BIG DATA ANALYTICS AS A DRIVER FOR DATA-DRIVEN BUSINESS MODEL INNOVATION IN SMALL AND MEDIUM-SIZED ENTERPRISES IN SOUTH AFRICA

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ABSTRACT

Small and Medium-sized Enterprises (SMEs) play a key role in the digital economy and are generating employment, contributing to innovation and global economic development. Digital transformation is revolutionizing many enterprises, globally and is putting immense pressure on small and big businesses, to reflect on their current business operations, strategies and develop new business model innovation. The emerging trends such as big data analytics blockchain, cloud computing and Internet of Things (IoT) are regarded as one of the most prominent tools with a significant impact on business innovation, transformation and performance, and are used in a number of industries including Small and Medium-sized Enterprises (SMEs). The integration of these innovative technologies into all areas of business leads to new business innovation models and value creation. Although business model innovation is considered key to achieve sustainability in small and big enterprises, however, many SMEs are slow to adopt innovative technologies in developing new business innovation models, and have therefore not fully grasped the potential benefits to be gained from technologies such as big data analytics. This study thus reviewed literature on digital transformation of SMEs through the adoption of big data analytics, with a view to highlight how these technologies can support the development of Data-Driven Business Model Innovation (DDBMI) applicable to SMEs. The study revealed that big data analytics has the potential to revolutionize SMEs' processes, practices, performance and enhance competitive advantage.

Keywords: Digital Transformation, Big Data Analytics, Business Innovation, Business Model Innovation, Small and Medium-Sized Enterprises, Digital Technologies

INTRODUCTION

Digital transformation or digitalization is the integration of digital technologies into business processes. Innovative technologies such as intelligent analytics, data science, big data analytics, cloud computing and three-dimensional (3D) printing, just to name a few, are providing new tools for rapid scaling. The emergence of these technologies has substantially transformed small and big businesses, and bringing fundamental changes and enabling new operational practices. The diffusion of innovative technologies has further led to an explosion of available data, making data analytics and machine learning capabilities important competitive advantages for companies (Hanelt, Bohnsack & Marz, 2020). Big data has been interpreted as

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the next frontier for innovation, competition and productivity (Manyika et al., 2011). As noted by Shan et al. (2019) the recent development of the big data phenomenon is leading companies to increasingly focus their attention on the management of internal and external data with the aim of seizing new opportunities suitable to sustain their competitive advantage. Therefore, in this era of digital transformation, small and large businesses have access to a high volume and variety of data, which can be integrated and packaged for analysis. Big data analytics has broadened the scope of performance management by allowing for a better understanding of business dynamics and better decision-making. Groves et al. (2018) described big data as data that is continually being generated from multiple sources and diverse data formats that are both structured and unstructured. Big data analytics allow SMEs to make proactive knowledge-driven decisions on future trends. The use of big data and analytical tools enables SMEs to extend their products, services as well as to create new ones. Data analytics can be described as the process by which leaders gather data together from a single source to create and represent the present and future state of the organization (King & Forder, 2016). Data analysts collect and process data in real-time, store data remotely in the cloud, and have faster access to data from anywhere and anytime at a reduced cost.

Digital transformation is thus seen as an entrepreneurial process that led to the adoption of a variety of new business model innovation and data-driven business models, which are revolutionizing many SMEs, worldwide. As noted by Teece and Linden (2017) a business model essentially describes the business logic of a firm and how it creates, delivers and captures value, and it involves changes in the value proposition, value delivery and value capture of firms (Parida, Sjodin & Reim, 2019). Although the business success of SMEs increasingly relies on the adoption of BIS such as Artificial intelligence and Data analytics however, many SMEs are lagging in using these technologies to support business model innovation. Efforts to improve or develop new business models has been increasing throughout business practice and research (Amit & Zott, 2012) however, leveraging Artificial Intelligence technology, Big Data and constructing DDBMs invariably remains a challenge for many SMEs. Linde, Frishammar & Parida (2021) concur that many digital transformations fail because firms are unable to leverage the potential benefits of their significant investments in digital technologies. Royal Institution of Chartered Surveyors'(2017) report indicates the need for gathering, processing and taking advantage of knowledge within facility management companies however, as noted by both monetization of data-based products and fitting such products into company's business models are neglected by the report. The study by Nardelli and Rajala (2017) on the evolution of business models within facility management companies also stresses their research on the aspects of inter-organizational collaboration across different phases of the innovation process, leaving data itself aside. Data seems to be neglected although it is regarded as the fuel supplying organizational knowledge and wisdom necessary for agile business operations in this era of big data and business intelligence. It is however, challenging to identify best practices or real-life applications of reference models that may constitute the basis for tailor-fitting, although the reports and several studies from national and international organizations confirm that business models are evolving towards data management in various enterprises. This study focuses on how SMES

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advance their business models on account of big data collection, processing and analysis, with a view to develop Data-Driven Business Model Innovation (DDBMI).

PROBLEM STATEMENT

SMEs are more important for employment growth, in most developing countries although larger employers offer better jobs in terms of working conditions than these small enterprises. Snodgrass and Biggs (1996) argued that SMEs are more innovative than larger firms probably due to the adoption of niche strategies such as high product quality, flexibility and responsibility to customer needs as a means of competing with large-scale businesses. However, these innovations often take time and only large enterprises may have more resources to adopt and implement business model innovation. Most of SMEs show low level of adoption of big data analytics as compared to large enterprises. Digital transformation is thus a period in which the business practices are transformed and new emerging approaches and business innovation models are developed. For digital transformation process to be successful, SMEs should thus transform their organizational structures and businesses by adopting innovative technologies such as big data analytics and artificial intelligence to support business model innovation. Business models play a fundamental role in attempts to commercialize the technology, as a way to achieve its objective economic value (Chesbrough, 2010). These enterprises need to design, develop and improve business innovation models in order to benefit from advantages of digital technologies and to remain competitive in this complex and ambiguous digital business context (Schoemaker, Heaton & Teece, 2018). Barton and Court (2012) also emphasized the implementation and adoption of data-driven strategy, choose the right data and sources using Information Technology (IT) support, build models that predict and optimize business outcomes and transform the capabilities of the company. However, the results from a 2016 survey indicated that 48% of organizational leaders invested in big data projects, but 60% of these organizational leaders struggled to gain a competitive advantage and business insights to improve performance (Groves et al., 2018). SMEs leaders lack strategies to use big data analytics to recognize patterns for gaining business insights and to identify trends to improve processes or reduce costs, for increasing sustainability. The growth of big data has created a gap in terms of figuring out what tactics and strategies can be adopted by SMEs for effective business innovation. The majority of SMEs are struggling to analyse massive data in real-time and analysing big data using standard approaches is also a time-consuming process. SMEs thus, requires a technique that can aid in the faster and more accurate analysis of big data. Another pressing challenge in times of unprecedented change related to the digital transformation of enterprises and society at large, is recognizing and translating these changes into Data Driven Business Model. This study explored how SMEs advance their business models around data to handle data-driven products and how this contributes to their innovativeness and performance. Research objectives formulated for this study were to**:**

- Determine the adoption of big data analytics as a driver for business innovation model in SMEs.
- Determine the barriers to effective adoption of big data analytics in SMEs
- Determine the strategies for the development of data-driven business models within SMEs

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- Propose a Data-Driven Business Model Innovation applicable to SMEs.

RESEARCH METHODOLOGY

This study provides a holistic understanding and insights on digital transformation of SMEs towards supporting the development of data-driven business model innovation. Qualitative content analysis methodology was adopted, to apply and increase knowledge in a particular area of research, thereby showing proficiency in reviewing, synthesising and critically analysing the relevant research literature. To carry out the literature review, the author searched the relevant articles on previous studies and initiatives reporting on the application of modern or new technologies for digital transformation of SMEs in South Africa. The process of literature review was guided by a protocol-driven approach that offers researchers a framework to select, analyze, and assess articles with the aim of ensuring robust and defensible results (Massaro, Dumay & Guthrie, 2016). The search was restricted to peer-reviewed journals and books, based on keywords such as "digital transformation and Small Medium-sized Enterprises", "big data analytics and business innovation models", big data analytics and Small Medium-sized Enterprises ''data-driven business innovation models and Small Medium-sized Enterprises," appearing in the title, abstracts or subject terms, in order to ensure the inclusion of all relevant studies in the content analysis. Literature review on the application of innovative technologies such as big data analytics in developing and supporting data-driven business innovation models in SMEs was also conducted in major databases such as Scopus, EBSCO, ScienceDirect, JSTOR, Wiley, Springer, Sage and Google Scholar. After searching all relevant articles, each article was checked for the inclusion of keywords in the title, abstract and keywords, in order to ensure that the articles fit the research objectives of the study. The review of business innovation models also enabled researcher in identifying various elements or variables that guided the study in developing and supporting data-driven business innovation model applicable to SMEs.

A review of theories, models and frameworks on big data analytics adoption

The study required the collaboration of different theories and models to give grounded coherence in order to develop Data-Driven Business Model Innovation (DDBMI) applicable to SMEs in South Africa. The business canvas model was also used to guide the study, and a DDBMI based on the data collected from literature review and models, were further provided.

Service models of big data analytics

Big data analytics technology has been delivered in three main service delivery models known as Data as a Service (DaaS), Analytics as a Service (AaaS) and Software as a Service (SaaS). These service models are useful way for business managers to think about the best solutions for their enterprises. The new ecosystem is now leveraging several new roles in the ecosystem, such as Data as a Service (DaaS) and Analytics as a Service (AaaS) providers, to aggregate, process and manage wide range of data sources, as noted by Naous, Schwarz and Legner (2017), while providing wide range of analytics capabilities on top of the consolidated data. These services are driving the emergence of new business models across the overall

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analytics ecosystem. Software as a Service (SaaS) on the cloud and web delivered model is an obvious choice for many of such DaaS and AaaS enabled offerings (Delen & Dimirkan, 2013). Data as a Service (DaaS) can leverage commonly managed cloud and web-based infrastructure and tools as well as hosted and Web delivery models to offer rich set of data processing, management, and access services, in addition to in house implementations (Chen, et al, 2011). These entities typically leverage common infrastructure and tools such as cloud, common data and analytics tool to provide high quality data and analytics services. Big data is gaining importance in business analytics, and as stated by Ghosh (2020) it is not only an organizational asset but also a distinct revenue opportunity via data-related services offered under DaaS. DaaS service providers deliver value-added intelligence or information via a digital network (Ghosh, 2020), which is most often cloud-based, and offer more value-addition to customers. The delivered data and analytics services are also highly customizable, consumable and easy to integrate with other enterprise applications or processes. SMEs can create high value analytics services such as business intelligence reporting, text analytics, and advanced analytics such as predictive modelling (Marilex, et al, 2018), all made in composable forms to allow for direct consumption, integration and customizations and to boost productivity and create value for all, on top of DaaS. These services are referred to as Analytics as a Service (AaaS).

As noted by Chen, et al (2011) both DaaS and AaaS help to maximize value for the overall ecosystem by eliminating common costs and delivering high value data and analytics services. The emergence of these services is transforming the overall analytics ecosystem and forcing significant cost structure and productivity model shifts, i.e. where to cut cost and where to make money which are two key metrics to a business model (Chen, et al, 2011) This ecosystem change creates rich opportunities for service providers, partners and client industries to collaborate and create win-wins for all. Many new collaborative partnerships can thus be formed since DaaS and AaaS often have to work with multiple data, analytics providers and industry partners to deliver end-to-end solutions. SMEs can rely on external big data application providers, instead of developing costly and complex big data analytics systems.

SMEs can also use Software as a Service (SaaS), a distribution model of cloud computing services that delivers software applications over the internet, whereby a cloud computing infrastructure is provided to consumers usually in the form of subscription plans. SaaS offers a pre-coded data structure for SMEs to use, and some of the examples of SaaS for enterprises include cloud Enterprise Resource Planning (ERP), cloud consumer relationship management, cloud office suite such as email systems offering auto-completion functions for writing or graphic software integrating machine learning framework to increase workflow efficiency (Seethamraju, 2014).

Business canvas model

Most of SMES rely on data in supporting and developing new business models in this era of digital transformation, characterised by big data analytics and business intelligence. Business model depicts how products, services, image, distribution, organization of staff and the operational infrastructure are uniquely put together by a company to generate value for

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customers (Chesbrough & Rosenbloom, 2002). As noted by Lindgardt et al (2009) business model innovation may be considered a multidimensional and orchestrated set of activities that lead to the re-invention of at least two business models' components to deliver value in new ways. Business models thus articulate value propositions, identify market segments and define value chains within companies, as stated by Chesbrough and Rosenbloom (2002). Osterwalder and Pigneur (2010) described a business model canvas as a conceptual tool which is widely used in making the business model and it thus serves as a blueprint for achieving the business strategy. It defines how the values are conveyed to the target audience, the architecture and partnership in marketing, supply chain and cash flow (Osterwalder & Pigneur, 2010). Lokitz (2018) distinguished three categories of business models built around big data based on their value propositions and customers, namely: data, information and answers as services.

The framework of Johnson, Christensen and Kagermann (2008) also delivers a value proposition based on four interlocking components, namely: customer value proposition, profit formula, key resources and key processes. The Service Technology Organization and Finance (STOF) model by Bouwman, Haaker & De Vos (2008) features services, technology platforms or architecture, ecosystems as well as finance and risk-related uncertainties. This study was mapped with business canvas model that may be used to depict how SMEs generates, delivers and captures value, and enables increasing the understanding of how a given business operates. The business canvas model outlined nine paths of business canvas model in promoting business innovation, namely: the "what" in terms of the value proposition, "how" the value proposition will be addressed comprising the key partners, key activities, and critical resources, the "how much" component of the business model canvas would include cost structures and revenue models, and the "who" details the target customers, channels and relationships (Osterwalder & Pigneur, 2010), and are summarized as follows.

- **Key partners** describe the network of suppliers and partners required by the business. SMEs should thus cooperate with start-ups and involves external experts who represent various professions and specializations (e.g. data scientists, lawyers and digital designers) to a considerable degree
- **Key activities** outline the most important things an enterprise must do to make its business model work such as software development and supply chain management or consultancy.
- **Key resources** include the most important assets required by the business model such as human, financial and knowledge the enterprises need to run its business.
- **Value proposition** represents the services provided by the SMEs that creates value for a given customer segment. It describes the core value of product or service that can be conveyed to the customers and demonstrates in which dimension one product or service can stand out among peers.
- **Customer relationship** describes the type of relationships an enterprise establishes with customers and how to maintain this relationship. It focuses on building long-term relations with customers based on personal and IT-supported channels, and there are other activities aimed at building direct relationships i.e sales activities, conferences and seminars

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- **Channels** depicts how SMEs reaches and communicates with its customer segments to deliver the value proposition, and it is built around the SES support platform which in this case acts as Information Technology tool that aggregates information about processes. SES support platform enables building relationships at the operational level, SMEs may develop a mobile version of the platform to facilitate contact with customers and customers may use a web browser to initiate processes and to observe their progress.
- **Customer segments** determine various classes of retail organizations that SMEs may aspire to reach and serve. It describes certain groups of people a company wants to reach based on common needs, common behaviours or other attributes and look for the segments that provide the more revenue.
- **Cost structure** describes most important costs incurred to operate a business model. Some business model is cost driven, focusing on minimize and optimize the overall costs whereas some business is value driven aimed at providing the premium user experience. Business canvas model 's cost structure generalizes total costs incurred to operate a business model, for example, pertained to creating or delivering value, perpetuating customer relationships, generating revenue and focusing on long-term customer relationships. SMEs' cost structures can be divided into fixed costs (monthly salaries, rent for office spaces, license fees) and operational costs (electricity bills, expenditure regarding maintenance of machinery, cars, tools, marketing).
- **Revenue streams** describe the main revenue streams the enterprise receives from the business model, either from one-time transaction or predictable revenue in the future. It also describes in what way a company can generate cash flows from each customer segment and it has to consider how much customers will be willing to pay for the value the enterprise delivers. It includes revenues from property maintenance, energy efficiency management and providing basic data analytics to customers.

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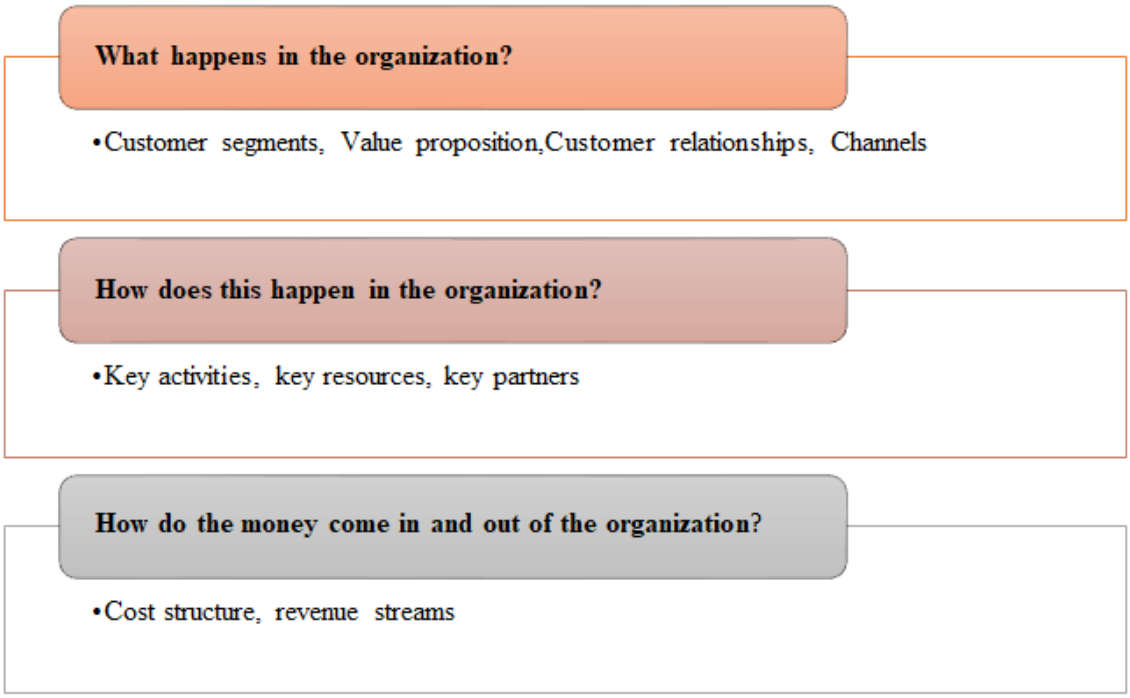

FIGURE 1.1
BUSINESS MODEL CANVAS

Figure 1.1. illustrate the overview of business model canvas components by Osterwalder and Pigneur (2010).

The set of elements or nine paths of business model canvas and their relationships thus represent the business logic of the company and could also help SMEs to identify their resources and capabilities, and match them to the needs in the market. However, it is up to SMEs to take advantage of business model innovation to transform company's operations and services as well as improving its performance.

Adoption of big data analytics to support the development data-driven business model innovation (ddbmi) in smes

Modern companies worldwide introduce technology-based innovations to streamline their business operations and increase competitive advantage, to carve out new markets and meet policies put in place by governments and various regulators as well as making their businesses more sustainable, as noted by Wang and Xu (2018). The proliferation of big data, algorithmic advancement, more powerful computing and storage facilities have also opened new possibilities for transformation of data into business insights, decisions and actions (Chui, Kamalnath & McCarthy, 2018). Big data analytics technology is considered as one of the leading technologies behind rolling out complimentary services and securing additional revenue streams by small and

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large enterprises. Big data refers to data that comes in enormous volumes in many different formats and forms, while being generated with high intensity and not without risk of inaccuracies, gaps and other factors that potentially reduce the reliability of data (Bange & Derwisch, 2016). Krishnamoorthi and Mathew (2015) defined business analytics as concerned with the extensive use of data, statistical, and quantitative analysis to support management decisions and actions. As pointed out by Mazzei and Noble (2017) the adoption rate of big data analytics tools is rising in every major industry. International Data Corporation (IDC) (2017) estimated that the big data analytics market will surpass $203 billion in worldwide revenues by 2020.

Big data enables organizations to establish data analytics and to integrate data in real-time from a variety of sources, with supporting information-sharing and decision-making in mind (Bange & Derwisch, 2016). SMEs are setting up business innovation solutions that take advantage of big data repositories to lean toward database-related sources, in this era of digital transformation. Data collected in databases and other big data repositories maintained by SMEs is transforming products and services delivery in these enterprises. The pervasive adoption of big data analytics and the implementation of digitally enabled infrastructures have fundamentally changed the business practices, and the nature of products and services in small and large enterprises, across the world. As stated by Sohl et al. (2020) the advancements in innovative technologies such as artificial intelligence, big data analytics, cloud computing, blockchain, virtual and augmented reality, robotics, the Internet of Things and 3D printing have led to new digital activities and new ways to configure those activities for value creation, proposition and capturing, which are the sources of SMEs' growth and performance. Delen and Demirkan (2013) described three types of analytics that businesses use to drive their decision making, namely: descriptive, predictive and prescriptive data analytics. Descriptive data analytics also denoted as business reporting, focuses on historical data and their analysis to identify problems or opportunities. It comprises interactive reporting using online analytical processing tools for the multidimensional analysis of aggregated quantitative data. Predictive data analytics help SMEs to identify patterns and future trends based on past and current data using a wide range of data mining and advanced analytics tools. Predictive data analytics is the use of statistical techniques and forecast models to predict future insights or occurrences using past and present data (Nagarajan & Babu, 2019). It seeks to improve business performance by determining a set of alternative courses-of-actions or decisions given a complex set of objectives, requirements, and constraints (Delen & Demirkan, 2013). It relies on mathematical modelling, optimization, and simulation models as well as expert systems and decision modelling tools.

Artificial intelligence and data analytics are therefore, one of the leading technology-related trends nowadays (Konanahalli et al., 2018). Big data analytic technology is regarded as the catalyst of business model innovation adopted by small and big enterprises, and it transforms how businesses create and capture value, triggering business and technology innovation in the digital era. Big data analytics technology can offer substantial value such as enhancing customer services, driving productivity, reducing cost and lowering prices, improving product and service offerings. As stated by Erevelles, Fukawa and Swayne (2016) new business opportunities are created, with the availability of high volume and variety of data. Increasing number of SMEs are

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transforming available data into knowledge and wisdom to constitute a new source of income. SMEs are adopting the data-driven approach whereby a high volume of operational and sensor-based data being collected creates added value in terms of new data-based products.

As stated by Martínez-Alonso, Martinez-Romero and Rojo Ramirez (2020) companies that obtain higher technological innovation efficiency are reported to be among those that achieve the highest growth rates. Big companies such as Apple and Amazon focus on business model innovation and data-driven business model to approach their customers with new services and products, as well as to secure additional revenue streams (Lokitz, 2018). The concept of a data-driven business model is built around data as a product and it lays out benefits for users of data-based services and introduces methods for managing (i.e. promoting, pricing, sale and delivery) of such products (Bange & Derwisch, 2016).

Barriers to effective adoption of big data analytics in smes

One of the biggest challenges faced by SMEs is to extract value from big data, make better decisions, improve operations and reduce risk. The study by Asay (2017) revealed that around 80% of businesses have failed to implement their big data strategies successfully, despite the popularity of big data analytics as a game changer in revolutionizing the way organizations make decisions and operate. Baldwin (2015) further noted that more than 65% of organizations have reported below average returns on their data management investments. The high failure of adopting big data strategies is due to shortage of organizational resources such as infrastructure and human capital, required for the adoption of big data analytics in SMEs. Therefore, an infrastructure that supports human capital development, data preservation, mining and hardware are thus essential in leveraging big data analytics.

The technological barriers are also identified as major categories of common constraints faced by many SMEs. Technological barriers include the costly infrastructures required for big data acquisition, storage and analysis to the shortage of qualified data scientists and analysts (Sivarajah et al., 2017). Big data analytics systems thus require revamped IT infrastructures as the conventional data management tools are not scalable to keep up with the pace of new data creation. Tabesh, Mousavidin and Hasani (2019) noted that the implementation of big data initiatives also calls for capital investment in building or buying new data management systems such as Hadoop, to enable effective storing and analysis of big data. Building and maintaining business intelligence system remain a costly investment and broader big data analytics diffusion requires investments in adapting the technology to business processes and skills structure. Although an effective implementation of big data analytics solutions requires developing and adopting complementary technologies, however SMEs lag behind large enterprises in all technological areas.

The analysis of big data fails due to managerial misunderstandings about the process or due to their inability to incorporate the insights gleaned from big data into organizational decisions (Ross et al., 2013). Ross et al. (2013) also noted the lack of data-driven culture as among the major reasons for the high failure rate of big data analytics projects in SMEs. Gupta and George (2016) defined a data-driven culture as the extent to which organizational

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employees, managers and executives make decisions based on the insights extracted from data. A survey of executives from 108 countries by LaValle et al. (2011) showed that many organizational executives lack a common understanding of what big data analytics is and what benefits it can generate for their business operations and outcomes. Michael and Miller (2013) also argued that leaders would face challenges using big data analytics when trying to understand how much data to collect and store, how long should the data be maintained, whether the data would be secure, and how much this would cost. The digital transformation era is predicated on the adoption of smart and digital technologies to mobilise real-time data. However, as noted by Ashok et al. (2022), the development of these technologies has historically been typified by a 'purview' of a few highly skilled individuals across functional areas including engineers, scientists, programmers and architects. Lack of relevant technical skills or expertise is also a growing threat, preventing SMEs from harnessing the full potential of transformative technologies (Travaly & Muvunyi, 2020), whereas lack of funding, is hampering the adoption of expensive and more advanced digital technologies in SMEs.

As observed by Saldžiūnas and Skyrius (2017) big data analytics can yield beneficial information, however, some challenges such as managing large sets of data, data silos, data centralization, data protection and privacy, management training, having the right skills to conduct analysis such as data scientists, cost of implementation and organizational cultural change exist. The lack of knowledge on how to use big data analytics tools or systems has also been one of the obstacles to further adoption, and could raise a series of challenges for users and producers of big data analytics solutions. SMEs also face barriers such as lack of awareness and readiness, high costs and uncertainty about data analytic benefits, in adopting big data analytics. Awareness raising among the employees including better information about the complementary role big data play in SMEs is key for effective implementation of big data analytics solutions**.**

Another challenge is that big data analytics application and transformation may not deliver immediate benefits and productivity gains, which raises higher costs for SMEs before a growth potential could be achieved. Although SMEs produce and handle a great volume and variety of data, they have unclear understanding of potential and risks of using big data analytics. These enterprises often lack the ability to collate, manage and protect big data, and data collected and stored may not be of adequate quantity or quality to derive meaningful insight (Bianchini & Michalkova, 2019) and data collected can expose SMEs to more data breaches. Dependency on Software as a Service (SaaS) solutions can expose SMEs to lock-in effects and make it difficult for them to reconsider their subscription plans and switch to other solutions and providers (Seethamraju, 2014). SaaS can also expose SMEs to external risks as their business activities rely on the continuity of the software provision and they may not be able to access their data and software anymore for in case their SaaS providers discontinue their services.

Strategies for effective development of big data analytics to support ddbmi

Doz and Kosonen (2010) pointed out that successful firms run the risk of failure if they stay with what used to be right, without changing their business models and implementing the strategies in line with the changing or improving business environment. Achtenhagen, Melin and

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Naldi (2013) noted that the business models need to change over time if firms want to sustain their value creation and value capture, and therefore SMEs need to shape, adapt and renew their underlying business models on a continuous basis. Some of the identified strategies or mechanisms for effective development of big data analytics in SMEs include: data exploration and visualization, implementation of performance management systems, social media analytics approach and using cloud computing services for big data storage.

Data exploration and visualization

Data exploration is the first step in data analysis involving the use of data visualization tools and statistical techniques to uncover data set characteristics and initial patterns. Data exploration refers to the initial step in data analysis in which data analysts use data visualization and statistical techniques to describe dataset characterizations, such as size, quantity, and accuracy, in order to better understand the nature of the data(Parise, et al., 2012). The goal of visual data exploration and analysis is to facilitate information perception and manipulation, knowledge extraction and inference by non- expert users. The visualization techniques, used in a variety of modern systems, provide users with intuitive means to interactively explore the content of the data, identify interesting patterns, infer correlations and causalities, and supports sense-making activities that are not always possible with traditional data traditional data analysis techniques (Bikakis, Papastefanatos & Papaemmanouil, 2020). As noted by Parise, et al. (2012) data visualization in data exploration leverages familiar visual cues such as shapes, dimensions, colors, lines, points, and angles so that data analysts can effectively visualize and define the metadata, and then perform data cleansing. This makes the data more natural for the human mind to comprehend and therefore makes it easier to identify trends, patterns, and outliers within large data sets. Data visualization also leverages predictive modelling techniques to predict user behaviour based on their previous business transactions and preferences. This approach makes use of statistics to experiment and get answers to questions that managers in SMEs might not have thought of previously.

Implementation of performance management systems

With the exponential growth of data generated from different sources, there is a need for extensive exploitation of data for performance management systems. Performance management involves understanding the meaning of big data in SMEs' databases using pre-determined queries and multidimensional analysis. SMEs need to manage their processes continuously and improve their performance to achieve their objectives through using performance management systems. Performance management systems involves defining the organization's objectives, identifying the key performance indicators likely to measure the degree of achievement of the objective, evaluating performance level and implementing an action plan (Souifi, et al., 2021). These systems thus translate the organization's critical success factors into a set of metrics to communicate critical objectives and support decision making (Bititci et al., 2015). Managers in SMEs can ask questions such as which are the most profitable customer segments and get

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answers in real-time, and that can be used to help make short-term business decisions and longer-term plans.

Social media analytics approach

Social media analytics approach focused on extracting useful insights from social media data, with the aim of helping individuals and organizations take the most optimum decisions regarding several disciplines of life (business, marketing, politics, health, etc.) online social media websites stand as a critically important platform of big data sources (Yaqoob et al., 2016). This approach measures the vast amount of non-transactional data that exists today, and much of this data exist on social media platforms, such as conversations and reviews on Facebook, You tube, Twitter, Instagram etc. (Sebei, Taieb & Aouicha, 2018). Social media analytics approach also measures three broad categories, namely: awareness, engagement and word-of-mouth or reach, as outlined by Sebei, Taieb and Aouicha (2018).

Awareness looks at the exposure or mentions of social content and often involves metrics such as the number of video views and followers or community members. Engagement measures the level of activity and interaction among platform members such as the frequency of user-generated content. In this digital era, mobile applications and platforms such as Foursquare provide organizations with location-based data that can measure brand awareness and engagement, including the number and frequency of check-ins with active users rewarded with badges. Word-of-mouth or reach measures the extent to which content is disseminated to other users across social platforms, and can be measured with variables such as the number of retweets on Twitter and shared likes on Facebook.

Using cloud computing services for big data storage

Most SMEs often struggle with cost, data storage, analysis and bottom line due to the rapid technological change and the general increase in data-intensive operations (Wang, et al., 2018). The needs to store different formats of big data for decision making and improving access have pushed SMEs to seek better solutions other than traditional storage servers and processes. Cloud computing services are regarded as an ideal solution for big data storage. Wang, et al (2018) described cloud computing as a network-based infrastructure capable of storing large scale of data in virtualized spaces and performing complex computing near real time. The combination of lower cost, powerful, timely processing and analysing thus make cloud computing an ideal option for SMEs to fully take advantage of big data analytics.

Proposed data-driven business model innovation for smes

Data-Driven Business Model Innovation **(**DDBMI) was developed based on the factors identified from the literature review, models and theories related to busines model innovation and it was mapped with business canvas model in transforming traditional SMEs to a higher level and thereby increasing its revenues. DDBMI integrates the following components: service models, business data analytics, target outcome, target customer, key activities, key assets and processes,

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key partners and network, cost structures and revenue streams that directly shape the data-based revenue approach development.

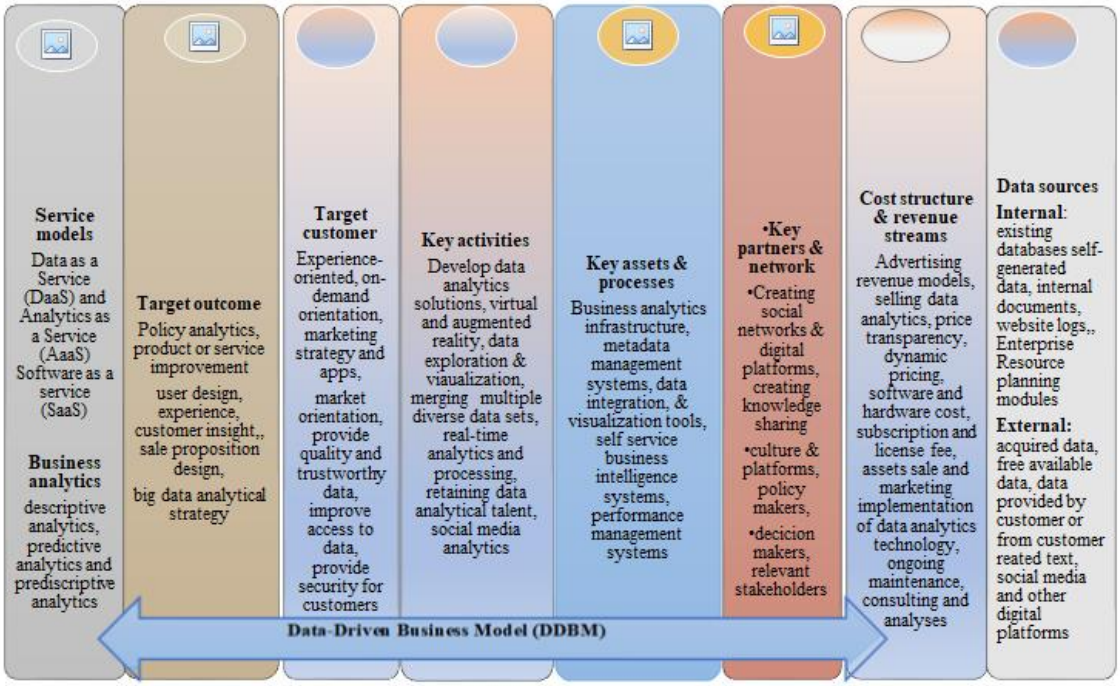

FIGURE 1.2
PROPOSED DATA-DRIVEN BUSINESS MODEL INNOVATION FOR SMES

The DDBM was therefore drawn from the principal capability factors drawn from the above four components of the framework upon which business innovation in SMEs depends. This integrative conceptual model was developed after investigating the business innovation needs and requirements that are vital to effective data driven business model. It was based on the elements or factors identified in the business canvas model and the factors from literature review.

It is argued that all these factors are key to understanding and guiding business innovation practices and are appropriate for implementing the sustainable DDBMI in SMEs in South Africa. The current study found it appropriate to use business canvas model as it highlights the areas of innovation which enables enterprises to explore and develop alternative business models.

A major purpose of business canvas model is to facilitate a broader understanding of the business innovation requirements and it focuses on areas of innovation where alternative business models can be considered which concurs with the study. The study thus suggests that all the elements of DDBMI are inseparable and very dependent on each other and their combination is therefore central to the future and success of data-driven business innovation practices within SMEs in South Africa.

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CONCLUSION AND RECOMMENDATIONS

This study reviewed literature on digital transformation of SMEs through the adoption of big data analytics technologies, with a view to highlight how these innovative technologies can revolutionize the business processes, practices, and organizations' performance and support the development of Data-Driven Business Model Innovation (DDBMI) applicable to SMEs. While many organizations have jumped on the bandwagon to take advantage of big data opportunities, only a small percentage of them have benefitted from their investments (Ross, Beath & Quaadgras, 2013). The increasing number of SMEs is therefore implementing and using data analytics solutions, while others are too slow to adopt these technologies. SMEs in South Africa are still faced with barriers hindering the effective implementation and adoption of big data analytics solutions as there is a need for investing in new business processes and complementary technologies and reskilling managers and employees. There is thus a need to raise awareness among SME owners and managers about the opportunities big data analytics could bring into their business, and how these technologies can transform their business processes, operations and improve company's performance and business innovation models. SMEs should also train decision makers so that they are able to rethink business processes and to reconfigure tasks and organisational structures. The study suggests the following recommendations:

- Build a big data culture and ensure that big data analytics transition takes place with improved digital risk management practices in SMEs
- Raising awareness among SME managers and empl0yees on the benefits of big data analytics, the conditions of a transition and how the risks could be best managed.
- Reskilling SME managers and employees and ensuring a participatory approach for redesigning work processes and big data analytics models.
- Creating, promoting and supporting knowledge sharing practices and platforms in SMEs.
- Managers and employees in SMEs do not have the required expertise, and therefore training need to be prioritized in the use of innovative technologies.

REFERENCES

Achtenhagen, L., Melin, L., & Naldi, L. (2013). Dynamics of business models–strategizing, critical capabilities and activities for sustained value creation. *Long range planning*, *46*(6), 427-442.

Amit, R., & Zott, C. (2012). Creating value through business model innovation. *2012*, *53*.

Asay, M. (2017). 85% of big data projects fail, but your developers can help yours succeed. *Big Data Tech. Rebuplic*, *11*, 1-5.

Baldwin, C. Y. (2015). Bottlenecks, modules and dynamic architectural capabilities. *Harvard Business School Finance Working Paper*, (15-028).

Bange, C., & Derwisch, S. (2016). Building data products to realize data-driven business models.

Barton, D., & Court, D. (2012). Making advanced analytics work for you. *Harvard business review*, *90*(10), 78-83.

Bianchini, M., & Michalkova, V. (2019). Data analytics in SMEs: Trends and policies.

Bikakis, N., Papastefanatos, G., & Papaemmanouil, O. (2019). Big data exploration, visualization and analytics. *Big Data Research*, *18*(1).

Bititci, U. S. (2015). Managing business performance: The science and the art. John Wiley & Sons.

Citation Information: Masenya M T. (2022). Big data analytics as a driver for data-driven business model innovation in small and medium-sized enterprises in south Africa. *International Journal of Entrepreneurship*, 27(S1), 1-18.

Bouwman, H., de Vos, H., & Haaker, T. (Eds.). (2008). *Mobile service innovation and business models*. Springer Science & Business Media.

Chen, Y., Kreulen, J., Campbell, M., & Abrams, C. (2011, March). Analytics ecosystem transformation: A force for business model innovation. In *2011 Annual SRII global conference* (pp. 11-20). IEEE.

Chesbrough, H. (2010). Business model innovation: opportunities and barriers. *Long range planning*, *43*(2-3), 354-363.

Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Industrial and corporate change*, *11*(3), 529-555.

Chui, M, Kamalnath, V. & McCarthy, B. (2018). *An executive's guide to AI*. McKinsey & Company.

Delen, D., & Demirkan, H. (2013). Data, information and analytics as services. *Decision Support Systems*, *55*(1), 359-363.

Doz, Y. L., & Kosonen, M. (2010). Embedding strategic agility: A leadership agenda for accelerating business model renewal. *Long range planning*, *43*(2-3), 370-382.

Erevelles, S., Fukawa, N., & Swayne, L. (2016). Big Data consumer analytics and the transformation of marketing. *Journal of business research*, *69*(2), 897-904.

Ghosh, P. (2020). *Data-as-a-Service (DaaS): An Overview*. DATAVERSITY.

Groves, P., Kayyali, B., Knott, D., & Kuiken, S. V. (2016). The'big data'revolution in healthcare: Accelerating value and innovation.

Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies*, *58*(5), 1159-1197.

Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. *Harvard business review*, *86*(12), 57-68.

King, N. J., & Forder, J. (2016). Data analytics and consumer profiling: Finding appropriate privacy principles for discovered data. *Computer Law & Security Review*, *32*(5), 696-714.

Konanahalli, A., Oyedele, L., Marinelli, M., & Selim, G. (2018). Big data: a new revolution in the UK facilities management sector.

Krishnamoorthi, S., & Mathew, S. K. (2018). Business analytics and business value: A comparative case study. *Information & Management*, *55*(5), 643-666.

LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big data, analytics and the path from insights to value. *MIT sloan management review*, *52*(2), 21-32.

Linde, L., Frishammar, J., & Parida, V. (2021). Revenue models for digital servitization: a value capture framework for designing, developing, and scaling digital services. *IEEE Transactions on Engineering Management*.

Lindgardt, Z., Reeves, M., Stalk, G., & Deimler, M. S. (2009). Business model innovation. *When the Game Gets Tough, Change the Game, The Boston Consulting Group, Boston, MA*, *118*.

Lokitz, J. (2018). Exploring big data business models & the winning value propositions behind them.

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., & Hung Byers, A. (2011). *Big data: The next frontier for innovation, competition, and productivity*. McKinsey Global Institute.

Llave, M. R., Hustad, E., & Olsen, D. H. (2018). Creating value from business intelligence and analytics in SMEs: Insights from experts.

Citation Information: Masenya M T. (2022). Big data analytics as a driver for data-driven business model innovation in small and medium-sized enterprises in south Africa. *International Journal of Entrepreneurship*, 27(S1), 1-18.

Martínez-Alonso, R., Martínez-Romero, M. J., & Rojo-Ramírez, A. A. (2019). The impact of technological innovation efficiency on firm growth: the moderating role of family involvement in management. *European Journal of Innovation Management*.

Massaro, M., Dumay, J., & Guthrie, J. (2016). On the shoulders of giants: undertaking a structured literature review in accounting. *Accounting, Auditing & Accountability Journal*.

Mazzei, M. J., & Noble, D. (2017). Big data dreams: A framework for corporate strategy. *Business Horizons*, *60*(3), 405-414.

Michael, K., & Miller, K. W. (2013). Big data: New opportunities and new challenges [guest editors' introduction]. *Computer*, *46*(6), 22-24.

Nagarajan, G., & LD, D. B. (2019). Predictive analytics on big data-an overview. *Informatica*, *43*(4).

Naous, D., Schwarz, J., & Legner, C. (2017, June). Analytics as a Service: Cloud Computing and the Transformation of Business Analytics Business Models and Ecosystems. In *Proceedings of the 25th European Conference on Information Systems (ECIS 2017)*.

Nardelli, G., & Rajala, R. (2018). The evolution of facility management business models in supplier-client relationships. *Journal of Facilities Management*.

Osterwalder, A., Pigneur, Y., Oliveira, M. A. Y., & Ferreira, J. J. P. (2011). Business Model Generation: A handbook for visionaries, game changers and challengers. *African journal of business management*, *5*(7), 22-30.

Parida, V., Sjödin, D., & Reim, W. (2019). Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. *Sustainability*, *11*(2), 391.

Parise, S., Iyer, B., & Vesset, D. (2012). Four strategies to capture and create value from big data. *Ivey Business Journal*, *76*(4), 1-5.

Ross, J. W., Beath, C. M., & Quaadgras, A. (2013). You may not need big data after all. *Harvard business review*, *91*(12), 90.

Saldžiūnas, K., & Skyrius, R. (2017). The challenges of big data analytics in the mobile communications sector. *Ekonomika*, *96*(2), 110-121.

Schoemaker, P. J., Heaton, S., & Teece, D. (2018). Innovation, dynamic capabilities, and leadership. *California management review*, *61*(1), 15-42.

Sebei, H., Hadj Taieb, M. A., & Ben Aouicha, M. (2018). Review of social media analytics process and big data pipeline. *Social Network Analysis and Mining*, *8*(1), 1-28.

Seethamraju, R. (2014). Effectiveness of using online discussion forum for case study analysis. *Education Research International*, *2014*.

Shan, S., Luo, Y., Zhou, Y., & Wei, Y. (2019). Big data analysis adaptation and enterprises' competitive advantages: the perspective of dynamic capability and resource-based theories. *Technology Analysis & Strategic Management*, *31*(4), 406-420.

Sivarajah, U., Kamal, M. M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of Big Data challenges and analytical methods. *Journal of business research*, *70*, 263-286.

Indexed at, Google Scholar, Cross Ref

Smit, D., Eybers, S., & de Waal, A. (2022). A data analytics organisation's perspective on the technical enabling factors for organisational AI adoption.

Snodgrass, D. & Biggs, T. (1996). *Industrialization and the Small Firm: Patterns and Policies.* International Center for Economic Growth.

Sohl, T., Vroom, G., & Fitza, M. A. (2020). How much does business model matter for firm performance? A variance decomposition analysis. *Academy of Management Discoveries*, *6*(1), 61-80.

Souifi, A., Boulanger, Z. C., Zolghadri, M., Barkallah, M., & Haddar, M. (2021). From Big Data to Smart Data: Application to performance management. *IFAC-PapersOnLine*, *54*(1), 857-862.

Citation Information: Masenya M T. (2022). Big data analytics as a driver for data-driven business model innovation in small and medium-sized enterprises in south Africa. *International Journal of Entrepreneurship*, 27(S1), 1-18.

Tabesh, P., Mousavidin, E., & Hasani, S. (2019). Implementing big data strategies: A managerial perspective. *Business Horizons*, *62*(3), 347-358.

Teece, D. J., & Linden, G. (2017). Business models, value capture, and the digital enterprise. *Journal of organization design*, *6*(1), 1-14.

Travaly, Y., & Muvunyi, K. (2020). The future is intelligent: Harnessing the potential of artificial intelligence in Africa. *A Brookings institute foresight Africa report*.

Wang, L., Ma, Y., Yan, J., Chang, V., & Zomaya, A. Y. (2018). pipsCloud: High performance cloud computing for remote sensing big data management and processing. *Future Generation Computer Systems*, *78*, 353-368.

Wang, Y., Kung, L., & Byrd, T. A. (2018). Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. *Technological forecasting and social change*, *126*, 3-13.

Wang, Y., & Xu, W. (2018). Leveraging deep learning with LDA-based text analytics to detect automobile insurance fraud. *Decision Support Systems*, *105*, 87-95.

Yaqoob, I., Hashem, I. A. T., Gani, A., Mokhtar, S., Ahmed, E., Anuar, N. B., & Vasilakos, A. V. (2016). Big data: From beginning to future. *International Journal of Information Management*, *36*(6), 1231-1247.

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