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Faculty of Business Economics

Master of Management

Master's thesis

How management control systems use Big Data and Analytics for decision making through optimising Business Intelligence processes in SMEs

SHELDEN ADIH AGINGI

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Business Process Management

SUPERVISOR :

Prof. dr. Koenraad VANHOOF

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www.uhasselt.be
Universiteit Hasselt
Campus Hasselt:
Martelarenlaan 42 | 3500 Hasselt
Campus Diepenbeek:
Agoralaan Gebouw D | 3590 Diepenbeek

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How management control systems use Big Data and Analytics for decision making through optimising Business Intelligence processes in Small and Medium-sized Enterprises(SMEs)

Shelden Adih Agingi(1953913)

UNIVERSITY OF HASSELT

Author Note

Shelden Adih Agingi, **Faculty of Business Economics,**
Master of Management, **Business Process Management.**
University of Hasselt, Campus Diepenbeek, Agoralaan Building D,
BE3590 Diepenbeek
Email:sheldenagingi@gmail.com
sheldendih.agingi@student.uhasselt.be

Supervisor

Prof. Dr. Koenraad VANHOOF

Disclaimer

This master thesis was written during the COVID-19 crisis in 2020-2021. This global health crisis might have had an impact on the (writing) process, the research activities and the research results that are at the basis of this thesis.

Preface and Acknowledgement

This is a master's thesis carried out at the University of Hasselt during spring 2021 year. This work for me has been a great opportunity to experience and be able to perform the thesis at the Faculty of Business Economics and there are many people who have helped me with making this thesis.

Firstly, I would like to thank my supervisor, Professor. Doc. Koenraad VANHOOF for his guidance during this thesis report, on questions and constructive thoughts on writing. His cooperation added lots of value, all the chats we had especially on Skype and emails that gave me critical feedback and recommendations. I would like to thank Koenraad VANHOOF. I enjoyed working with you very much! I would also like to thank Prof. Dr. Allard VAN RIEL for critical guidelines lesson sessions on how to approach a Master of Management thesis. I would like to thank Liesbeth CELIS and Marijn STRAETEMANS for their information sessions, guides, notes, and updates that help me become acquainted with the scientific contents of this paper and posters.

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Last but not the least I would like to thank my parents, brothers, and sisters for helping me stay focused during my thesis and my study in general and your trust in me.

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Shelden Adih Agingi

Abstract

Information in its high volume, velocity, variety, veracity (big data) from several sources when exposed to advanced technology, analytical methods, and capabilities (big data analysis), could be transforms into valued information that could help SMEs like other big enterprises in making strategic decisions. This could help managers of SMEs improve customer acquisition and retention, enhanced advertising and marketing campaigns, risk management, product innovation and development as well as management of supply chains. SMEs as a result, could become strategically efficient and gain a competitive advantage in a challenging market when data is managed accurately and on time. This could also be enhanced by an optimised Business Intelligence(BI). Though Big Data(BD) has proved successful to generate value, and useful for making strategic business decisions, SMEs however could be constrained by limited finances, lack of expertise, limited data culture, weak management agenda, limited infrastructure usage and security risk upon implementation. Nevertheless, there are some potentials for adoption. Cloud computing, Open-source learning, data-oriented forums, and government initiatives could be seen as solutions to facilitate implementation of big data by SMEs lite in big enterprises. These could limit some constraints implementing and using big data and analytics. This paper examines impacts of well managed Big Data and Analytics (BDA) by looking at some organisational cases, theories, and concepts on BDA. In doing so, this thesis contributes to the above-mentioned research stream on BDA application uses, their implementation constraints and the adoption potentials for strategic decision making that could benefit SMEs. The method of study used requires a systematic approach in performing a literature review on information system science, which includes respective processes of looking for applicable literature, scanning of papers, content assessment of articles, data retrieval, synthesis of studies, and writing the review. The findings showed that considering SMEs constraints of implementing BDA, cloud, open-source learning, expands the potential for SMEs to assimilate BDA as a critical method for decision-making. SMEs could also learn from big enterprises data culture to stay competitive. For clear understanding, this paper also shows use example cases on use and benefits of a well-managed BDA by both small and big enterprises. This paper concludes with suggestions for SMEs to understand the importance of a well data driven culture.

***Keywords**: Big Data(BD), Big Data Analytics (BDA), Business Intelligence (BI), Small and Medium Sizes Enterprises (SMEs), Management Control Systems (MCS), Data Applications, Cloud Computing.*

CONTENT

CHAPTER 1: INTRODUCTION

1.1 Research problem

In recent decades advancements in Big Data, Big Data Analytics and Business intelligence have gained interest in the domains of business and academics (H. Chen, Chiang, & Storey, 2012; Wixom et al., 2014). These advancements have made it possible for SMEs to generate a vast amount of data with a rate of about 10 times every five years, relevant to make business decisions and become more competitive (S. Coleman et al., 2016; Del Vecchio et al. 2018). Data expansion forecasted by the International Data Corporation (IDC) 2020-2023, indicated that, due to the COVID-19 pandemic, ICT investments by SMEs will flatten in 2020, compared to 2019 and will be kept afloat by expansion in new advance technologies, that is projected to see a rise at least 5% each year from 2021 to 2023 (Casalini, 2020; Cheng, Chien, & Lee, 2021). Big Data Analytic (BDA) attributes to large amounts of information stored, processed, and analysed by enterprise management to make better strategic decisions and gain competitive advantages (Assunção, Calheiros, Bianchi, Netto, & Buyya, 2015). Big Data has changed the way the markets operate and has opened new possibilities for large, medium, and small sized enterprises. The massive amounts of information when managed using Business intelligence and Analytics tools could create value to enterprises (S. Coleman et al., 2016). As depicted by the S-Curve Big Data sets are characterized by their volume, velocity, variety, veracity, that can be modulated over time to create Value as shown in figure 1.

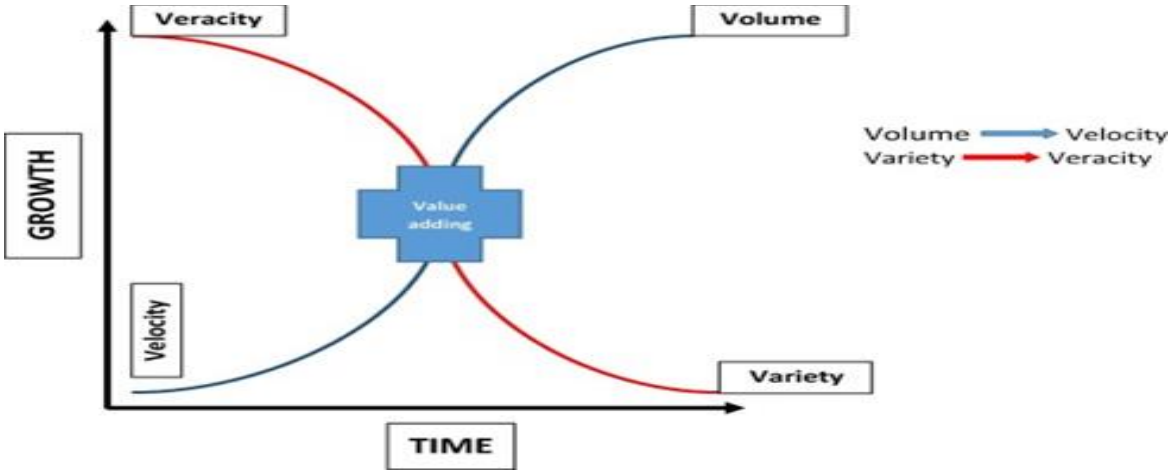


Figure 1, the S-Curve of Big data

S-Curve shows that data volumes are impacted by processing speed (Velocity) of the traditional database methods as they cannot perform effective analysis. Advanced analytic systems, however, can extract, treat, and interpret information timely. The S- Curve horizontally, reflects big data processing and information exchange dynamics between the different stages of implementation (time). Vertically, the S-Curve defined the Big Data features. According to, (Manyika & Roxburgh, 2011; Ogbuokiri, Udanor, & Agu, 2015) Big Data could be seen as the next frontier for creativity, competitiveness, and productivity and can be used for strategic operations and decision making.

Nowadays, SMEs benefit from value created from Big data through optimised Business Intelligence framework (Bradlow, Gangwar, Kopalle, & Voleti, 2017).

Business Intelligence (BI) gained interest throughout the late 1980s though it was initially introduced in 1958 by IBM researcher, H.P. (H. Chen et al., 2012). BI according to (Fan, Lau, & Zhao, 2015; Sun, Zou, & Strang, 2015) is essential decision-making tools for management systems that create value from data in an accurate and timely manner. BI could be defined as a set of software solutions, and technologies used for collecting, consolidating, and processing information into meaningful and timely results that an SME can use to make informed business decisions on pricing, sales, marketing, resource deployment, market segmentation, product, and service development (Gibson, Arnott, Jagielska, & Melbourne, 2004). The adoption of big data, analytic technologies and modern BI systems has impacted the projected improvement in innovative thinking, data infrastructure, information strategy, and contributed to business growth and can now distinguishes massive high-profit businesses from low-profit businesses (Bonnard et al., 2019; Brands & Holtzblatt, 2015; Frizzo-Barker, Chow-White, Mozafari, & Ha, 2016; Liu, 2014). According to (S. Coleman et al, 2016) in a report conducted in 2012, the acceptance rate of big data analytics among small and large enterprises was 0.2 per cent and 25% respectively. This implies that SMEs are constrained in adopting BDA compared to big companies. Also, studies conducted in Germany revealed that 46 per cent of all SMEs have no plans to implement big data analytics because SMEs lacks a proper integration of complex computing resources, finance, operational, technology, privacy, and security issues (Provost & Fawcett, 2013;S. Coleman et al., 2016). Nevertheless, despite issues of massive data acquisition, integration, retrieval, analysis, several capabilities are worth examining that are proposed to facilitate adoption of big data such as cloud computing, open-source learning, amongst others (Bhatt & Grover, 2005; Scholz et al., 2010).

Consequently, Big Data heterogeneity could help enterprises perform product design, product maintenance, check out competition, identify trends, recruit talents, engineer products and develop business models amongst others to secure a competitive advantage. These could be conceptualized as a resource-based and dynamic capability. According to (Malmi & Brown, 2008; McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012), technology infrastructure and organisational capabilities are critical for decision-making thus need to be optimized by management control to create value for Small and Medium Sized Enterprises(SMEs).

1.2 Research objective

This research aimed to explore how management control uses Big Data and Analytics for critical decision making by optimising business intelligence processes. This paper therefore looks at how massive amount of data creates value and help in making strategic data-driven decisions from data analysis in SMEs. Also, for better comprehension, this paper looks at the obstacles SMEs encounter in implementing BDA, and the existing potentials for adopting BDA to help ease decision making processes that SMEs benefit in attaining a competitive edge for example, by introducing cloud computing, open-source learning, and opening data policy culture. Because SMEs relevance and

strategic role in any given economy, this paper focuses, with SMEs, though uses some comprehensive cases of big companies. According to a 2014 report on European SMEs, SMEs constituted on average 99.8 % of enterprises among member states and accounts for 66.9 % jobs in the total, which thus contributes to 57.8 % of total value-added for EU industries (Muller et al., 2015).

SME's, like large companies, could gain knowledge by understanding high amounts of information and interpreting it to extract practical insights. SMEs, however, lack finance, infrastructure, data culture, a dedicated IT department and technological knowledge or expertise which constrains them. Nevertheless, online computational platforms such as cloud services, open-source initiatives, data-oriented forums, and government initiatives expand SME capacity for effectively and efficiently taking data-driven decisions that benefit on product design, product maintenance, checking out competition, identifying trends, recruiting talents, and developing business models amongst others to secure a competitive advantage.

Consequently, as technology advances, cloud computing with little operating and maintenance costs are being introduced that could help implement management control systems and BDA framework for data analysis managers and policy makers to take better decisions (Trigueros-Preciado, Pérez-González, & Solana-González, 2013). Particularly looking at the goals of this research, the aim of this dissertation could be attained by understanding the major research problem on:

How management control systems use Big Data and analytics for decision making through optimising Business Intelligence processes in Small and Medium-Sized Enterprises(SMEs)

Understanding this main question, sub-research questions arise in the path to addressing the key research issues.

• What are Big Data´s and Big Data Analytics, SMEs, and Business Intelligence, Management control, Data Applications and Cloud computing?

• How does the management of Big Data Analytics create business value? And how does the BDA help improve strategic decisions?

• What are the challenges implementing Big Data and Analytics in SME and the potential solutions for adopting BDA and BI analytics as a tool for decision-making?

Looking at the goal of this article, it could be synthesised and explained how management at a strategic level uses big data, optimises business intelligence to make strategic decisions, considering the existing challenges of implementing BDA and the potentials for its possible adoption by SMEs. Understanding these sub-research questions could help SMEs integrate BDA into company culture. In other words, the study continues to illustrate a range of possibilities for European SMEs as they use advanced BDA and BI through cloud systems to make strategic decisions.

1.3 Research outline

This dissertation could be seen organized as follows: In Chapter 1 offers an introduction to this research paper. This chapter defines the research problem in section 1.1, the research objective in section 1.2 and the research outline follows in this section 1, 3. Section1, 4 defines some index terms in this dissertation: Big Data(BD) and Big Data Analytics(BDA), Small and Medium-sized Enterprises(SMEs), Business Intelligence (BI), Management Control Systems (MCS), Big Data Applications and Cloud Computing.

Followed by this, Chapter 2, presented the research methodology employed in this research paper. Further, Chapter 3, presents a literature review structured into two sections: sections 3.1, which answers a sub-question on "How the management of big data applications create business value?" and sections 3.2, attempted to answer the research sub-question on " How does the management of big data and analytics create business value? And help enterprises make strategic decisions? This chapter concluded with some practical example cases in or concepts on BDA decision making tools used in SMEs and big companies for clear overview.

Additionally, Chapter 4, attempted to answer research sub-questions on "What are the operational challenges of implementing Big Data in SME and the potential solutions for adoption as a tool for decision-making?" This sub-question is structured into section 4.1 what presents constraints by SME implementing big data and analytics. Section 4.2 examines some potential for SME could use big data and business intelligence. This chapter concluded with some practical cases of BDA applications use and benefits with examples in both SMEs and big enterprises for a clearer understanding. Chapter 5 concluded and summarized the contributions of this thesis with Section 5.1, which concluded this paper and section 5.2, which outlines some recommendations on ways SME could move forward to implementing BDA.

1.4 Understanding Index terms

In this section, an understanding of some key terms of interest in this research are defined such as Big Data, Big Data Analytics, Big data Applications, Business Intelligence, Management control Systems (MCS), Small and Medium-sized Enterprises (SME's) and Cloud Computing as follows.

i. Big Data

Big data tools are the new age of the Information Technology (IT) revolution, with the potential to make information accessible and more reliable (McAfee et al., 2012). According to (Nguyen, 2020; Urbinati, et al., 2019) Big Data has become a major bonus for businesses and the values for global information was estimated to expand from $42 billion in 2018 to $103 billion in 2027, with a compound annual growth rate (CAGR) of 10.48 % . Information created in mass volume from Big Data frameworks could be used and exchanged by advanced IT which consequently impacts on enterprises' company management decision process (Assunção et al., 2015; Janssen, van der Voort, & Wahyudi, 2017).

Several definitions of big data understandably exist. According to (Frizzo-Barker et al., 2016), Big Data could be related to storage, control, and computational applications of data sets, and methods difficult to interpret by hand and traditional database systems but necessitate an effective and efficient management system. To (A. Bharadwaj, et al., 2013) Big Data could extend beyond traditional organisation activities as a tool that captures, organizes, handles, and stores data. Big Data therefore creates a large and noticeable technological change and cultural shift in organisations and contributes to strategic decisions (Chow-White & Green Jr, 2013). Additionally, according to (Gandomi & Haider, 2015) Big Data is often used to describe a massive volume of data produced by both structured and unstructured sources of information. Most importantly, according to (Frizzo-Barker et al., 2016; Goes, 2014; Porsche, Wilson, Johnson, Saltzman, & Tierney, 2014), to provide a comprehensive understanding of Big data, insights into Big Data features such as volume, velocity, variance, veracity, and Value is needed as outlined subsequently in figure 2.

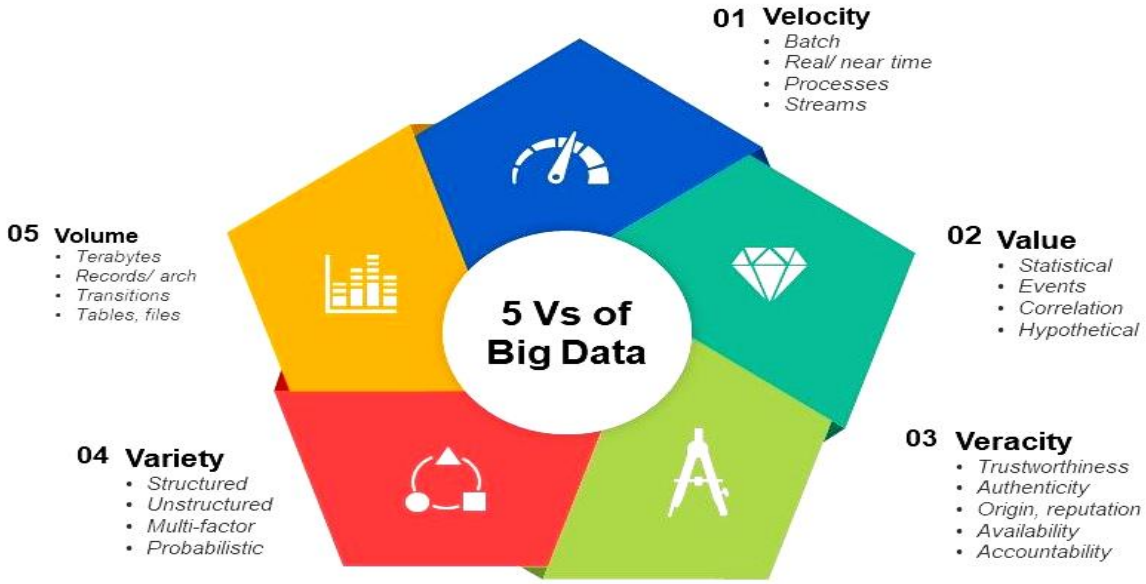


Figure 2: Big data features (5 Vs concept of Big Data)

- **Volume**

Data volume represents large amounts of information gathered and available in the system that is usable in its vast amount. For years, the possibility for further information gathering is made possible as access is improved. For example, datasets can be obtained recently via smart phones, machines, automobiles, and social networks (McAfee et al., 2012; Sharma, 2016).

- **Velocity**

Data velocity shows the time rate or speed at which data is searched, collected, and analysed. Data treated can represent a competitive advantage for businesses (Davenport, Harris, De Long, & Jacobson, 2001; Frizzo-Barker et al., 2016; Porche et al., 2014).

- **Variance**

Data variance covers the formats, sources, and forms of data collection. Data variance could be organised or unorganised, structured, semi structured, and unstructured data (Frizzo-Barker et al., 2016; Porche et al., 2014). For example, the emergence of social media platforms assisted in generating information about different messaging, alerts, and imaging sources (Sharma, 2016).

- **Veracity**

Data veracity overviews the consistency and quality of data and could be useful for strategic business decisions (Assunção et al., 2015). Big data, for example, makes valuable information collected from diverse sources accessible for managers to help them make fair, accurate, and up-to-date decisions (Affendey & Mamat, 2015; Assunção et al., 2015).

- **Value**

Data value indicates usability and importance of big data sets and benefits well managed and implemented big data applications. For example, big data adds valuable information assets that could be analysed to support strategic decisions (Frizzo-Barker et al., 2016).

Overall, Big data could be defined as a high-volume, high-velocity and or high-variety information asset that demands cost-effective forms of processing that enable enhanced insight, decision making and processing automation (Power, 2014). Looking at Big Data sets attributed to Volume shows huge amounts of data, Varieties are presented as different formats of data from various sources, Veracity presents the consistencies and uncertainties in data, Velocity could be measured on speed of accumulation of data, and Value are extractions from useful treated data.

ii. Big Data Analytics (BDA)

BDA are a set of mathematical and statistical techniques, such as data mining, and machine learning that enable the processing and management of Big Data for strategic decisions (Reiz, de la Hoz, & García, 2019). According to (Vilarinho, Lopes, & Sousa, 2018; Yigitbasioglu & Velcu, 2012), BDA aims to identify historical data, build connections between process variables and predictive analytics settings, and then visualise the results on a dashboard for human interpretation that help SME make strategic decision. Moreover, according to (Riahi & Riahi, 2018) BDA could be understood as being descriptive, predictive, prescriptive and diagnostic as explained in figure 3 on some concerted Data Analytic Model by Gartner and some practical examples.

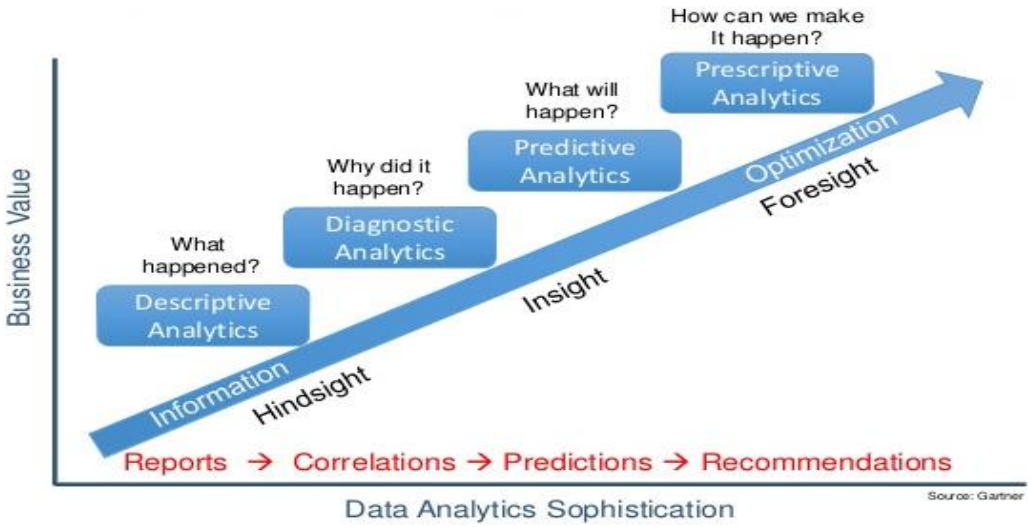


Figure3, Data Analytic Maturity Model, The progression of analytics

a. **Descriptive Analytics**

Descriptive analytics could be understood as, what happened? This explains a preliminary stage of data analysis that generates a compilation of historical data. Data mining techniques organise data and assist in the discovery of trends that provide information. Descriptive analytics offers potential odds and patterns, as well as an indication of what could happen in the future (Riahi & Riahi, 2018).

For example, Many LMS platforms and learning frameworks have descriptive analytical reports to aid companies and organisations to assess the success of learners so ensure that training expectations and objectives are reached. Notable examples in the field of training analysis could be used to monitor recruitments, enrollments, compliance rates.

b. **Diagnostic Analytics**

The question, "Why did this happen?" help with the understanding of Diagnostic analytics which identify the root cause of an issue. These are stages in which descriptive research data is compared toward other measures to determine whether something occurred. They are used to figure out that something happened and seeks to discover and understand the underlying causes of events and behaviors.

For Example, an online retailer can use diagnostic analytics to determine which regions purchased a certain product from new arrivals the most.

c. **Predictive Analytics**

The concerted question, "What is going to happen or what will happen?" could explain predictive analyses which look at past results useful for forecasting. Predictive analytics applies data processing, mathematical modules, and statistics, to current data to try to interpret uncertain

possible events or behavior. Predictive models are used in industry to better understand consumers and forecast purchasing habits, future risks, and possible opportunities (Riahi & Riahi, 2018).

***For Example**,* Retail industries could use predictive analytics, to boost its sales role and build stronger relationships with consumers. One of the most popular examples includes Amazon's reviews. Orders made, displays a list of other related products that other shoppers bought presenting topics such as, customer segments, business divisions, and site location.

d. **Prescriptive Modeling**

Predictive analysis could help understand what should happen or what can be done? Determine the best course of action to take. Prescriptive analytics are employed on similar modeling frameworks to forecast outcomes and then employ a mixture of machine learning, business law, artificial intelligence, and algorithms to simulate different approaches to these different scenarios. It could then be recommended as the most possible steps to optimise management activities. (Riahi & Riahi, 2018)

For example, SideTrade employs prescriptive analytics to get a better interpretation of a client's actual payment actions. Side Trade could rate clients based on their payment history using prescriptive analytics. This increases clarity and consistency, allowing Side Trade and its customers to properly account for expensive payment delays.

Further, there exist a variety of big data analytic tools or platforms for efficient and effective analysis such as Hadoop, Spark, Kafka, Pig, Hive, Cassandra, among others and are useful depending on the needs of the enterprise (C. P. Chen & Zhang, 2014; Mazumder, 2016), as illustrated in figure 4 below.

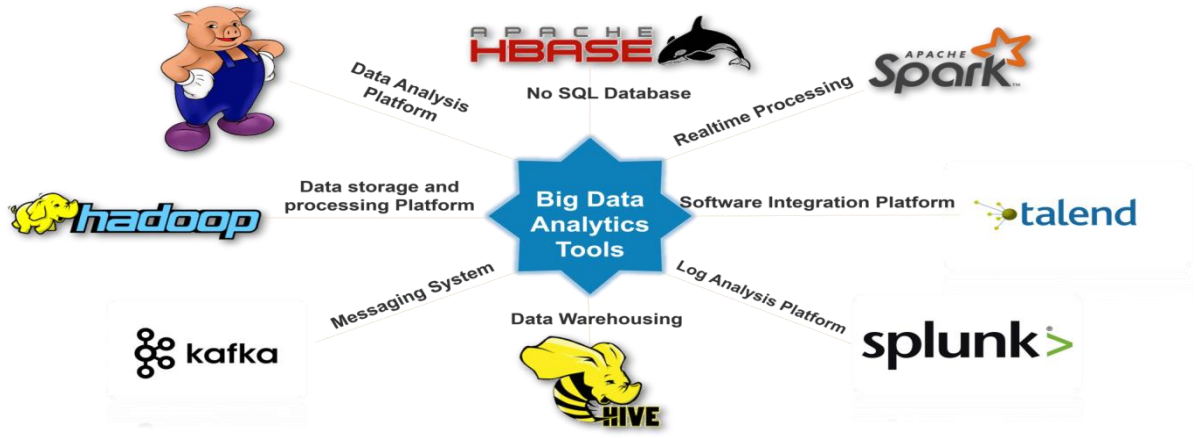


***Figure 4**, big data analytics tools, source https://www.edureka.co/blog/big-data-analytics/*

BDA tools are multiple and being used differently, for example, Hadoop used for data collection and distribution, Pig used for data mining and networks, Live for data warehousing, Cassandra used for sequel databases, Sparks could be used for real-time data processing, and Kafka for messaging.

Equally, MongoDB, my SQL, Cloud era, Google Cloud Framework, and other data analytics systems are available for Business Intelligence Analysis (Rao, Mitra, Bhatt, & Goswami, 2019). Real time data collected, distributed, and stored in large volumes can be essential for strategic business decisions and Hadoop framework can provide these solutions as shown in the concerted case of BDA tool below.

Case, Hadoop as a big data solution

Enterprises use computers for storing and processing large amounts of data and programmers depend on preferred database vendors, such as Oracle, IBM for data storage (Watson, 2014). Users often communicate with these programs performing the data collection and analysis (Watson, 2014).

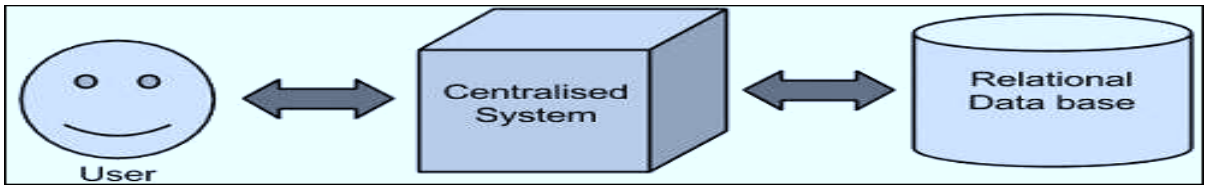
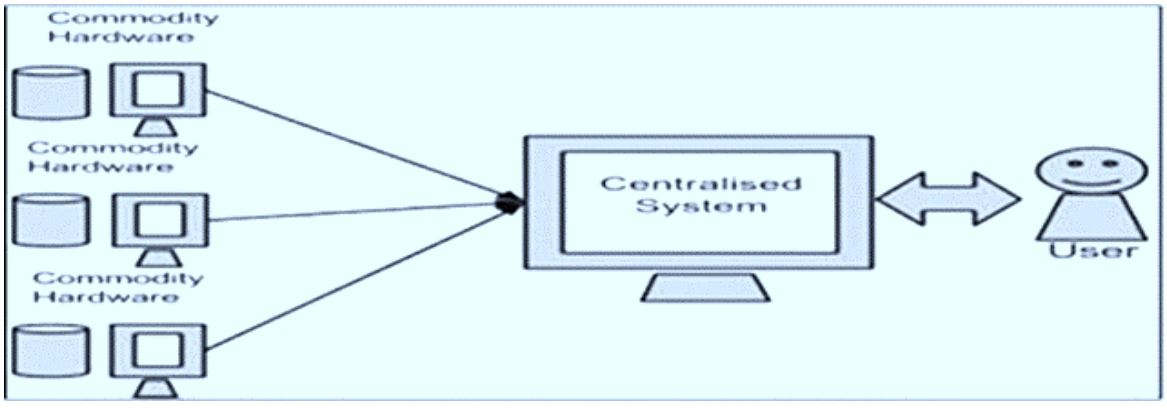


Figure 5, Data communication interface

A communication interface often generates voluminous data by traditional database servers. However, working with large volumes of scalable data, are often challenged especially for Small businesses with implementing advanced analytic solutions (S. Coleman et al., 2016). Nevertheless, Google could provide useful solutions for analysis (Holmlund et al., 2020).

Google's solutions used an algorithm known as Map-Reduce to solve this problem. This algorithm splits the assignment into small bits, assigns them to several machines, and extracts the responses, which are then combined to form the result dataset (Holmlund et al., 2020; Ramírez-Gallego, Fernández, García, Chen, & Herrera, 2018).



Figures 6, splits the assignment into small bits.

In summary, Hadoop could be used to create programs that can conduct detailed statistical analysis on massive volumes of data (Sweeney, Liu, Arietta, & Lawrence, 2011; White)

Hadoop Framework

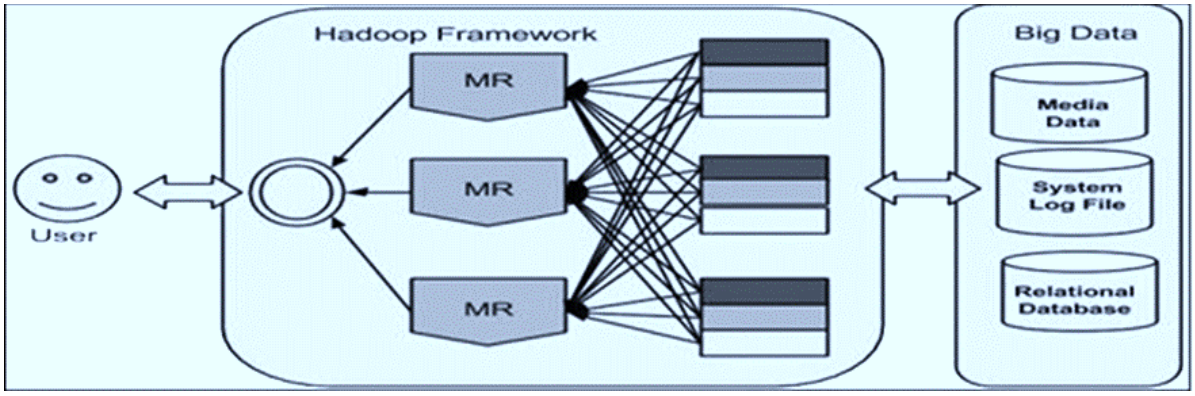


Figure 7, Hadoop Framework

Hadoop frameworks are Java-based Apache open-source platforms that allow for the distributed processing of large datasets across clusters of computers using basic programming models. The Hadoop architecture implementation operates in a computing environment that allows for distributed storage and computation across computer clusters. Hadoop could be scaled from a single computer to thousands of computers, each of which provides local computing and storage (Taylor, 2010).

According to (Dittrich & Quiané-Ruiz, 2012; Sethy & Panda, 2015), Hadoop has two big layers at its core been the Processing/Computation layer (MapReduce), and the storage layer (Hadoop Distributed File System). **MapReduce** presents a parallel programming model for writing distributed applications developed at Google to efficiently process massive volumes of data on large clusters of commodity hardware in a stable, fault-tolerant manner. **Hadoop Distributed File System (HDFS**) built on the Google File System (GFS) provides a distributed file system configured to run on commodity hardware and shares several parallels with current distributed file systems. The distributed file systems are extremely fault-tolerant and intended to be deployed on low-cost hardware. Also, it offers high throughput access to server data and is appropriate for systems with massive datasets. In addition, Hadoop architecture contains **Hadoop Common** which contains a collection of Java libraries and utilities that are required by other Hadoop modules. **Hadoop YARN** manages cluster resources and arranges tasks or jobs.

- **How Does Hadoop Works**

Usually, it could be expensive to build larger servers with heavy configurations that handle large scale computing, but as an option, Hadoop could connect several commodity computers with single-CPU, as just a specific component distributed system. Practically, Hadoop reads the dataset in parallel and has a much higher throughput and a low cost to run through a cluster of processors. This method comprises the following tasks: Initially, Hadoop Presents data into directories and files, and divides files into 128M and 64M uniformly sized blocks (preferably 128M). These files are then spread to different cluster nodes for processing. The processed files are supervised by HDFS, which sits on top of the local file system to handle hardware failure. This is done by repeated blocks that

checks to see how the code was successfully executed. Further, Hadoop Implements the sort that occurs between the maps and reduces stages and sends the sorted data to a specific computer. To every task, it creates debugging logs (Kaur, 2016).

- **Advantages of Hadoop**

Hadoop architectures enable users to easily create and test distributed frameworks. Hadoop power could be attributed to automatically distributed data and jobs done through processors, using the inherent parallelism of the CPU cores. Hadoop does not depend on hardware to provide fault-tolerance and high availability (FTHA); rather, Hadoop libraries are configured to detect and manage errors at the application layer. Servers can be dynamically inserted or deleted from the cluster, and Hadoop continues to run without interruption. The GNU/Linux platform and its variants support Hadoop. As a result, to set up the Hadoop configuration, designers must first uninstall a Linux operating system. Hadoop significantly could benefit enterprises in being an open-source platform due to its Java foundation. HDFS stores a vast volume of data which makes it easy to use. To contain such large amounts of data, the files are spread over many computers. These files are stored in a redundancy manner to protect the device from data loss in the event of a malfunction. HDFS also enabled parallel processing of applications (Anuradha, 2015; Feng, Zhu, & Zhang, 2016).

- ***Example of big data domains using tools as Hadoop and other analytics.***

- **Financial service**s firms used analytics to evaluate risk, design investment models, and develop trading algorithms; Hadoop has been used to assist in the development and operation of these technologies (Fang & Zhang, 2016). Banks and other financial services companies could use algorithms to distinguish between fake and legal market transactions. Programmers recommend urgent steps, such as blocking suspicious transactions, which prevents theft and increases profitability.

- **Retailers** used it to help process structured and unstructured data to better interpret and satisfy their clients (Fang & Zhang, 2016). Big Data Analytics is commonly used in retail, including e-commerce and in-stores, to maximise their market for instance, Amazon, Wal-Mart, and so on.

- Telecommunications providers could use Hadoop-powered analytics to perform predictive maintenance on their infrastructure. Big data analytics could also be used to design optimised network routes suggested for optimal locations and network expansion.

- Public-sector projects to predict and prevent epidemic outbreaks and detect tax evaders could be done by Hadoop frameworks (Saxena, 2021). For instance, The Indian government used big data analytics to forecast the country's trade. They examined the degree toward which states trade with each other using Central Sales Tax invoices.

- Education is one area where Big Data Analytics is being cautiously and steadily adopted. Using big data driven technologies as a learning tool instead of conventional lecture methods improved student learning and enabled teachers to practice good student success (Chaurasia & Rosin, 2017).

- Insurance firms use big data analytics for risk assessment, fraud prevention, marketing, consumer insights, customer engagement, and other purposes (Fang, Jiang, & Song, 2016).

- Telecom. According to (Chen, 2016) telecoms are one of the most important contributors to Big Data. The telecom sector boosts service efficiency and traffic routing. These firms can detect fraudulent behaviour and take corrective action by analysing call data records in real-time. The marketing division will tweak its campaigns to properly reach its clients and use the data obtained to create new goods and services.

iii. Small and medium-sized companies (SME) and Business Intelligence (BI)

- **Small and medium-sized Enterprises (SME)**

SMEs are at the forefront of major economic developments and an interest to many economies and academicians. According to (Schmiemann, 2008) most European Union businesses are involved in the non-financial market and at the EU-27 in 2005 (99.8 %) represented were SMEs with less than 250 staff. According to (Berisha & Pula, 2015), SMEs employ a sizable portion of the global workforce, with about 140 million SMEs in 130 countries employing 65 % of the labour force. According (Reijonen & Komppula, 2007), SMEs produce half of Europe's revenue and employ about 53 % of the labour force. According to (Chaudhuri, Dayal, & Narasayya, 2011), SMEs could produce large amounts of data from their daily activities used as information to develop new opportunities and benefit from them during the decision-making process. Several SMEs according to (Habeeb et al., 2019), however failed to collect and store data at the right time for efficient data analytics. For example, SMEs are challenged to collect vast volumes of information from logistics, and marketing operations that are encrypted or concealed, making it difficult to use (Bilal et al., 2016).

- **Business Intelligence(BI)**

Business Intelligence(BI), according to (Sharda, Delen, & Turban, 2014) could be seen as a broad concept that covers a multitude of systems, architectures, analytical methods, apps, databases, and strategies of a broad range of analytical software and solutions for capturing, consolidating, and analysing data in a way that allows customers in an organisation to make better business decisions. According to (Chaudhuri et al., 2011), BI tools are a set of supporting technologies that assist managers in making accurate and timely decisions. Also, (Watson & Wixom, 2007) defined BI as getting data in and out of the data warehouse using data for a query, analysis, and reporting. Also, according to (H. Chen et al., 2012), BI to SMEs are technologies, applications, methods to processing mass data for policy decisions that can produce market advantage. According to (Elbashir, Collier, & Davern, 2008), firms that use BI software have a significant edge over their competitors. **For example**, BI could help credit managers recognise creditworthy consumers and may be used to routinely analyse the competitive market (Chung, Chen, & Nunamaker Jr, 2005). Nonetheless, SMEs are often limited by financial resources, infrastructure, and skills set to incorporate BI systems. Thus,

according to (Rezaei & Alikhani, 2014) the need for processes, review, design, implementation, execution, assessment, and development are required as shown in figure 8 below.

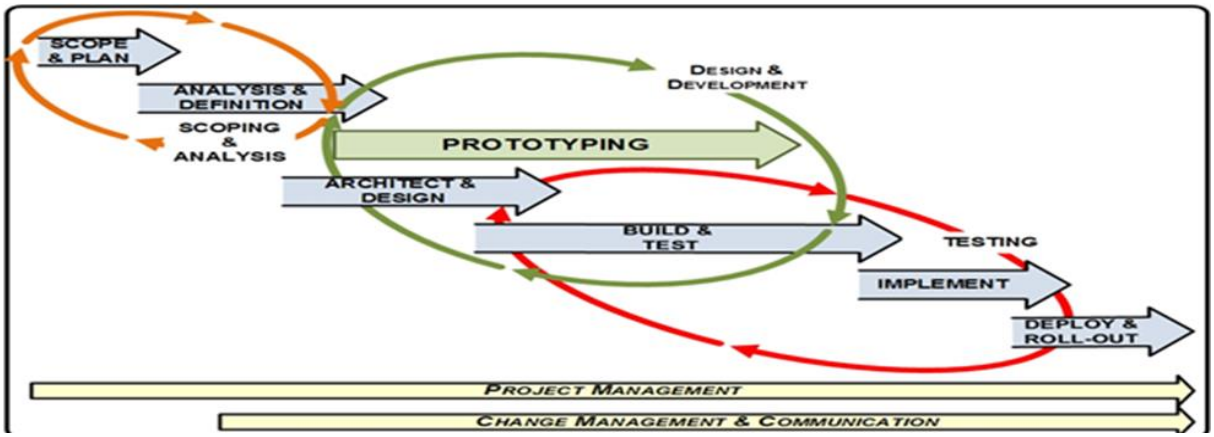


Figure 8, Business Intelligence Life cycle. Project implementation

BI solution requires a designed component, data sources, as well as sufficient storage and necessitate, scoping, and research review. To maximise success and meet expectations and requirements, prototypes are used in the study of functional deliverables. During the deployment process, the predefined modules and functions are created and checked, as well as related data from internal and external data sources is sourced and stored (ETL). The end of the deployment process ensures that the product has been applied and made available to the customer, as well as for addressing new customer demands (Rezaei & Alikhani, 2014). Thus, according to (Lim, Chen, & Chen, 2013), BI could assist businesses in gaining insight into the increasing volumes of transaction, commodity, inventory, consumer, competitor, and market results transmitted by enterprise-wide applications including Enterprise Resource Planning (ERP), information management, and cloud services . Overall, BI systems could be defined as combining data collection, storage, and knowledge management with analytical tools to present dynamic internal and competitive data to planners and decision makers (Negash). This definition implies that business intelligence programmes provide actionable insights to decision makers at the right time, in the right place, and in the right format aimed at increasing the timeliness and accuracy of decision-making process, thereby making managerial work easier (Negash).

Examples of business intelligence solutions for SMEs

a. **Microsoft Power BI**.

Many businesses started their BI journey with Microsoft BI because of its simple set up and has data analytics support with self-service access to third-party data providers like Marketo and Salesforce. Power BI also seamlessly blends with Microsoft Excel, providing a familiar working atmosphere. Power BI provides SQL (Structured Query Language) Server Analysis Services for power users such as data analysts and market consultants (Parenteau et al., 2016). Designed for analytics teams, the interface organises content based on user needs, allowing each Data Analyst to have their own

personalised dataset. Complex reports can be generated with SQL and then shared publicly for easy access on any browser, online, or in emails. Power BI tools are appropriate for businesses of all sizes, particularly if they are already using other Microsoft applications because of a flexible yet cost-effective BI solution (Lim et al., 2013).

b. **Grow**.

Software as a Service (SaaS) has current standards, with a variety of solutions for highly complex business functions (Seethamraju, 2015). Grow was created to pull together all SaaS data in real-time to make effective business decisions. This app is ideally suited for small and medium-sized businesses with several staff. Grow could be quickly linked with SaaS applications out of the box, allowing for the development of customised dashboards for specific Key Performance Indicators (KPIs). Data from Salesforce, Google Analytics, and Twitter, as well as a host of other apps, can be clearly viewed on a single screen for online retailers. Analysts could go deeper with Grow and control data with SQL for more sophisticated analysis. Rather than simply viewing performance from various SaaS on a dashboard, the SaaS may be integrated into a single metric, including a master cost per lead acquisition. Other BI solutions include **Dundas BI, looker, Board** that provide simple integration with data sources and dashboards that will boost timely decision making (Parenteau et al., 2016).

iv. Management Control Systems (MCS)

The definition of MCS has developed over time, and many studies have been conducted to investigate MCS's active function (Ahrens & Chapman, 2004). According to (SIMONS, 2019), MCS are strategies used by managers to introduce changes in organisational practices by using relevant data decision-making procedures. According (Anthony & Govindarajan, 2007), MCS includes a planning framework consistent within organisations used for reporting the best information for decision-making. Also, according to (Chenhall, 2003), MCS are a wider concept that includes MAS (Management Accounting System) and other built-in organisational controls such as statistical quality control and just-in-time management. MCS, according to (Merchant & Van der Stede, 2007), are a wider sphere of strategic and learning processes that cover any part of the organisation, not just MAC, but also employee behaviour. Consequently, extensive consumption interpretation of controls, as well as cumulative expertise, is needed to arrive at strategic decisions (Zimmerman, 2001).

Examples of management control software.

a. SAP Business One

SMEs may benefit from Enterprise Resource Planning (ERP) applications. SAP Business One helps in managing all aspects of any small or medium-sized business. SAP Business-One applications are cost-effective, customised business management systems tailored especially for small to medium-sized enterprises (Seethamraju, 2015). The applications are available in the cloud, on-premises, or operated by SAP HANA, the company's groundbreaking in-memory database. With SAP Business One, you can handle and streamline the critical business processes such as finances, customer

relationship management, warehousing, monitoring, sourcing, and more in a single streamlined solution. This allows tracking parts for effective decisions. Other business management software that defines Enterprise Resource Planning (ERP), business process management includes Odoo, Open bravo etc. (Gómez-Llanez, Diaz-Leal, & Angarita-Sanguino, 2020).

v. What are big data applications?

Big Data applications are a recently necessary aspect of business, and its implementation continues to grow amongst businesses. SMEs invest in big data to attain competitive advantage. Notably, one of the most important growths of big data adoption is thanks to the evolution in cloud computing and or mobile technology (Yang, Huang, Li, Liu, & Hu, 2017). Mobile applications offer convenience and sustainability that often outperform other in-house systems and minimise research and development costs. According to (Brynjolfsson & Hitt, 2000), SMEs require big data frameworks to perform essential decision-making operations such as on Customers Relationship Management (CRM), Accounting and Communication.

Examples of application of BDA to SMEs

a. **Analytics and CRM**.

According to (Mikalef, Pappas, Krogstie, & Pavlou, 2020) Business analytics are a critical component of management and the most significant advantage of big data in 2020. For example, information from consumer purchase data may be converted into data on potential purchasing patterns, which aids in marketing and financial management. Tableau and Salesforce are two of the most well-known data analytics and are more costly than SigmaXL, Excel plugin, Klipfolio (cloud-based software), and Sisense which are cheaper and free.

b. Communication.

Effective communication, particularly when working in remote environments, is essential to the smooth operation of an enterprise. According to (P. Gupta, Seetharaman, & Raj, 2013), SMEs invest in a private email server, such as Gmail for Enterprise, as well as a strong communication app for the team, paper editing, and sharing. Slack, Microsoft Teams, and Flock are some communication applications.

c. Accounting

Accounting operations are primary to SMEs and should be outsourced by off-the-shelf bookkeeping programs (Oluwaremi, 2016). For example, Quickbooks, Sage Business Online Accounting, Xero, and FreshBooks are examples of comprehensive accounting tools and cloud-based applications. Also, few decent accounting applications are available free for example Wave, Zoho and Zipbooks, are entirely free cloud-based software, which operates similarly to their paying partners.

vi. Cloud Computing

While several standardised meanings been introduced in academia and industry, the one given by the U.S. NIST most widely could be used (National Institute of Standards and Technology). According to (Dillon, Wu, & Chang, 2010), Cloud infrastructure elements are model for allowing easy, on-demand network access to a pool of configurable computing resources (e.g., networks, servers, storage, software, and services) that could quickly provision and released with limited management effort or service provider involvement. Five basic aspects of cloud computing are specifically articulated; On-demand self-service, broad network connectivity, resource pooling, rapid elasticity, and measured service are all available. In addition to these five important characteristics, the cloud community has widely used the three service models (Dillon, Wu, & Chang, 2010) mentioned below to categorise cloud services: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and Data Storage as a Service are all examples of cloud computing. Recently, cloud implementation models are being identified in the Cloud community (Dillon, Wu, & Chang, 2010): Private cloud technology that operates entirely within a single entity and has been maintained by the organisation or a third party, whether on-premises or off-premises. Also on Community cloud, many organisations collaborate to build and distribute cloud infrastructure, as well as policies, specifications, principles, and concerns. The cloud society achieves a degree of economic scalability and political equilibrium. The public cloud could be used by the public cloud users, and the cloud service provider has sole control of the public cloud, with its own regulation, value, and benefit, costing, and charging model. Many common cloud providers are public clouds, like **Amazon EC2, S3, Google App Engine,** and **Force.com.** The hybrid cloud architecture includes two or more clouds (private, cooperative, or public) that remain distinct entities but are linked through structured or proprietary technologies allows data and device portability. Virtual Private Cloud (VPC) are stable and transparent bridge between an organization's internal IT system and the Amazon public cloud. **Example cases,** Amazon.com has entered this market segment of the Internet ecosystem. Amazon Web Services(AWS) charges per gigabyte-month for data storage and per CPU-hour for processing power. Google is also testing the App Engine, which offers hosting on Google server farms as well as a development ecosystem based on the Python programming language and the Bigtable distributed storage framework.

Examples of cloud operations management software's

a. Ops Compass Cloud provides AWS, Microsoft Azure, and Google Cloud Platform with true multi-cloud organisational visibility, security, and power. Compliance analysis, cost forecasting, and security posture optimization are all covered by the system (Manweiler, Jain, & Roy Choudhury, 2012).

b. Splunk Enterprise cloud-based application which could be used by enterprises to handle big data and analyse computer data (Chainourov, 2017). Data visualisation, performance analytics, data processing, real-time scanning, indexing, KPI tracking, reporting, and monitoring are all important features (Simon, 2014).

CHAPTER 2: RESEARCH METHODOLOGY

This research paper examined how management used big data and analytics by optimising business intelligence to help make strategic business decisions in SMEs. In answering the main research question, this paper examines how to create value and take decisions from big data and analysis. It also examined the issues implementing BDA as well as the potential solutions for SMEs adopting BDA and BI analytics to make strategic decisions. Specifically, to accomplish the goal of this article, three (3) research questions are formulated, as seen in chapter 1 and their answers seek to help answer the key research question on; "How management control systems use Big Data and analytics for decision making through optimising Business Intelligence processes in SMEs?"

The appropriate structure of these study questions sets the pace and course for the appropriate literature review. This initial process adds to undertaking a literature search and a literature review of information from published scholarly journals, as approached by (Levy & Ellis, 2006) and (Okoli, 2015). The systematic methodology used in this paper also included the following steps: (1) searching for literature, (2) screening papers, (3) evaluating quality articles, (4) extracting results, (5) synthesising studies, and (6) writing the review or report.

To proceed, the quest for systematic literature entailed finding high-quality academic articles important to this paper. And during the related literature selection process, they found research articles were improved by keyword search. Keywords like Big Data, Big Data Analytic, SMEs, Business Intelligence, Management Control Systems and Cloud computing were included. These words are assumed to catch publications that discuss similar literature of interest. This search was performed using open access and specific topic sources such as Google Scholar, Science Direct, Research Gate, ProQuest, and EBSCO. The quest for additional articles is supplemented by using both backward and forward search techniques to draw on the list of papers to ensure that all references can be found or exhausted. Backward search helps you to look up backward sources, publishers, and previously used keywords of interest or relevant articles (Levy & Ellis, 2006). Routing reference scans and articles were used to establish recent publications related to the publications being studied (Levy & Ellis, 2006).

Following an online search for articles and journals, one hundred and eighty-six (186) literature papers were initially reviewed. However, the bulk of these papers is inapplicable in terms of presenting answers to any of the study questions. As a result, the realistic screening process is critical, as journals are scanned to find papers whose material was considered relevant or inapplicable to any formulated research questions (Okoli, 2015). The scanning was carried out by reading abstracts and papers from the original search. Considerations were taken in this case based on what was fairly regarded as broad base information from a variety of literature that can theoretically and satisfactorily address the research questions. This measure assisted in reducing the number of papers used for analysis to one hundred and sixty-nine (169), making it more manageable. Both potentially qualifying papers were extensively read to assess their content on definitions, concepts, theories, examples, on Big Data and Data Analytics, Business Intelligence

tools, MCS, cloud computing and open-source learning. This helped in an effective reading and reviewing of relevant concepts and cases from ninety-seven (97) articles. The material and information generated from these papers serve as sources for the literature review. Furthermore, the retrieval of this information depends on its relevance to the research questions. It was also important to synthesise insights gained from the selected papers. That is, details from the paper had to be aggregated, structured, and correlated explicitly. Thus, a simple narrative approach has been used to bring out all the synthesis that serves as literature research.

CHAPTER 3: LITERATURE REVIEW

3.1: How does the management of Big Data and Analytics create business value?

Enterprises could increase their analytical ability by investing in skilled professionals, quality information, and advanced technologies that promote strategic decision making (Byrd & Turner, 2001). With BDA and BI enterprises can integrate advance analytic applications into their business operations, allowing them to use the available information from structured, semi-structured and unstructured data from multiple sources for strategic decisions such as allocating capital, making investment decisions, managing business risk, and improving customer experience (McAfee et al., 2012; Wamba et al., 2017). According to (Elia, Polimeno, Solazzo, & Passionate, 2020; Saggi & Jain, 2018), value creation could be closely linked to competitive advantage using BDA.

This chapter attempted to answer the first sub-question on how BDA creates market value? Section 3.1.1 identifies big data as a resource, while Section 3.1.2 explores how SMEs generate value using Big Data. Parts 3.1.3, 4.1.4, and 3.1.5 offer an understanding of current literature theories on value creation using Big Data Schumpeterian Innovation Theory, Resource Base Theories (RBT), and Dynamic Capability Theory (DCT), respectively. These ideas attempted a general explanation of value and Section 3.1.6 x-rays the usability and strategic implication of Big Data Analytics as seen by the theoreticians.

3.1.1 BD as a resource

The exponential growth of BDA tools has increased data access and volume in SMEs (Horakova & Skalska, 2013). BDA uses network architectures such as Hadoop, HBase, MongoDB, MS SQL, and Cassandra, to create solutions for businesses (Gessert, Wingerath, & Ritter, 2020). According to (Hongliang, Longxin, Fugeng, Kaiming, & Yurong, 2019), Big data features make it easy to treat as valuable information, and it differs from traditional dataset structure, which is complicated, imprecise, and unstructured. Thus, according to (Provost & Fawcett, 2013), big data could be valued as a potential tool or resource for strategic decisions. And data sources such as Facebook, Twitter, are high data key knowledge or human capital resources. According to (A. S. Bharadwaj, 2000) big data assets include capital, infrastructure needed effectively and efficiently for business operations. Additionally, to (Provost& Fawcett, 2013), large volumes of data obtained from daily transactions serves business managers information to find emerging opportunities, create new goods, and make decisions. Furthermore, according to (S. Coleman et al., 2016) Big Data resources offer non-consumable potential as a human resource. According to (Del Vecchio et al., 2018; Fisher, Turner, & Morling, 2009), BD could be distinct from other production resources as its attributes lack physical properties and cannot be replaced with other data objects thus generating possibilities for competitive advantage.

3.1.2. Strategy creating value from BDA and BI.

Companies need to have a strategic information gathering system that is consistent with their strategic approach to generate value from massive datasets (Akter, Gunasekaran, Dubey, & Childe, 2016). According to (Suoniemi, Meyer-Waarden, Munzel, Zablah, & Straub, 2020), a clear data

strategy identifies relevant data sources and develops a consumer data vision to differentiate from competitors. Also, according to (Lai, Sun, & Ren, 2018), BDA requires investment in statistical properties, intellectual infrastructure. For instance, capturing any requests made on the company platform, whether from customer service calls, emails, could be extremely helpful in defining new trends. Data from different sources act as a possible reservoir of valuable experience and resources (Boisot & Canals, 2004). Data in the most complex computational databases represents an enormous potential for a company, but this only adds benefit to the company when it is used effectively. Attempting to exploit these opportunities using Business Intelligence Analysis sparks creativity and provides information in real time which could generate a competitive advantage by incorporating new and real time knowledge into new products and services (Božič & Dimovski, 2019). Big data analytics produces competitive market value by exploiting its dynamic capabilities through incorporating infrastructure and capacity building. as shown in Figure 9 below.

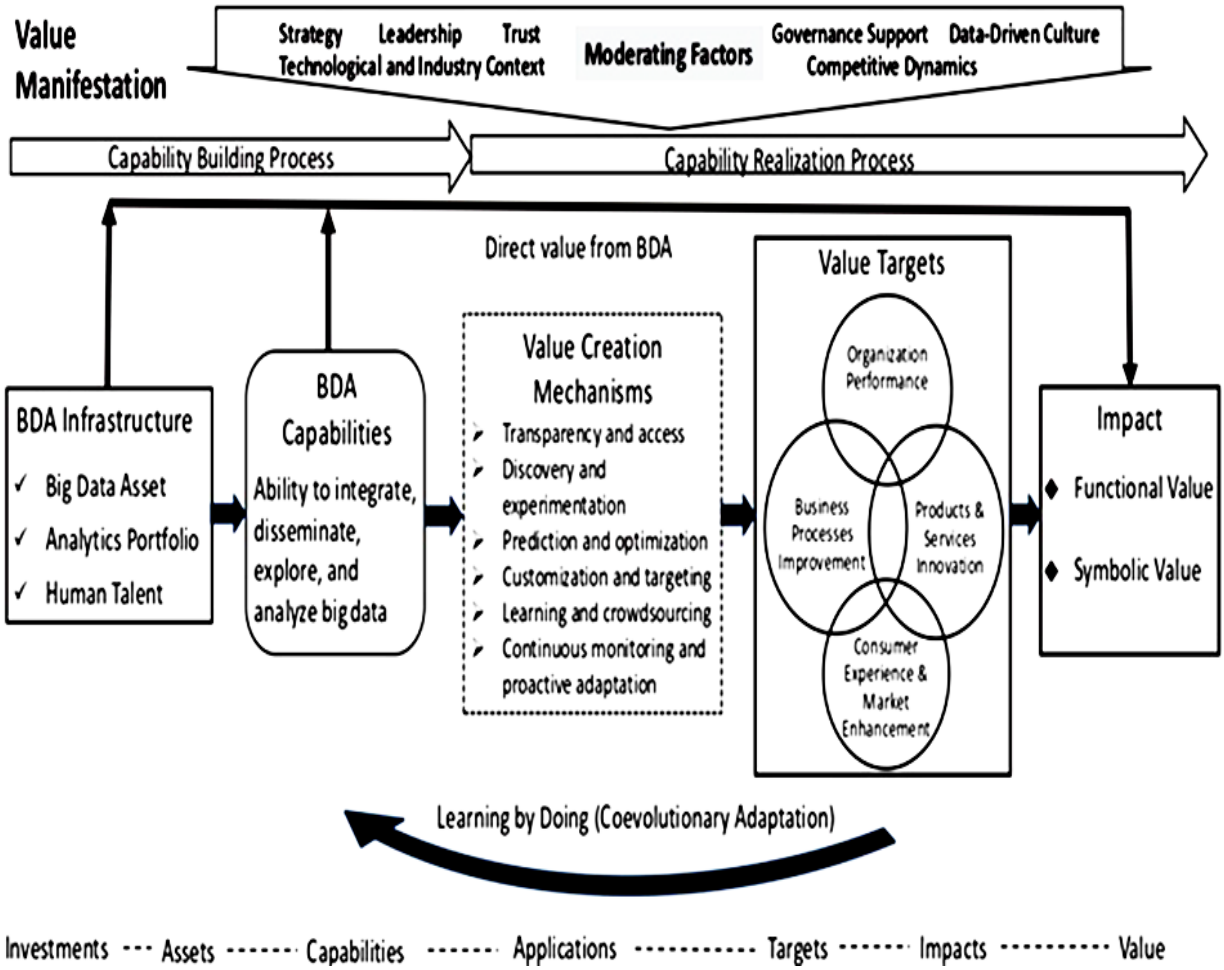


Figure 9: *Value creation by Big Data Analytics, Source: Creating strategic business value*(M. Gupta & George, 2016)

According to (M. Gupta & George, 2016), developing BDA Capability entails converting IT investments in BDA into useful capabilities. This complicated process involves deciding when, how,

and what value will be generated. Capabilities allow the collection and analysis of data, as well as the development of new information. Firms must thus develop a clear BDA strategy on how to generate revenue, through increased sales, lower costs, and/or increased customer satisfaction.

Also, establishing BDA Infrastructure requires evolved data Networks. According to (Mikalef et al., 2020), BDA development differs from traditional investments that are static and specific systems to create direct functional and symbolic value from big data.

According to (H. Chen et al., 2012), businesses must invest in several computing components, large data assets, and analytics portfolios, and human resources such as transactional, click stream, social networking as well as a platform for storing, integrating, sharing, and analysing information. Several examples of open-source big data frameworks include Hadoop, Spark, Kafka, Pig, Hive, Cassandra, and most using cloud solutions to leverage networks, platforms, and web capabilities (Fernández et al., 2014). Big data analysis could produce market value for SME through BDA such as SAS, Qualtrics and Google Analytics that can exchange data, collect new kinds of data, incorporate, and treat datasets to arrive at decisions. According to (M. Gupta & George, 2016), BDA creates valuable solutions for SME such as security, financial risk management, strategy analysis, and price-performance analysis. Given the prevalence of Big data value creation to businesses , BDA theories are vital to understanding how BDA serves as a resource and its importance as a tool for strategic decision making by looking at Resource-based theory (RBT), Dynamic Capacity Theory (DCT), and the Schumpeterian Theory as follows:

3.1.3 Schumpeterian innovation

According to (Amit & Zott, 2001), businesses could create value by developing new technologies in manufacturing targeted toward new customers, suppliers, and redesigning enterprises through innovation. This theory was limited to both the mixture of raw materials and the combination of virtual assets as the basis for the development of new products and services. According to (Galunic & Rodan, 1998), creative thinking makes a knowledge-based resource and a capital input resource that is important in strategic positioning required for value creation. According to (Allee, 2008), knowledge services rely on input resources for both advanced pieces of knowledge of the individual inputs and management awareness of how the multiple input sources create value.

3.1.4 Resource-based theory

According to resource-based theory (RBT), strategic resources are provided to businesses with the opportunity to gain long-term advantages over competitors. A resource could be seen as valuable if it lets an organisation build unique strategies that retain prospects while minimizing the costs. According to (Peterafa & Barneyb, 2003; Wernerfelt, 2014), enterprises own several special, heterogeneous resources that when integrated generate strategic advantages and businesses with comparable capital, on the other hand, could operate differently and benefit from different economic potential. According to (Grant) capabilities are vital expertise and implicit knowledge accumulated over time and represented intellectual capital impossible for other businesses to reproduce.

Nonetheless, innovative technologies are critical in gaining competitive advantage, proposed by Dynamic Potential Theory (TEECE, PISANO, & SHUEN, 2008).

3.1.5 Dynamic Capabilities Theory (DCT)

The resource-based view (RBV) struggled to interpret the production and redevelopment of capital and capacities in response to rapidly changing environments, leading to the introduction of dynamic capabilities theory. According to (TEECE et al., 2008), DCT paves way to achieve a competitive advantage. The definition goes far beyond the assumption that a firm's long-term competitive advantage is based on the acquisition of scarce, unique, and non-substitutable assets capital but developed into a highly successful lens for both strategic management and IT management (Schilke, 2014; TEECE et al., 2008). According to (Zahra, Sapienza, & Davidsson, 2006), physical resources, intellectual and organisational tools all contribute to decision-making processes. DCT concept according to (Nuruzzaman, Singh, & Pattnaik, 2019; TEECE et al., 2008) explains that decisions on enterprise capital depend on processes, functions, and routines systems as a result, for enterprises to manage data veracity, value, routine synchronisations.

Additionally, according to (Sunder M & Ganesh, 2020), segmentation of Management dynamic capacity, emphasis on the value of institutional learning and development. This positioning addresses first-order dynamic capabilities, which are the regular practical routines that depend on an enterprise's operating resources. The second-order dynamic capabilities comparatively are more sophisticated capabilities that are responsive to changes in the competitive climate. Thus, according to (Dagnino, Picone, & Ferrigno, 2021), Dynamic capabilities are processes that allow an organisation to reinvent its strategy and resources to achieve a long-term competitive edge in rapidly changing environments.

3.1.6 Understanding the strategic implications of Schumpeterian, RBT, and DCT concepts on Big Data and Analytics.

Throughout organisational strategy, Porter was active at developing a competitive advantage model (Porter, Bower, & Christensen, 2010). According (Redman, 2008) Business information could be rare, unique and each business uses it as an opportunity to gain a sustainable competitive advantage. According to (Teece, 2018), competitive advantages are receptive to competitors and might lead to the production of value. Big data and knowledge-based tools, according to (Herden, 2019) differ across businesses in terms of analytical skills and years of experience and provide companies with a competitive advantage. In this light, enterprises with data analytics experience will provide a unique combination of data, resources, and infrastructures that other organisations cannot replicate. According to (Isson & Harriott, 2012; McAfee et al., 2012), the expertise gained reflects information size and may include resources extracted from a massive pile of unstructured and unorganised information as seen in figure 10 below.

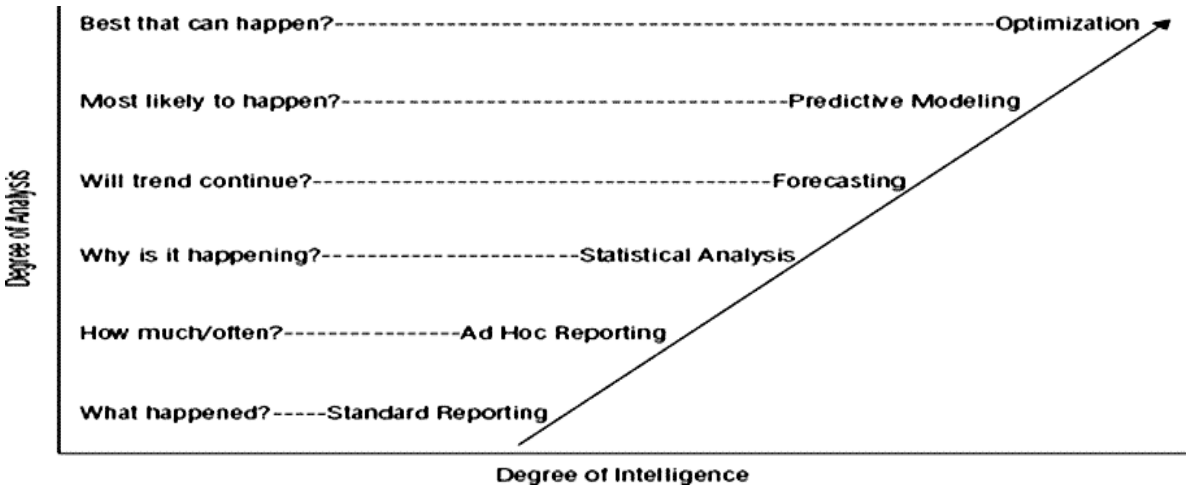


Figure 10: Win with advanced business analytics. Creating business value from your data (Isson & Harriott, 2012).

Looking at creating value from data, according to (Isson & Harriott, 2012), the degree to which enterprises attempt a deeper understanding of the market issues could be reflected by their expertise to execute one or more evaluations. As seen in figure 6 the degree to which management understands market issues such as describing what happened? How often? Why does it happen? Will the trench continue? What to happen? What can happen? Depend on their degree of intelligence to perform analysis such as standard reporting, ad hoc reporting, statistical analysis, forecasting, predictive modeling, and optimisation respectively. According to (Grover, Chiang, Liang, & Zhang, 2018), better decisions would be transformed into profit-generating activities and competitive advantage since knowledge can be unique. For example, access to customer data, helps organisations to obtain and process market contextual information while leveraging client preference research trends, which enable companies to gain profits and a competitor's advantage. According to (Akter et al., 2016), RBT affirms that Big Data capability affects customer loyalty, sales efficiency, profitability, and return on investment. According to (Fosso Wamba et al., 2017), RBT and DCT reviewed the potential direct impact of Big Data on operational excellence. Also, (M. Gupta & George, 2016) highlighted that material, intellectual capabilities build Big Data capabilities that add value to the enterprise. In summary, whether BDA creates businesses competitive advantages are still being debated on business decision strategies.

3.2: How does data analysis assist businesses in making competitive decisions?

Several studies show that BDA presented more insights on data obtained for strategic business decision-making. According to (Davenport & Patil, 2012), one of the most critical ways is removing biases, minimising cost, uncovering the hidden patterns, correlations and to give insights for business is for proper business decisions to be made within an enterprise. According to (Elgendy & Elragal, 2016), strategic decisions are used as a core performance of a firm's resources to boost customers acquisition and retention, solve advertisers' problems, and offer marketing insight, risk management, and for innovation. Thus, managers could be more objective and data-driven

considering how big data is evolving (Provost & Fawcett, 2013). Furthermore, decision-making theory, according to (Wang, Kung, & Byrd, 2018), identified technologies such as BD and strategies that contributed to successful decisions and basically these fast and agile systems offer competitive advantage to businesses. Example of BDA tools to manage high data volume, velocity, variety, include Google Analytics, SAS, Qualtrics, Tranzlogic, Alteryx, IBM Cognos Analytics as understood below amongst others are the most popular SME big data solutions that help in strategic decision.

Example of BDA tools or solutions for SME

a. Google Analytics

Google Analytics a free digital analytics program by Google provides SMEs with tools to review website data from all touch points in one location (Alford & Page, 2015). Google Analytics could extract long-term data to uncover patterns and other useful knowledge, for informed data-driven decisions (Holmlund et al., 2020). For example, monitoring and evaluating user behaviour such as how long visitors spend on your website helps in making better decisions on online shops. SMEs may also monitor social media traffic, allowing them to make improvements to their social media marketing strategies. As a result, SMEs can manage social media activity, analyse mobile app traffic to help you make well-informed business decisions.

b. SAS

According to (Elgendy & Elragal, 2016) SMEs no longer have barriers to acquire consumers. SAS turns data into insights that help guide decision-making and provide a new perspective on the market. SMEs are faced with many obstacles like multinational corporations. SAS is user-friendly analytics, for automatic forecasts, and data mining. SAS allows businesses with limited resources to get more out of limited resources. These analytics assist businesses in overcoming obstacles that help them grow and compete (Marr, 2016).

c. Qualtrics

According to (S. Coleman et al., 2016), SMEs that lack rich data sources, research could be the solution. Qualtrics enables SMEs that perform a broad range of studies and surveys to obtain quality information for data-driven decisions (Ogbuokiri et al., 2015). Furthermore, the company recently launched Qualtrics Experience Management (Qualtrics XM), four apps that enable companies to improve and maintain the interactions they deliver to all stakeholders – consumers, staff, prospects, users, collaborators, vendors, people, students, and investors. Qualtrics XM assists SMEs to measure, select, and optimise consumer, employee, brand, and for product interactions. Qualtrics also has real-time analytics, polling tools, ad testing, concept testing, and market analysis programmes that help in decision making (Polkowski, Khajuria, & Rohadia, 2017).

d. Alteryx Analyzing

Alteryx provides sophisticated data processing and visualisation software, as well as knowledge straightforward and easy to understand by SMEs. Alteryx blends proprietary details from the SMEs with publicly accessible statistics to help businesses make smarter business decisions (Alsahli & Kandeh, 2020). From the dashboard, users can build diagrams, scenarios, and immersive graphics using these observations. It also has teamwork capabilities that allow for team discussions. Alteryx can supply data to SMEs departments such as communications, finance, sales, logistics, and consumer analytics (Jain, 2016). Retail, Media-entertainment, Financial Services, and Healthcare are also amongst sectors covered.

e. IBM Cognos Analytics

IBM's Cognos Analytics makes sophisticated and predictive market analytics available to SMEs (Ogbuokiri et al., 2015). The platform does not necessitate any knowledge of advanced data processing and analysis systems; instead, it automates the process for users. This self-service analytics approach provides a package of data access, refining, and warehousing services, allowing it to plan and present data in a clear and actionable manner to inform business decisions, IBM Cognos Analytics unifies data analysis projects into a single platform such as marketing, sales, finance, human resources, and others. IBM technology identifies problems, recognizes patterns, and gains meaningful insights on sales deals, and employees' satisfaction (Bose, 2009; Ogbuokiri et al., 2015).

3.3. Used cases on how SMEs could learn from Big companies using Big data to improve business decision process and create value targets.

Big data can create value for businesses with a variety of business activities, ranging from customer experience to analytics (Mikalef & Krogstie, 2020). Enterprises could gather data from various consumer touchpoints, such as portals, enterprise applications, social media accounts, smart devices, blogs, records, files, and more. However, simply collecting data is insufficient to have a significant effect on the market. It must analyse and transform the gathered data into valuable information. Enterprises are using Big Data to drive important business decisions in several sectors of activity (Akter, Wamba, Gunasekaran, Dubey, & Childe, 2016). SME like big companies can use big data to drive the same important business decisions (McAfee et al., 2012). For a clear understanding on how SMEs can improve decisions using BDA , this paper section looks at some example cases from large companies which SMEs in the course of implementing big data could learn from their experience to properly implement BDA in their operations. here are some examples using big companies for clear understanding.

a. Big Data Analytics used for Customer Acquisition and Retention (Spiess, T'Joens, Dragnea, Spencer, & Philippart, 2014)

Customers are the most asset on which companies depend. SMEs like big business as seen in the example below could use big data to observe different customer-related habits and trends that generate loyalty. In theory, the more data a company receives, the more patterns and trends this could identify. Recently, with advanced technology, companies could effectively capture the consumer data they need to know their needs. Essentially, with a proper consumer data and analytics mechanism in operation, businesses extract critical behavioural information from which to function to maintain a customer base. Understanding consumer insights will assist companies in providing what consumers want. This move contributes to customer satisfaction.

Example of enterprises using Big Data for Customer Acquisition and Retention

Coca-Cola was able to improve its data policy by launching a digital-led loyalty scheme in 2015. According to Coca-Cola CEO, Consumers do an excellent job of communicating by phone, email, or social media – allowing them to hear their voices that help and change their approach."

Also, Starbucks uses behavioral habits to cater for its customers; they gather lots of information about their customers buying habits from their preferred drink to what time of the day they are usually ordering. The company directs exciting offers and coupons to their customers and ensures to maintain their interest.

b. Big Data Analytics used for advertising and Marketing (Jobs, Gilfoil, & Aukers, 2016)

Big data analytics has the potential to transform enterprise processes. This involves being able to meet consumer expectations, updating the company's product portfolio, and, of course, ensuring that marketing efforts are effective. The marketing and advertising firms do a more sophisticated study by analysing internet traffic and tracking point-of-sale purchases. Gaining insights into consumer behaviour necessitates a collection and analysis of customer data to create focused and tailored strategies. Big data analytics is beneficial to marketers in both big and SMEs because it allows them to better understand their customers' shopping habits.

Example of enterprise using Big Data for Targeted Adverts

SMEs could learn strategies from big Companies. Companies like Netflix employs big data analytics for personalised ads. With over 100 million viewers, the corporation gathers massive amounts of info, which is critical to achieving the market status that Netflix enjoys. Subscribers have ideas on the next movie to watch. This is accomplished primarily using previous search and watch results. This data was used to provide input into what the subscriber is most interested in.

c. Big Data Analytics used for Risk Management (Choi, Chan, & Yue, 2016)

.Risk management strategies, in general, are a vital investment for SMEs like big companies. Being willing to anticipate a possible danger and mitigate it before it happens is crucial if the company is to stay successful. Big data analytics has made significant contributions to the advancement of risk assessment strategies. The resources at their disposal enable companies to measure and model the threats they pose daily. Given the growing availability and variety of statistics, big data analytics has enormous potential for improving the efficiency of risk management models. As a result, a company can implement smarter risk-mitigation plans and make rational choices. To do this, companies must first gather internal data to obtain concrete knowledge that will help them. More critical is the integrated method of research that an organisation employs. A proper big data analytics framework aids in the identification of places of vulnerability or perceived danger.

Example of enterprise using Big Data Analytics for Risk Management

Banks could scale from small to Big companies and could both benefit from risk management. Singapore's UOB bank employs big data to drive risk assessment. UOB Bank recently reviewed a big data-based risk management system. The big data risk assessment framework allows the bank to reduce the time it takes to calculate the value at risk. It used to take over 18 hours, but with the risk assessment system that uses big data, it now takes a few minutes. The bank will be able to conduct real-time risk assessments soon because of this initiative (Jafari, Ali, & Dattana). SMEs could learn and adopt such strategies for proper business risk assessment.

d. Big Data Analytics used for new product and service development (Jagtap & Duong, 2019)

Big data has become a means of generating new sources of revenue by allowing inventions and quality improvement. Any design process creates a match for the consumer need, and small like big companies could determine the right way to build the consumer need based on big data analytics rather than relying on intuition. Before implementing a plan of action, an analysis would be carried out to ensure sound reasoning. Fortunately, manufacturers of all sizes have a distinct edge when it comes to collecting and harnessing big data, allowing them to enhance their product line by developing new products.

Example enterprise case using Big Data to Drive Innovations

SMEs like big companies need to innovate their product and services to stay competitive. Amazon Fresh and Whole Foods as an example, use big data for product growth and creativity. Amazon uses big data analytics to enter a wide market. Amazon now has the skills it needs to create and generate better profitability thanks to data-driven logistics. Amazon Whole Foods knows how consumers purchase groceries and how manufacturers communicate with the grocer by focusing on big data analytics. This data provides insights into the need for further reforms (Veilleux Jr, 2019). Procter

and Gamble (P&G) uses market basketball analysis and price optimization to optimise their product. Market basketball analyzes customers' buying habits by finding associations between the different items that the customer put in their shopping basket. The SMEs could also use uses simulation models and predictive analysis to create the best demand for its product .

e. Big Data used for Supply Chain Management (Jain, Mehta, Mitra, & Agrawal, 2017)

Big data provides better precision, transparency, or insight to supplier networks. Suppliers gain contextual intelligence through supply chains by utilising big data analytics. With big data, suppliers can gain access to higher levels of qualitative knowledge, which is needed for supply chain performance. Modern supply chain structures built on big data allow more complex supplier networks. These are based on information exchange and high-level teamwork to achieve relational intelligence. Big data analytics could be seen as a groundbreaking tool by supplier executives for transformation management and performance for SMEs like in big companies as seen on examples below for be.

Example case of enterprise using Big Data for Supply Chain Efficiency

PepsiCo is a consumer-packaged goods business that depends on massive amounts of data to handle the supply chain. The corporation is committed to ensuring that sufficient quantities and varieties of items are replenished on retailer shelves. Clients submit updates towards the organisation that include their storage inventory and POS inventory, and this data is used to reconcile and predict supply and shipping requirements (Divakar, Ratchford, & Shankar, 2005). As a result, the organisation guarantees that suppliers have the best items in the right quantities and at the best price.

SMEs could learn from strategies of big companies to better understand importance of big data. Enterprise could access to a vast amount of information about their clients' identities, spending histories, and emails to build strong customer relationships. However, big businesses have an advantage since they have the necessary capital and manpower. But even small businesses could benefit from big data insights without incurring significant costs. BDA would be an important investment for a SMEs and rising enterprise and can gain a strategic edge, lower operating costs, and increase customer satisfaction by implementing big data analytics. Technically, businesses currently have data at their hands. It would be up to individual enterprises to ensure the sufficient data collection processes are in place to collect and manage the massive amount of data. SMEs constrained implemented efficiently BDA and BI as seen next.

CHAPTER 4: What are the operational constraints implementing Big Data in SME and the potential solutions for adopting BD and BI analytics as a tool for decision-making.

Nowadays, SMEs benefit from a vast volume of data from a multitude of information sources to make accurate and quicker decisions. According to (Sivarajah, Kamal, Irani, & Weerakkody, 2017), business intelligence integrates large quantities of operational data into functional information that decision-makers can aggregate, analyze, and interpret to make informed decisions. According to (Elgendy & Elragal, 2016), SMEs use BDA to improve decisions that increase productivity, and competitive edge. Chapter 3 of this paper describes how SME uses BDA to make strategic decisions that can create value that could serve as a competitive advantage, and how this process requires SME to make decisions on how to invest in infrastructure and knowledge to accomplish this objective. However, SMEs are often challenged implementing BDA due to lack of finance, limited knowledge capability, poor management awareness, a lack of data-centric culture, lack of infrastructure and data insecurity, amongst others (S. Coleman et al., 2016). As a result, chapter 4 focuses on these issues implementing BDA as a SMEs, and potentials solutions for adopting BDA such as use of Cloud computing, open-source initiative, emergence of Data-oriented Forums and Government support schemes.

4.1. Constraints implementing BDA by SMEs.

The key obstacles implementing BDA are more technical and apply to resource, skills, operational, cultural, access, and attitude issues as shown in figure 11 below. The main constraints for SMEs are inadequate financials, a lack of expertise and a lack of management awareness (S. Coleman et al., 2016; LaValle, Lesser, Shockley, Hopkins, & Kruschwitz, 2011).

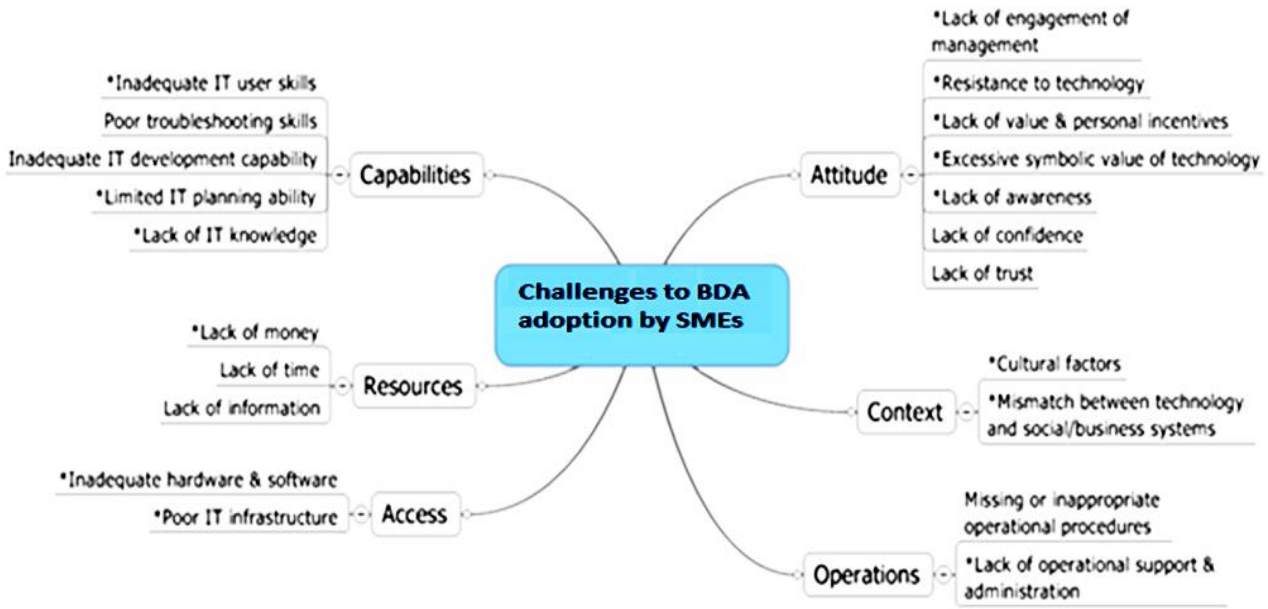


Figure 11: Challenges to BDA Adoption by SMEs.

4.1.1 Limited Financial Resources by SME.

The availability of financial capital encourages creativity and growth, even though SMEs are often financially limited in their ability to introduce innovative technologies and employ analytical expertise (S. Coleman et al., 2016; Kiron & Shockley, 2011). SMEs and start-ups are rigorous and face complicated processes to secure credit with the possible risk involved to decide how much money to spend in BDA. Frequently, to quantify the overall implementation and the skill set required to implement big data technologies could be impossible. Thus, they are often required to receive maximum support for the costs associated with creating a particular data analytics system within their sector, as well as a substantial budget for recruiting experts to oversee these systems.

4.1.2 Limited knowledge, understanding and interpreting information by SME.

Managers of SMEs do not know how to use value-added information. According to (S. Coleman et al., 2016), a study among SMEs in Germany noticed, 30% of SMEs deem their Big Data processing capabilities extraordinary. Also, SME lack understanding of data collection, and data interpretation. This explains why SMEs are reluctant to direct resources to BDA projects, which often come at a cost in terms of their expected future returns about their volatility. This trend does not encourage value creation since failure to understand the significance of data analysis shows a shortage of knowledge required to deploy and use existing analytical capabilities to deliver business operations such as improving procedures and developing new products and services.

4.1.3 Limited data-driven culture by SMEs.

BDA requires enterprises to make fast real-life decisions rather than assumptions. According to (McAfee et al., 2012), intuition adds to decision-making mechanisms and SMEs make decisions based on a mixture of facts and intuition. Such a decision could be fragile, making it difficult for most SME managers to separate decision-making from personal priorities. SMEs managers lack valuable evidence to justify their decisions because they often use assumptions, and this reflects an inability for BDA to generate value for SMEs. Thus, SME must move from instincts towards the knowledge of reality to find meaning from big data (Krishnan & Scullion, 2017).

4.1.4 Weak data management agenda and a lack of awareness attitude by SME.

BDA requires analytical tools, management capabilities for data collection, preparation, and interpretation thus a need for an efficient management agenda (Kiron & Shockley, 2011). According to (Kiron & Shockley, 2011) data content has also been improved collaboratively. However, the inadequate capacity or skills to process big data by SMEs is a challenge not just in BDA but also in managing data as a resource. According to (Davenport et al., 2001), data could be seen as a prerequisite for all strategic management decisions, but SMEs do not understand their data and are unable to access real-time data, because of a shortage of in-house management experts. A weak management agenda resulted from insufficient staff expertise giving high wages for experts in the labour market (Provost & Fawcett, 2013).

4.1.5 Limited access and usage of IT infrastructure by SMEs.

SMEs' use of big data could be explained by an increased access to big data infrastructure and market intelligence, though these practices are still relatively new. As a result, to take full advantage of big data, businesses must employ open techniques and technologies, such as BI analytics, which could provide an understandable User interface essential to managing big data interpretation inequalities. Furthermore, considering the ignorance of SMEs on management framework the tutorial mode and advanced information systems (cloud systems) should be carefully studied. Particular attention should be paid to software applications that do not require cloud systems. Another significant issue could be lack of the ability to use a timely and adequate user interface to receive input and advice. As a result, SMEs need to learn how to use the framework by massive open online course programmes (Goosen, 2019).

4.1.6 Limited operational strategy and support by SMEs .

SMEs must implement a specialised operational strategy (Ogbuokiri et al., 2015). According to (S. Coleman et al., 2016), SMEs must introduce a management plan to reduce risk, expand opportunities, and diversify , understand, and innovate their activities, as well as develop their commodity portfolios. Furthermore, SMEs work in a highly specialised market, which creates an opportunity for them to succeed though this specialised strategy reduces their ability to generate greater demand and competitive advantage. As a result, SME rigidity in their strategic objectives not only negates the benefits of big data processing techniques but also limits their ability to create value.

4.1.7 Limited Data security by SMEs.

Transferring proprietary data to third-party storage systems could be dangerous to SMEs, particularly if the data contains sensitive information. An in-house data centered strategy on building infrastructure for storing and processing data eliminates the issue of data piracy though costs for configuration and protection architecture must be addressed. In this regard, it is critical to investigate guidelines and procedures that could help SME make the best decision possible based on confidentiality and security considerations. According to (P. Gupta et al., 2013), SMEs see considerably lower levels of IT competence which may explain why obsolete and unsupported database technologies are more prevalent. As a result, SMEs are more vulnerable to cyber-attacks, unauthorized access to data. As a result, SMEs need to invest in less costly and more reliable systems cloud computing.

4.2: Potentials solutions for adopting big data analysis by SME for strategic decision making.

Many factors interacted to prevent SMEs from implementing BDA. Several advanced IT frameworks and opportunities exist to adopt BDA such as the Clouds, Open-source initiative, emergence of Data-oriented Forums and Government support schemes (S. Y. Coleman, 2016; Marinescu, 2017;

Narwane et al., 2020; Radiology, 2017). This section would look at the factors that impact business opportunities for SMEs to adopt BDA as well as some practical cases of how SMEs implement BDA.

4.2.1 Availability of Cloud service.

The introduction of cloud computing is one of the most important breakthroughs in the use of BDA by SMEs (Narwane et al., 2020). In cloud storage, all data is collected in data centres and then transmitted to end users. Furthermore, automated backups and documents management are ensured for business continuity; all such services are available in the cloud. There are no specific physical locations for these resources but just dummy terminals such as desktops, tablets, computers, as well as an internet connection. There are several methods for gaining access to the cloud such as applications Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) (Bokhari, Shallal, & Tamandani, 2016).

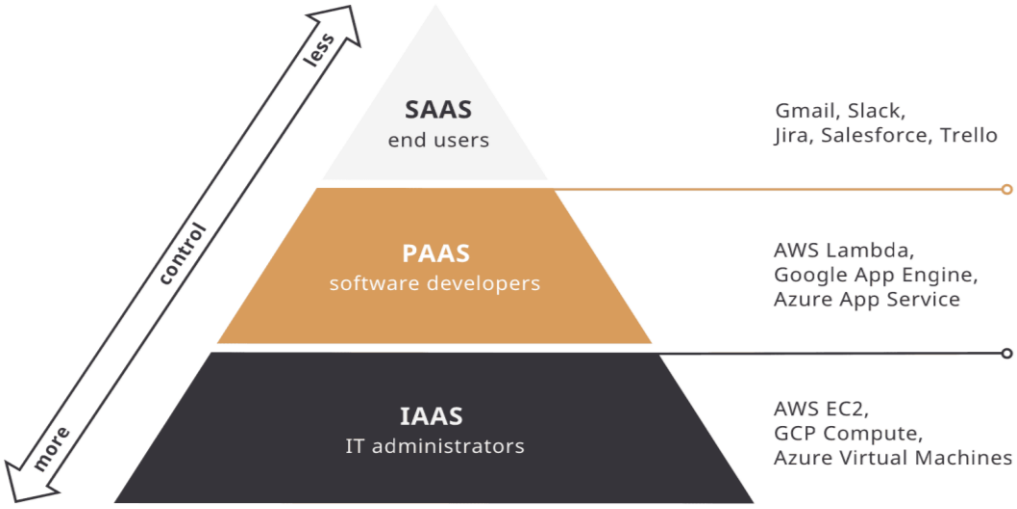


Figure 12, Cloud computing with 3 service modes

i. Software as a service (SaaS)

SaaS provides access to cloud-based applications managed by third-party providers across the Internet (Bokhari et al., 2016; Janssen & Joha, 2011). Many clients use SaaS via a web browser, with no need for downloads and installation, such as Microsoft Office 365, Salesforce.com, Dropbox, Google Drive.

SaaS model allows clients to access and rent software from the vendor without having to mount them on their own computer (Bokhari et al., 2016). This means that the approved applications delivered to clients are running on cloud storage through web server interfaces such as Google Chrome, Internet Explorer, and others. Software-as-a-service is a product in which software and applications are developed on platforms supported by the PAAS layer. The SaaS layer concerns end users since these applications created through cloud providers can be accessed and used by end

users. The vendor will maintain and monitor the infrastructure; only a limited range of users can have their own configurations; a collection of predefined configuration settings will be used to configure the applications. The SaaS model could be regarded as the most effective method for obtaining lightweight applications such as Microsoft Word, Microsoft Access, or media players. The issue includes network slowness causing the time required to process data for heavy-weight applications such as 3D games to be delayed (Bokhari et al., 2016). The cost of SaaS applications varies by application; some companies charge the client a flat rate regardless of use, while others charge the client based on use (Kulkarni, Chavan, Bankar, Koli, & Waykule, 2012).

Advantages of SaaS for SMEs

There are many benefits of using the SaaS model (Bokhari et al., 2016), including.

- The price of application software licenses is flexible with more predictable budgeting. Also, SaaS delivers applications to clients on a one-to-many basis, such that a single program can be used by several clients at the same time. Thus, more scalable usage

- It will be the responsibility of the application vendor to maintain access as well as limiting the use of applications. It eliminates the need for infrastructure because it uses the cloud's own infrastructure.

- SaaS model implementations can be configured via API. However, it cannot be completely customised. It can be integrated with other applications from common software providers. Finally, the SaaS model has a secure socket layer (SSL) used.

Examples of SaaS Provider include, Salesforce, Microsoft 365, Microsoft 365, Amazon web service Zoom, Shopify, Slack, Netflix

a. Salesforce,

Salesforce.com stands at the forefront of the cloud computing movement used as a SaaS (Benioff & Adler, 2009). The customer relations management solution allows companies to gather all information on clients, opportunities, and leads through a centralised web network, allowing approved workers to view sensitive data from any connected computer at any time. Salesforce attributes the tools to a growth in customer revenue, improved brand interest and satisfaction (Patole, 2019).

b. Microsoft 365,

Microsoft collaboration programmes such Word, Excel, and PowerPoint are workplace standards, but the cloud-based Microsoft Office 365 significantly extends the Office suite's parameters providing SaaS (Yadegaridehkordi, Nilashi, Shuib, & Samad, 2020). Users can now build, update, and distribute content throughout real-time from any PC, Mac, iOS, Android, or Windows smartphone, collaborate with colleagues and customers using a variety of platforms ranging from email to video

conferencing, and utilise a variety of collaboration technology enabling safe communications both within and outside of the enterprise (Grønli, 2012).

c. Amazon Web Services (AWS),

Amazon has expanded beyond its main e-commerce site to enable on-demand distribution of cloud-based IT services and software, aided by pay-as-you-go pricing options. Amazon Web Services now includes more than 70 services in total, including computing, storage, networking, database, analytics, deployment, management, and Internet of Things resources (Lee, Yan, Ma, & Zhao, 2011).

ii. Platform as a Service (PaaS)

PaaS provided a suitable framework or forum in which the developers create applications and services to internet deployment without the need to install or maintain the development environment (Bokhari et al., 2016). PaaS enables customers to rent virtualized servers and associated resources to run existing software or build and validate new ones. The user would have no leverage over the cloud's resources, such as servers, networks, storage, or operating systems, but he or she does have control over the configured applications and their configurations (Ashraf, 2014). Data transmission is done per GB, utilisation per hour, I/O requests per million, disc use per GB, including storing data requests per thousand can be used to calculate service costs (Mahmood, 2011).

Advantages of PaaS for SMEs

There are many benefits of using the SaaS model (Bokhari et al., 2016), including.

- Increase the production process's stability while decreasing disc capacity overhead. Also, a simplified edition deployment and Storage are offered, which includes data protection, recovery, and replication.

- Minimises cost by renting the physical space and eliminating the requirement for expert personnel to run the facilities.

- Offers adaptability, on the ability to adjust as the conditions change.

- PaaS works on a one-to-many basis, multiple developers can work on the same program. PaaS are Flexible and consumers have control of the technologies that are installed to existing platforms and the ability to create new platforms to meet their specific needs.

***Example of PaaS* include** SAP Cloud, Microsoft Azure, Google App Engine

a. SAP Cloud

SAP has a variety of service models including Cloud PaaS as an open business portal. It was created to make it easier for developers to construct apps by providing both width and depth of operation. The platform also enables the integration of Cloud and on-premises applications, as well as multiple

supporting utilities for PaaS, thanks to SAP's massive partner network, which offers a breathtaking catalogue of over 1,300 apps developed on the same platform (Boillat & Legner, 2013).

b. Microsoft Azure

Microsoft Azure could also be seen as a PaaS-based deployment and development environment. Azure, by definition, serves the entire web app creation life cycle, from create to deploy and beyond. Azure also provides support for a diverse set of technologies, languages, and systems. Developers that use it have access to over a hundred related resources, including Microsoft's cloud hosting service. Azure covers all three Cloud models – SaaS, PaaS, and IaaS – due to its massive scale (Marinescu, 2017).

c. Google App Engine

Google App Engine adds to part of the Google Cloud ecosystem and a highly scalable serverless PaaS that can be deployed quickly (Kumar, 2019). Google, being efficient, could deploy highly capable servers for handling nearly every number of queries. However, several designers have expressed concerns about the operation. This included the slight lack of support for some language environments, a scarcity of programming resources, and the failure to plug-and-play some apps and a vendor lock-in with Google.

iii. Infrastructure as a Service (IaaS)

IaaS offers virtual resources and raw hardware that can be used to build, maintain, and delete storage and virtual machines (VMs) through a web-based service (Bokhari et al., 2016). IaaS architecture evolved from the virtual private server. The IaaS vendor provides the customer with a virtual server as well as one or two CPUs running a variety of operating systems (Rani & Ranjan, 2014). The VM can be rented for an hour or longer. The infrastructure facilities can be scaled to meet the needs of the customer and billed based on the amount, size, and additional services used by client from the VM. Some providers allow virtual instances to be linked to the company's network via a virtual private network (VPN), making the network look like a single large flexible IT infrastructure. The contractor oversees running, hosting, and maintaining the technology to support the customer. The client has power over the IP address, CPU, memory, storage, deployed programmes, operating system, and a limited range of networking components. The cost of usage is primarily comparable to the arrangement of PaaS (Bokhari et al., 2016).

Advantage of IaaS to SME

There are many benefits of using the SaaS model (Bokhari et al., 2016), including.

- The customer can raise or decrease the infrastructure based on demand.

- The client can run a virtual machine because of virtualization as a service.

- Network as a service is offered, which involves load balancing as well as router and firewall hardware.

-IaaS saves money for human capital and hardware and Lowering ROI risk and lowering entry barriers. Also, IaaS Scaling is Automated and streamlined.

Examples of IaaS Include Google Cloud Infrastructure, IBM Cloud, Oracle Cloud Infrastructure, Green Cloud Technologies, Amazon Web Services, Microsoft Azure

a. Microsoft Azure.

Azure has a formidable power in all three categories: SaaS, IaaS, and PaaS. Customers use Azure to deploy different configurations of managed networks in IaaS (Marinescu, 2017). Azure IaaS could be seen as ideal for a wide variety of market needs due to its highly adaptable design. Rather than emphasising IaaS's technology advantages, Microsoft has put Azure in terms of market benefits. For e.g., boast compliance, analytics, unified execution, and a high level of cost versatility.

b. Amazon Web Services.

Amazon Web Services (AWS) with its ease to use and provides a wide range of tools for IaaS (Lee et al., 2011). Practically, unlimited providing consumers with benefits of simplicity and affordability, all of which are critical as companies grow. However, it does have a few pitfalls, on the EC2 limits. Based on how the program is used, this may impede company activities. Resources can be constrained by location, potentially resulting in unexpected obstacles.

c. IBM Cloud

IBM Cloud could be seen as another classic example of how top Cloud service offers an extensive package of IaaS (Alam, Pandey, & Rautaray, 2015). This includes compute components, network infrastructure, storage, and more. The most distinctive aspect of IBM Cloud includes the Bare Metal as a Service (BMaaS) product. This gives their IaaS customers unique access to the hardware that powers their Cloud service. Cloud Object Storage could be seen as another notable product in their IaaS portfolio. Unfortunately, IBM Cloud's corporate success has been less impressive. In terms of Cloud market share, the firm lags well behind market leaders Amazon and Microsoft.

However, despite the advantages of using the cloud, there are some data privacy security risks issues, charging model, what to migrate and service level agreements (Dillon, Wu, & Chang, 2010). Nevertheless, there are advanced cloud operations management software's such as Ops Compass, Splunk Enterprise, amongst others.

4.2.2 Open-Source initiatives.

BDA, such as Apache Mahout, can now be performed by SMEs thanks to open-source initiatives. According to (Dittert, Härting, Reichstein, & Bayer, 2017), software solutions like RapidMiner or R have basic visual interfaces that are necessary for understanding analysis. With this data mining, data analytics is now a drag-and-drop process, with users helped by visual tutorials for traditionally

complex and time-consuming modelling methods. According to (S. Coleman et al., 2016), open-source software for online visual analytics training is becoming more widely accessible due to SMEs challenges in developing skills sets. Thus, SMEs could learn from a wide variety of classes, including data mining on massive open online courses (MOOCs), to understand strategic analysis and competitive markets. However, SME data analysts who take a MOOC should be able to use or play with business information to achieve the expected benefits. In the context of data analysis and the creation of analytical knowledge, the open-source sourcing project provides SMEs with analytical resources that could help them make strategic business decisions on new and improved market opportunities.

Examples of on massive open online courses (MOOCs) *include.*

a. Google Primer

A new Google App designed to teach digital marketing fundamentals in a fast, easy-to-learn setting. Lessons are brief and to the point, and ideal for busy consumers with just a few minutes to spare. **Google Primer** could be found free on Apple and Google Play stores.

b. Treehouse

Through this outstanding eLearning program, Treehouse established the "future classroom." Treehouse, with its stunning graphics and surprisingly consistent tone, will assist users with learning new skills in coding and software creation. With high-quality, studio-produced video lessons hosted by talented in-house coaches, Treehouse have raised the bar in online learning**.**

4.2.3 The emergence of Data-oriented Forums

The extension of big data capacity-building projects opens excess possibilities for SMEs to recognise their full data analytics potential. For example, the **European Data Forum (EDF**), funded by the EU and other partners, brings together all foreign professionals together to explore current developments such as Big Data, as well as to resolve the problems in Europe (S. Y. Coleman, 2016). This discussion aims to develop an action plan that will address issues such as legality, data security, and the dynamics of emerging business models. This platform could serve as the mechanisms of creativity and growth for SME throughout the Western Europe economy as seen by European Data Forum 2014 (Koops, 2014). This forum invites stakeholders to improve policies and provides recommendations to the European Commission and the EU Member States to promote the growth of the new European data economy, according to the forum's mandate European Data Forum 2016 (Radiology, 2017). This software supports SMEs in using BDA and directing them to knowledge-based tools, which has a positive effect on their ability to perform effective big data analyses and match those activities with other typical business operations (Becker, 2020).

4.2.4 Government support schemes.

Another way to improve data collection capacity could be through government-sponsored programmes on information sharing collaborations to enable young people to work on technology knowledge transfer partnerships (KTPs). According to (S. Coleman et al., 2016), KTPs are particularly well-suited for developing a new approach, member process and impartial external viewpoint. KTPs have a low-risk route for SMEs looking to embark on a new venture, such as sophisticated data collection or learning new technical skills (Knowledge Transfer Partnerships 2015). This helps SME managers who select experienced workers to set work pace and to understand data-driven decisions within an enterprise (Livesey, Minshall, & Moultrie, 2006).

4.3 Some Application benefits of BDA and optimised BI in SMEs

SMEs and independent traders require the same resources as bigger corporations such as Google or Facebook use to succeed and prosper in today's economy. Regardless of misconceptions with big data and the notion that it can only be used by the super-rich, big data could also help small companies with small capital succeed in having a competitive advantage and market dominance. When correctly used and analysed, it may provide useful insights into industry. Most importantly, big data can assist with corporate strategy and decision-making (LaValle et al., 2011). Big data has left its impact on every field conceivable, including healthcare, advertising, marketing, retail, telecommunications, and insurance amongst others. According to (Mikalef et al., 2020), small businesses are more adapted to big data because they are more flexible and can respond more efficiently to data-driven insights . SMEs could benefit from insights for product design and marketing, checking competition, identifying trends, product maintenance, improving operations, recruiting, and managing personnel’s, changing company models, and collecting statistical data, just to examine a few as seen below.

a. Product Design and Marketing

Big data SMEs understand customers and design products that makes their customers happy or satisfied (Ogbuokiri et al., 2015). Small companies could learn about their clients using big data from what makes them happy, why they buy, how they like to shop, why they choose, what they would buy next, and what factors drive them to recommend a company to others (Davenport & Patil, 2012). Businesses may also enhance customer interaction and engagement by analysing customer input to improve a product or service; this could be enhanced by intelligent tools such as Customer Relationship Management (CRM). Traditional in-house records such as sales and customer service logs, social media, browser logs, text analytics, and massive, public data collections are all useful data sources such as census data. Social media has grown in importance as a database, making tasks like finding niche markets and analysing consumer responses much simpler and less expensive. Twitter has been easier to explore than other platforms and nearly conversations are effectively held in public. This big data insight helps SMEs in their product design and marketing campaign, that help them stay competitive.

b. Checking out the competition.

Big data could help SMEs check competition for example, Google Trend, a free and simple-to-use app, shows how famous a brand or product could be and what people are talking about it. Such instruments could be used by SMEs to track the behaviour of competitors. This helps in further strategizing campaign efforts. Understanding how competition used to be restricted to business gossip, browsing competing blogs or stores. Some businesses may also claim to be consumers to learn more about a competitor's service (LaValle et al., 2011). Financial data could also be readily accessible, and Google Trends can provide visibility into the appeal of a brand or product, and social media research can explain success such as how much a business is mentioned and demonstrate what consumers are thinking. Again, social media platforms such as Twitter could be seen as a great place to start as data collected could be linked to a brand; for example, it would be good to check on competitors with high tweets about their products. Also, Twitter conversations from customers compared to other businesses could be important to get more insights and access to market intelligence. Thus, SMEs could remain ahead of the competition by staying up on the big data trends and applications.

c. Identify trends.

Big data could help SMEs predict patterns by monitoring and tracking behaviours, forecasting where things are headed, how demand for products or services will change over time, and what could cause the change (Hilbert, 2016). Pattern analysis and forecasting were largely based on speculation until recently Big data has taken a lot of the guesswork out of the equation. Trending topics appear on Facebook and Twitter every day, making it easy to figure out what people want. Trendera and Trend Hunter are two services that gather trend data and apply it to industry queries. Consumer behaviour in both online and offline stores can be measured down to the smallest detail, like how someone walks around a physical and online store. This data can be correlated to external data, such as the time of year, economic trends, and even weather, to provide a detailed image of what consumers in SMEs are going to buy and when.

d. Product Maintenance

In terms of product maintenance, real-time big data on operational wear and tears in SMEs could help reduce running and maintenance costs by predicting potential equipment failure. This would, in essence, avoid downtime in SMEs operations. For example, in a printing industry, if one of the machines fails during a print run, the company can suffer a significant financial loss. Overall, this would affect the customer's service delivery schedule if the delivery were postponed, and SMEs would need to pay the customer accordingly. Also, by detecting the heat vibration of the machinery, potential device malfunction may be predicted, and technician would easily dispatch in a rudimentary manner to prevent equipment malfunctioning (Maroufkhani, Tseng, et al., 2020; Selamat et al., 2019). Also looking at the fleet maintenance, big data from sensory features could be used to track the pace, mileage, and engine health. Also, gathering details on the vehicle's status an advance

maintenance plan could be created to avoid fleet downtime. Furthermore, by learning the driving habits of the fleet driver, personalised driving tips for the driver's progress could be given. It is possible to decrease CO2 emissions and extend car life expectancy by practicing efficient driving and maintenance (Johar & Khalid, 2019; Selamat et al., 2019). Also, with information gathered, data product engineering help increase the selection of product design and content by providing data to track the machine's state, configuration, and total use (Bertello, Ferraris, Bresciani, & De Bernardi, 2020; Saleem et al., 2020).

E. Improve stock, logistics and transportation operations.

Big data could be used to improve business practices and activities such as logistics, sales, and distribution in SMEs (McAfee et al., 2012). Companies could produce data from manufacturing equipment, distribution vehicle controls, and customer ordering systems and could be used to increase operational efficiencies. Machines, cars, and tools could be rendered 'smart' for manufacturing, which means they could be connected, data-enabled, and constantly communicate their status to one another. Businesses may obtain real-time insight into their processes and search for ways to improve performance by analysing this data. For example, Retailers could improve their stock management by using projections derived from social media info, site search patterns, and weather forecasts. This encourages retailers to stock up with the most common products, meaning that they do not lose out on sales and reducing the amount of unsold inventory. Business process such as is logistics, supply chain, or distribution benefits greatly from big data analytics path optimization (Maroufkhani, Ismail, & Ghobakhloo, 2020). For example, GPS and sensors are used to detect goods or delivery vehicles, as well as to optimise routes by incorporating real-time traffic data. The use of sensors in shipping containers could provide logistics with real-time data about package position and condition. Connecting real-time data to SMEs' warehouse management systems (WMS) could improve market efficiencies, delivery service, and customer service.

f. Recruiting and managing talent.

Big Data could assist SMEs identifying the most promising applicants, determining the right recruiting channels, and improving employee engagement. Most companies already collect a wealth of HR-related data, such as employee absenteeism, retention, personal development feedback, and employee satisfaction (Akter et al., 2016). Furthermore, businesses now can access a wealth of previously unavailable data, such as data from recruiting pages, statistics from ID badge sensors, social media data, and so on. All this data could be used to produce previously unknown insights to (LaValle et al., 2011).

g. product sales and engineering through the company's model

Big Data could also become a part of the SMEs business model, resulting in new revenue streams from increased sales. Monitoring the inventory and use of a certain component or related elements allows SMEs to anticipate whether consumers will need a supplement order or products. The sales

department of SMEs would then need to ensure that the appropriate items are in stock. By making the correct information readily available, the sales department could be diligent in its distribution, avoiding any possible business loss to competitors (Saleem, Li, Ali, Mehreen, & Mansoor, 2020; Selamat et al., 2019). Small companies can monetise their data by offering value added software or licensing it to consumers or third parties. SMEs are now using data from built-in sensors to change repair cycles automatically based on how much their customers use their device.

h. Produce intriguing statistical data for agriculture and medicals.

Big data could provide statistical data from Teamleader application. Team Leader provides a variety of ready-to-use information solutions that could provide insight into the business operations. The programme, for example, displays data on geographic location and the networks from which they are acquired. SMEs in the agriculture industry could use sensory data applications to monitor soil and air temperature, humidity, leaf wetness, rainfall, and fruit colour. Farmers will then use the gathered data to adjust the amount of watering, time, and picking schedules as required (Hong & Ping, 2020; Selamat et al., 2019). In the medical practice, medical doctors and hospitals could capture real-time data on patients through wearable devices or home health monitors. The real-time data collected by medical doctors could be used to track and optimise patient care, improve diagnosis and recovery (Nasrollahi, Ramezani, & Sadraei, 2020).

Therefore, SMEs could start leveraging big data and analytics like big companies by merely using all the big data they are surrounded with. Ignoring the big data revolution is a dangerous strategy for any small business. Thus, SME could create a big data strategy to recognise the opportunities and challenges presented by the global data explosion.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusions

Despite the growth in big data and analytics, SMEs repeatedly fail to incorporate and/or use these. This paper presents a framework on how SME creates value by making decisions and optimised use of BDA or BI. These could have implications for both research and practice. We conclude that successfully using BDA necessitates significant investment in data collection and storage tools, BI and analytic frameworks, specialist knowledge and analytical skills. As a result, companies must determine their competitive role and invest in cutting-edge technologies and data-savvy workers that master related technologies and data-driven market opportunities. BDA necessitates both a strong data-driven community and efficient data collection methods. This study also looks at how SME use BDA to make strategic decisions. According to (LaValle et al., 2011), enterprises are steadily dependent on BDA smart strategic decisions, which could only be achieved using BI and analytics. Businesses that use Business Intelligence and Analytics as a platform have increased the profitability of their operations. However, SMEs face constraints such as a shortage in finances, a lack of expertise and passion, a restricted data-driven community, a poor information management agenda, problems with technology infrastructure use, a limited operations plan and assistance, and security concerns. Financial difficulties are explicitly interrelated to other conditions, either directly or and affect the growth of big data. Additionally, SME management could be unaware of the opportunities of BDA. Besides that, SMEs have a small data-oriented community, making it impossible for them to compete with big businesses. Also, most SMEs personnel lack the expertise to view the data that has been analysed. This could be attributed to a lack of managerial expertise knowledge, which cannot be easily recruited from the labour force market due to their high hiring cost and wages. Furthermore, when data gathering is applied, data security should be handled which could often be costly. All of this makes it difficult for SMEs to completely incorporate BDA due to the need for financial and human capital that SMEs lack. However, advanced frameworks and sources such as cloud computing, create opportunities for SMEs to implement BDA services that could have been difficult in the past due to a lack of sufficient human resources, infrastructure, and financial support. Cloud storage is an option for SMEs by shifting costly infrastructures to a less expensive cloud provider, allowing resource-constrained SMEs to leverage BDA to achieve long-term strategic competitive advantages. Equally, Online courses (MOOC) have internal trustworthy information for data learning and processing, enabling SME workers to learn and improve their analytical skills. Finally, the government's sustainable growth support schemes increased finances toward SMEs and budget for strategic alignment toward BDA. The desire for financial, health, education organisations amongst others to adopt emerging technologies as BDA and BI as a way of creating value is a vital component of their development.

5.2 Recommendations

This segment aimed to teach SMEs, regardless of their strengths and shortcomings, how to advance in the world of big data. SMEs often are faced with significant financial and knowledge challenges

and could prioritise the development of a big data-oriented community to lay a valuable foundation for implementation and a stable forum for generating value. SME should recognise the value and use of BDA in the development of their businesses. This could be done by exploring the entire big data ecosystem, start small then grow, stay humble and focus on building skills. These principles, along with the company's strategy and policies, could help to improve management skills and knowledge of BDA. Management oversight and in-house BDA are provided if sufficient information and experience become available. Since BDA adoption requires general awareness, big data-based culture and BI analytic expertise knowledge, SMEs need to collaborate with other big companies already specialised in BDA to benefit from resources for analysis that could only be accessible in big companies. For example, Spotify, a music domain specialist, offers a premium app for listeners that includes ad-free music streaming through Spotify's primary business is music; they acquired a company called Echo Nest for musical analytics, which allowed them the ability to mix tracks using data processing that helps offer a smoother service to its customers (S. Coleman et al., 2016).

SMEs are also advised to use cloud computing to help direct their decision-making. Adoption of the cloud could be especially appropriate for SMEs, and may provide many benefits, including hardware cost efficiency, cost-cutting processing, limitless memory processing, and the ability to identify the strength of BDA. SMEs, which are constrained in their ability, could use cloud service providers to efficiently participate in research, delivering reliable technology and knowledge at a low cost, which could be necessary for applying data analytics. Nevertheless, cloud technology can be criticised for violation of privacy because its providers may legally or illegally monitor the information or data of their clients. Nonetheless, SMEs should take full advantage of this framework, as studies have shown that the implementation of BDA could be more efficient for cloud service. According to (Vajjhala & Ramollari, 2016), cloud technology could improve enterprise operational efficiency and minimise infrastructure financing costs. Thus, SMEs could have management capabilities, information, networking, and upgrades to manage cloud platforms for more efficient decisions.

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