants. The interview guide was drafted in such a way as to ensure open dialogue around essential themes that were identified in the literature (Saunders et al., 2016). The interview process was flexible for participants to be able to discuss additional relevant topics. Also, interviewees were encouraged to respond based on their present and previous experience. In the final stage of the interview session each participant was given the opportunity to contribute anything they believed was essential that had not been discussed or to ask additional questions. The interviews lasted between 25 – 55 minutes.

3.2 Data Analysis Procedure

The audio recordings from the interviews were transcribed. The study adopted a thematic analysis approach to analyse data from the semi-structured interviews. Thematic analysis is a method for identifying patterns or themes in qualitative data using six key phases: (1) familiarisation with the data, (2) generation of initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming of themes, and (6) reporting (Braun and Clarke, 2006). A conceptual model was developed based on the themes of the thematic analysis findings (Walls and Barnard, 2020). Data analysis involved using the Nvivo tool to assist in the facilitation of the analysis process. Nvivo is a computer aid program that helps organize and code data during the qualitative analysis process (Pedro et al., 2019).

3.3 Ethics in Research

Ethics in research clearance was obtained before participants we contacted. A letter was sent to the organisation management for approval before commencing with the interviews. Before conducting any interview sessions, all participants were briefed about the research. Participation in the study was entirely voluntary, and participants were asked for their consent before commencing. To protect the identity of the participants and the organisation, the transcripts were anonymised.

4 Findings

4.0 Functions using Big Data Analytics

Most of the participants explained that big data analytics was used for marketing opportunities such as customer trend analysis, customer insights, targeting customers, and direct customer marketing. PT001 explained that the function of big data analytics at the work-practice level is to "create insight for the customers… and monitoring as well.". According to PT002 big data analytics at the work-practice level can be used "…to derive and get insights concerning new markets, where you can seek to increase your market penetration". T004 was of the view that big data analytics at the work-practice level is used "…to better understanding their customers so that they can target the customer more into the product that they need…". Most participants explained that big data analytics was used to capture customer experience while using their products/services such as capturing customer trends and sentiments on various platforms like social media. PT002 explained "…we need to address key challenges…customers leaving our business for others or for some reason. So, you want to track their behaviour like where are they going? Are they going to a competitor? So, you want to leverage all those other platforms where they talk on social media… to capture their comments, their sentiments to see how you can shape your products to suit their needs..." PT009 explained that big data analytics' "…primary use is finding solutions that will help enhance customer experience…we are mining information inside the data that could help us improve our customer experience…"

It was noted that big data analytics is used for product innovation at the work-practice level. PT004 stated that the function of big data analytics at the work-practice level is "…for research and development to be able to develop the product…that best suit their customer…"

Most of the participants explained that big data analytics is used in the work-practice for fraud detection and prevention. A new project was initiated for the spotting of fraud within the organisation and big data analytics was used to analyse possible fraud activities. PT008 explained "…if you look at the project, such as fraud detection, we use the big data to analyse, which customers are most likely going to commit fraud, which agents are most likely going to commit fraud, and if they do commit fraud, what type of frauds are being committed…" PT002 stated "…fraudulent activities can be spotted on quickly and addressed…we are now able to detect such patterns and predict if someone is likely to act in a funny way…".

4.1 Big Data Analytics Capabilities

4.1.1. Strategic Alignment

Participants highlighted that managers clearly define business strategy to the big data teams which is in alignment with their analytics goals. PT005 said "So normally is this from the top down, and a certain KPI requirements set aside by the executives that focus down to our HODs and then comes to our SM back to the managers. PT004 "They do their analysis; they have strategies and then they use the big data analysis to support their strategy".

4.1.2. Human Expertise

Almost all participants made mention of technical skills such as the ability to manipulate or analyse data, business knowledge, technology knowledge, programming skills and database skills as essential for working with big data. PT002 said "You need to be analytical, you need to be team worker, you need to have problem solving skills, you also need to understand business…you need to master almost all the domain so when you're talking to insurance people, you need to have the insurance type of knowledge…" PT003 stated that "The basic tool that I think you need to have is SQL, you should be

able to write SQL source, so SQL skills, database skills, you need some coding skills, like coding in Python, for coding skills, SQL, yes, those are the basic tools if you understand the database structures, like tables, views, all those stored props, if you can write code in SQL or Python if you can move data from one source to another…". PT002 stated "…consolidate data from various systems, be it cloud systems, on premise systems, joined the data sets together in order to explore the information further to build, data insights..."

Almost all participants said that management in the organisation shows support for big data analytics initiatives. Management initiates BDA projects and assigns resources to the projects. PT006 stated, "They show support by actually requesting such initiatives themselves. They initiate such projects, while they support it by throwing resources to it, and resources, meaning time and money. And that's the biggest support of these initiatives that business has shown". Most participants further stated that management adopts the insights they generate when working with data to support decision making in the organisation. PT002 said "…they implement the recommendations that are provided throughout data sets". However, managers tend to pressure those working with data for solutions without full knowledge of how challenging it is to produce insights. PT004 stated that "…in most cases managers, are more interested in terms of the saving optimization without understanding like how challenging it can be for an analyst to come up with this solution using big data." In contrast PT005 stated that management show support by "also understanding limitations in terms of what data can provide you…".

Most of the participants highlighted the necessity of training in big data skills and technologies as one of the aspects necessary when working in with big data. PT003 highlighted the shortage of skills in big data "I think they need key big data professionals, they also need to train professionals, actually there is big shortage of skills in big data, they also need to invest in upskilling the young graduates in universities that are starting employment such that we have more skilled people." PT007 mentioned that organisations need to hire people with BDA skills to work with data - "there needs to be obviously, a certain emphasis on recruiting people that are very skilled within the field". Other participants highlighted that there are platforms where professionals can learn big data skills. PT005 stated "educational platforms where individuals can help themselves grow, learn more advanced skill sets within that environment."

Participants highlighted that apart from technical skills, ability to communicate insights to stakeholders is needed from the big data analytics teams. PT002 stated "you need to communicate well - when you do your technical side…you then need to communicate what you have built to business and others who don't really understand the things behind artificial intelligence, machine learning…the thing is communicating it, so it makes sense to the recipients...". PT005 shared the same sentiments "Essentially, you need to have good reasoning skills. Because analytics is not necessarily just a technical aspect, you need to understand the underlying subject matter".

4.1.3. Technology

Technology is regarded as one of the key resources required for big data analytics work. Almost all the participants mentioned that they are using market-standard technologies for big data analytics work. PT005 stated "…from a Microsoft Azure perspective, it is in line with current market trends…". Technology that is used for big data analytics work is both cloud and on-premises systems. PT002 stated that "…we have on premise systems, we also use cloud-based systems…". Some of the participants have started being involved in new projects where they are being exposed to latest technologies for big data analytics work. PT003 said "…currently in the current solution, we are actually moving to the Azure, to the Azure tools, we're making use of the Microsoft Azure center…in some areas they are also using AWS and the Amazon Web Services tool…".

Most of the participants highlighted that the data that the organisation receives is large enough to be considered as big data. Most participants explained that they do capture unstructured and semi-structured data, but most of the data is structured data. PT001 stated "…unstructured and structured.

So, the reason why we're pulling it into our data warehouse is for us to structure it. For instance, your Twitter, we pull data, raw data, unstructured one, and then we try and normalize it onto data warehouse…". PT003 said "It is mainly structured, we also get semi-structured and unstructured, but mainly it's structured. So increasingly, we're getting semi-structured and unstructured in the transition to big data…". PT008 stated "So in context of my organisation, for example, if you look at the customer behaviour as an example, in terms of who joins when and how, and at what time of the period of the year that they normally join. So that I would literally define as a big data…". Participants view varied when it came to data that the organisation is utilising for big data analytics work. PT003 explained big data is currently at an infancy phase in the organisation "well, it is there but it is still at its infancy. It is there but we are still in the migration process, it is actually still in its infancy from the way I see it…". PT007 highlighted that as much as they do receive large volumes of data, it not enough to be considered as big data "I'm not so sure that in our organisation, we really use data, which might be considered as big data. To me, the kind of data we operate with, with large volumes, but not like, massive volumes…"

4.1.4. Culture

Almost all the participants highlighted that the organisation is making decisions backed by data. Participants explained that there are policies in place to ensure that all decisions made are supported by data. PT002 "I think a majority of their decision at the moment are backed by the data – there is a policy actually in place, where managers' report certain statistical values, they have to come from our department, it is the duty of our department to ensure that we consolidate all the numbers into a single point of reference…you don't have to create a different number from what our team has, so there is a policy in place…". PT008 echoed this sentiment by stating "I think that it's pretty common across the business for the executives to be relying on the insights that come out of analytics teams in order to make data driven decisions. I think that's quite a standard way of work in our business…". PT006 stated that "one of the execs is very data-driven and the culture in the businesses just become very insights-led right. So, decisions are not made without any supporting data or information…". It is noted that new big data technology is introduced in the market at a fast pace. Organisations need to make constant efforts at upskilling its employees to ensure that they can make use of the new technologies that are introduced in the market. PT002 stated that "…they provide resources for training… they always make sure they provide that environment to learn the tools…". PT003 said "we as employees and teams were still coming up to speed with the tools… currently like in the project we are actually in the process of being on boarded and adopting the new technology…". PT006 stated that "…we keep learning as an Organisation. So, we have a learning organisation from that data, the value that we take is the lessons, whether good or bad, but we take our information and that data, and we learn as an organisation, and we improve as a result of that learning…".

4.1.5. Investment and Time

Almost all participants highlighted that the organisation is making an investment in big data initiatives. As technology evolves and new tools are introduced in the organisation, big data teams are given an opportunity to upskill in the new technologies. PT002 stated that "…this is seen by the investment that the company is putting into this BI project…" PT003 highlighted "…right now, they're actually investing in upskilling us so that we can make full use and exploit big data." PT005 said "…budgets allocated for the different tech stacks that are needed…" PT006 stated "they support it by throwing resources to it, right, and resources, meaning time and money…"

4.1.6. Governance

Participants explained that compliance is important when working with data. Big data analytics teams have a close relationship with the compliance team to ensure that insights are in line with company policies before they are shared.PT002 stated that "…we adhere to all the governance processes that are required to ensure that we don't end up in trouble with acts like POPIA…". PT004 said "we consult with the compliance first before we can deploy any solution that will affect the customers…".

4.2 Big Data Analytics at the Work-Practice Level

4.2.1. Approach to Data

Almost all participants highlighted that when working with big data analytics at the work-practice level, there is always a business requirement or business case. PT009 stated that "…we always have a business case, there is many cool stuffs that I feel like we'll try it out. But at times if it's not aligned with the business, remember, time is money. So, can't try all things out. It has to be aligned with the business requirements…".

Participants in the machine learning team highlighted that they have the flexibility to use the data for exploration purposes. PT007 mentioned that "…So like in our team, we do have, like, kind of an R&D mandate as well. So, for us, there is a lot of flexibility in going to find new use cases, it's part of the requirements for what you do…". Participant PT006 explained that they used to collect data having a business problem but recently there has been a new trend of collecting data and letting the insights guide them "…we have started seeing trends change, we just collecting data, so that we can mine it… then in the mining of the data, that's when we come up with some insights. So, initially, it was just having a business question…but currently, now we have seen the tight, turn, we just collecting data, and we mine the data to produce insights…".

Some of the participants highlighted that often when they carry out big data analytics work, there is mostly a goal or business case, however there is also flexibility to go beyond the business case and look for other insights. PT004 explained that "…We use unused data to discover the pattern, so we let sometimes the business rules to guide us and from there we test some new data that can be useful in terms of like building your models…". PT007 echoed same sentiments and also stated that "…there will be other departments that are trying to achieve very specific outcomes and KPIs, and then all of the sort of analytics activities that happen to support that would have that goal in mind. And there will be some flexibility within the team as to how to go about best achieving that, but the goal is a set one…". Some tasks at the work-practice level are started with a goal in mind, then they let data to guide them to new insights.

4.2.2. Form of Intelligence

Participants explained the importance of the human aspect in big data analytics work. PT002 explained that the work of experts when working with big data analytics is to "…ensure that we prepare data, that the algorithms can use, and check and validate if that information that the algorithm is producing is still reliable, is still correct, as per our experience…" PT004 shared the same sentiments that experts verify the outputs provided by algorithms - "…the expert, also does play important role to validate if those findings makes sense or not..".

Participants highlighted that algorithms used in big data analytics work help analyse large volumes of data in high speed. PT003 stated "…The algorithms actually assist in data quality, making the data so that it is of data quality, imaging data from several sources…those are some of the functions that the algorithms do and they actually help you to analyse, index, extract insights from the data…" PT007 said "…algorithms can process very, very large amounts of information, but, they just produce a

predictable output… they run a sort of predictable set of steps on some large amount of data to produce something that a human could then you know, find an intuitive meaning behind…".

4.3 Business Value

4.3.1. Measuring Value

Almost all participants highlighted that big data analytics value is measured through the KPIs shared in each department or rather teams that work with big data. PT003 "…we make use of key performance indicators…" PT009 was of the opinion that "The value is measured by whatever impact it has, on the problem they're trying to solve…". KPIs are commonly used as a measure of performance in most organisations, which can also be used to monitor and incentivise big data teams. PT002 shared similar sentiments as other participants but further mentioned that "…it is made part of our of the reward systems within our HR department". Participants highlighted that working with data has enabled fraud to be detected earlier through the automation of processes. PT005 stated "It saves time for some manual process that the fraud team are doing…automating the process or some of the processes using big data analytics." PT008 said "…his is the chatbot that was deployed…to assist our customers with resolving queries, that they do not necessarily need to interact with a human person….".

4.3.2. Product Innovation

Most of the participants mentioned that big data analytics has enabled the organisation to launch new products and decommission products. PT005 stated "So, that is either launching new products, using the data that's available to see the propensity of the market…and then based on obvious thresholds, we then make a call to say…these are changes that we making, or these are products that we take into market.". PT007 said "Like, it's either introducing the right products, you know, making decommissioning products that are not selling well."

4.3.3. Market Penetration

Participants highlighted that big data analytics value is to know when to enter new markets.

PT002 stated "specializes in deriving value from data to ensure that data becomes an asset within the company, to create value, capture new markets, increase your customer base…" derive and get insights concerning new markets, where you can seek to increase your market penetration."

4.3.4. Customer Satisfaction

Participants highlighted that value accrued from big data was to target their customers into the products that they required and the ability to improve product offerings based on the customer feedback or experiences shared. PT005 said "to better understanding their customers so that they can target the customer more into the product that they need so…". PT006 stated "So, it benefited the organisation by improving the customer experience for the customer and ensuring that they reach the right designation. So, essentially the value outcome is improved customer experience."

4.3.5. Revenue

Participants mentioned that working with big data has enabled the organisation to save costs and make profit. PT002 mentioned "…save on costs, there is a lot to it. When you know when to bring in more resources, there is cost saving involved, there is also efficiency involved. I mean, you can now channel your money or capital towards other projects where it's needed most.". PT006 stated that "It is

obviously the bottom line; the bottom line is what informs the value at the end of the day. And by bottom line, I mean the profits".

5 Discussion and Conclusion

Organisations spend significantly on big data analytics technical advancements and participate in data driven decision making. As such there is need to understand how they leverage big data analytics capabilities in different functions in order to create business value from insights at the work-practice level. The study illustrated various domains within the case organisation where big data analytics was employed, including customer service, customer relationship management, product innovation and fraud detection. These findings confirm that big data analytics is used for an increasingly diverse range of functions in organisations (Dhlamini et al., 2021; Walls and Barnard, 2020).

Big data analytics capabilities identified in the case organisation included strategic alignment, human expertise, technology, a data-driven decision-making culture, investment-and-time, and governance. These capabilities mirror those identified in literature (e.g. Mikalef et al., 2018, 2020; Walls and Barnard, 2020) and as depicted in Figure 1. Greater depth is added to certain capabilities like human expertise, where soft skills are also noted as relevant. The reviewed big data analytics literature did not bring this to the fore, although this category of skill has been noted as requisite for business intelligence professionals (De Jager and Brown, 2016). It also encompasses what is defined as relational knowledge in studies of big data analytics capabilities (Mikalef et al., 2018; Walls and Barnard, 2020).

The case organisation generates business value by adopting various work-practices such as inductively starting with data then seeking explanation from the discovered insights. In other situations they start deductively with a premise, then seek explanations from the data. Alternatively they may work with both approaches together, i.e. using an abductive approach to generating insights. The finding demonstrates that rather than the debate being about one or other of these approaches, organisations may use a combination of these approaches as deemed appropriate (Gunther et al., 2017). Similarly algorithmic and human-based intelligence are used in combination in the case organisation, with the sense-making capability of humans emphasized as being important. The latter view resonates with the subjective stance of what should be considered information, which is in contrast to a physical or objective stance (Boell, 2017). Business value accrued to the case organisation from insights gained at the work-practice level includes better performance measurement, product innovation, market penetration, revenue growth, and customer satisfaction. These findings resonate with those of Walls and Barnard (2020). The latter benefits can be defined as representing both social value (e.g. customer satisfaction) and economic value (e.g. revenue growth) (Günther et al., 2017).

This study was descriptive, as an understanding of the relationships between big data analytics capabilities, organisational functions, work practices and the creation of business value were not investigated fully. Future studies can therefore build on this descriptive foundation to generate theory that garners understanding of the relationships between these concepts. For example, the following questions can be pursued: How do the set of capabilities identified lead to improvements at the work practice level so as to increase business value? How does the combination of deductive, inductive and abductive approaches yield business value, and how do these vary by function? How do human-based and algorithmic intelligence and their interaction result in business value being derived, and how do these vary by function? What combination of capabilities are needed to ensure optimal business value is accrued, depending on the work-practice approaches and forms of intelligence employed in different functions?

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Appendix: Interview questions

General Questions	
1	Would you tell us about your position and role within the organisation?
2	Would you tell us about your area of specialization (related to big data analytics)?
3	Would you tell us how long you have been working in your field of specialty? And how many years have you been working in your current organization?
4	Would you tell us about the industry your organisation operates in? And, what does your organisation do?
Big data analytics	
1	How do you understand the term big data? And big data analytics?
2	Does your organisation have big data analytics?
3	What is the primary use of big data analytics in your organisation? ➢ Where is big data analytics being used in your organisation? ➢ Who is consuming big data analytics? ➢ For what purpose is it consumed?
4	Who in the organisation owns or controls big data analytics (i.e manages adds\delete\edit)?
Data	
1	Would you tell us about the data your organisation makes use of for big data analytics?
2	Where does the data come from? ➢ What is the major source of data in your organisation? ➢ What approach is used to collect data from the sources? ➢ Does the data collected need to be prepared? In what way? ➢ Which analytical techniques are used to prepare the data?
3	When data is collected, how well defined is the purpose of collecting that data? ➢ Is the data collected used for a purpose it was defined for only?
4	Can you describe instances, where data collected, was used for other purposes?
5	What happens to the data after it has been used for a certain purpose?
Technology	
1	What tools are used in your organisation for leveraging big data analytics? ➢ How advanced are your big data analytics tools?

2	Where are the analytics tools managed (e.g locally or in the cloud)?
3	Is the output of these tools fed into management reporting? If so, who is the end-user of the reports generated by these outputs?
4	Would you tell us about the technology your organisation has for big data analytics? ➢ Which desktop and visualization technologies are used?
5	How does the use of these tools help create business value?
Big data analytics employees	
1	How well would you say employees in the organisation understand big data and analytics?
2	How does management define data strategy to the big data analytics team? ➢ Is the definition of data strategy clear for the team to follow?
3	How do the top management in your organisation support big data analytics teams and initiatives?
4	Would you say managers in your organisation understand big data analytics value?
5	What would you say are the key skills required in big data analytics work? Of those, which technical skills are key in big data analytics work?
6	What type of daily activities are the big data analytics operational team involved in?
Big data analytics value	
1	What would you consider to be the 'value' of using big data analytics?
2	What type of value is created from using big data analytics in your organisation? How else can your organisation use big data analytics to create more value?
3	How does the organisation measure big data analytics business value?
4	Would you say your organisation is leveraging this value it creates from big data analytics? ➢ How does your organisation leverage value created from big data analytics?
6	How do big data analytics employees in your organisation contribute to the creation of value?
Working with data	
1	How is the data analytics team structure in your organisation? ➢ Which part of the organisation does the data analytics team fall in? ➢ Does the big data analytics team work in a single department or as part of the cross-functional team? Which department/s do they work in?

2	What would you say is the function of human actors in big data analytics work? What is the function of algorithms in big data analytics work?
3	Which one between human actors and algorithms does your organisation rely more on when coming to big data analytics insights?
4	Would you say human actors are relevant in big data analytics work? When do human actors and algorithms complement each other?
5	With the level of advance in big data analytics tools, does your organisation rely on human actors for big data analytics work?
6	How do human actors and algorithms create value? What type of value is created?
Closing Questions	
1	Would you like to add anything?
2	Would you like to ask any questions?
3	If needed, can I send you follow-up questions?
4	Would you recommend anyone else I can interview?